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ENCYCLOPÆDIA BRITANNICA.

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THE

ENCYCLOPÆDIA BRITANNICA,

OR

DICTIONARY

OF

ARTS, SCIENCES, AND GENERAL LITERATURE.

EIGHTH EDITION.

WITH EXTENSIVE IMPROVEMENTS AND ADDITIONS;
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VOLUME IV.

ADAM AND CHARLES BLACK, EDINBURGH.
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ENCYCLOPÆDIA BRITANNICA.

ASTRONOMY.

PART II.

THEORETICAL ASTRONOMY.

Theoretical Astronomy

CHAP. I.

GENERAL PHENOMENA OF THE HEAVENS.

SECT. I.—*Of the Celestial Sphere.*

WHEN a spectator on a clear evening directs his attention to the sky, he perceives a concave hemisphere studded with innumerable brilliant points, all which appear to move in parallel directions, constantly preserving the same distances and relative positions. New groups of stars incessantly follow one another, rising in the east, mounting to a certain height, and then gradually sinking till they disappear in the west. On turning his face towards the north he observes some groups of stars which remain visible during the whole night; wheeling round a certain fixed point, and describing circles of greater or less magnitude, according as they are at a greater or less distance from that point. The same phenomena are observed every successive night; and as the stars present always the same configurations, and succeed each other in the same order, the mind is irresistibly led to the hypothesis of the diurnal revolution of the whole heavens about a fixed axis. This hypothesis implies that the stars move in parallel planes, and that their mutual distances remain invariable. In order, however, to be assured that such is the case, it is necessary to have recourse to more accurate observations, and to refer their successive positions to something that is fixed,—to certain points or planes which do not participate in the general motion.

Horizon. What is most obviously adapted for this purpose is the *Horizon*, or the plane which appears extended all round us, and bounded by a circle of which the eye of the spectator occupies the centre. Let the circle SENW (fig. 1) represent the horizon, C being the centre or place of the observer. Suppose now that a star is observed to rise at a certain point of the horizon A, and, after tracing its circuit in the sky, to set at the point A′; suppose, also, that another star rises at B, and sets at B′; then, if the distances AB, A′B′ are measured by means of some angular instrument, it will be found that AB is equal to A′B′, and that this is the case with regard to any two stars whatever. Since therefore the arcs AB and A′B′ are equal, it follows that the chords A A′, B B′, joining their extremities, are parallel; whence we infer, that if two stars rise successively at the same point of the horizon A, they will also set at the same point A′, a circumstance which is of itself strikingly indicative of the uniformity of the motion of the celestial bodies.

Plate LXXVI. Fig. 1.

Theoretical Astronomy

Through C let a perpendicular be drawn to the chord AA′, meeting the boundary of the horizon in S and N. These two points are the *South* and *North* points of the horizon; and another straight line drawn through C, parallel to A A′, will meet the horizon in E and W, the *East* and *West* points. The four together, namely, S, E, N, W, are called the four *Cardinal* points of the horizon. The horizontal circle is itself denominated the *Azimuth Circle*. Azimuth distances are measured from the North and South points, so that SA is the azimuth distance of a star's rising at A, and SA′ is that of its setting at A′. The complement of the azimuth, or its defect from a right angle, is called the *Amplitude*, which is consequently measured from the East and West points; thus the arc EA is the amplitude of a star's rising at A, or its *ortive* amplitude, and WA′ is that of its setting, or its *occasive* amplitude.

Cardinal points.

Azimuth.

Amplitude.

Conceive a straight line to pass through C, perpendicular to the horizon. This line, which is called the *Vertical*, will meet the visible hemisphere in a point directly above the observer, which is denominated the *Zenith*; the point diametrically opposite, in which the prolongation of the vertical meets the invisible hemisphere, is the *Nadir*. The plane determined by the vertical and the straight line NS is called the *Meridian*, because when the sun reaches it, he is equally distant from the points at which he rises and sets, or, it is mid-day. The great circle formed by the intersection of the meridian with the celestial sphere is the *Meridional* circle; it divides the sphere into the eastern and western hemispheres. Any circle passing through the Zenith and Nadir is called a *Vertical Circle*; that which intersects the meridional circle at right angles, or which passes through the points E and W, is called the *Prime Vertical*.

Zenith.

Nadir.

Meridian.

Vertical.

Let HPZH′ (fig. 2) represent a meridional circle passing through P, that point of the sphere which appears to remain immovable; and let Z be the zenith, and HH′ the horizon. Join PC′, and let it meet the circle in P′. The points P and P′ are denominated the *Poles* of the world, and the straight line PP′ is the *Axis* about which the whole heavens appear to revolve. Let also *uv*, H*g*, *kl*, ÆÆ, *g*′H′, be projections of the paths of different stars

Fig. 2.

Theoretical Astronomy.

on the vertical plane PZH. One of the first circumstances which strikes the attention of the observer is the inequality of the times during which different stars continue visible above the horizon. A star which describes the circle ÆÆ continues visible during a shorter time than one which describes *kl*, and still shorter than one which moves in H*g*. It will be remarked, however, that the interval between two successive risings of the same star is always the same, in whatever point of the horizon it makes its appearance. Those which describe ÆÆ are peculiar in this respect, that the interval between their rising and setting is exactly equal to that between their setting and rising; hence the great circle which they describe is called the *Equator*, and when the sun describes that circle, the days and nights are exactly of the same length. In general, the time during which a star continues visible is greater in proportion as its path is nearer to the visible pole. Those, however, which describe the circle H*g*, or any other parallel, as *uv*, nearer to P, remain always above the horizon; hence such circles are called circles of *Perpetual Apparition*, and the stars describing them are called *Circumpolar Stars*.

Equator.

There are some other technical terms, chiefly employed in the old treatises of astronomy, to denote particular circles of the sphere. A *Secondary* to any great circle, is a circle passing through the poles of its primary: thus the meridian is a secondary to the horizon HH', and to the equator ÆÆ'. The *Colures* are two secondaries to the equator, one of which passes through the equinoctial points, and is called the *Equinoctial Colure;* the other intersects the equator at the distance of 90° from the former, and is denominated the *Solstitial Colure*. The small circles parallel to the equator are simply termed *Parallels;* those which are parallel to the horizon are called *Almucantars;* and the different meridians are likewise termed *Hour Circles*.

Secondaries.

Colures.

Parallels.

Almucantars.

The hypothesis of a spherical revolution implies, as has already been mentioned, that the stars move in parallel planes, or describe parallel circles round the pole. This point, in reference to any particular star, must be determined by observing whether its angular distance from the pole remains invariable during its whole revolution. Let Z (fig. 3) be the zenith, P the pole, and S the place of a star. The arcs PZ, ZS, PS, which join these points on the sphere, will form a spherical triangle, of which the sides PZ and ZS, or the distances of the pole and the star from the zenith, are given by direct observation. The angle PZS is also given in the same manner, for it is equal to the star's azimuth counted from the north point of the horizon. In the triangle ZPS we have therefore given the two sides ZP and ZS, together with the included angle PZS, from which data the polar distance PS is found by the following formula of spherical trigonometry:

Fig. 3.

$$\text{cos. PS} = \text{sin. ZS sin. ZP cos. PSZ} + \text{cos. ZS cos. ZP.}$$

In order to adapt this formula to logarithmic computation, an auxiliary angle φ may be assumed such, that $\text{tan. } \varphi = \text{cos. PZS tan. ZP}$, by the substitution of which the formula becomes

$$\text{cos. PS} = \frac{\text{cos. ZP. cos. (PZS} - \varphi)}{\text{cos. } \varphi};$$

from which the polar distance PS of the star can be easily computed.

On performing the computation for any particular star, PS is always found to be of a constant magnitude, whatever may be the value of PZS, that is, at whatever part of its course the star is observed. Hence we infer that the diurnal motion of the stars round the pole is exactly circular

After having recognised that the celestial bodies move in parallel planes, the next object of the astronomer is to determine whether they revolve with velocities uniform or variable. For this purpose it is necessary to compare, by means of a well-regulated clock, the angular distances between the meridian and the successive positions of a star, with the times elapsed since the star's passage over the meridian. Let *mno* (fig. 4) be the parallel described by a star, and *ss'* two of its successive positions. The arcs *ns*, *ns'*, intercepted between the meridional plane and the planes passing through the axis PP' and the points *s*, *s'*, are measured by the arcs of the equator C*a*, C*b*. Now, it is the result of constant experience, that the number of degrees in the arc C*a* or C*b* is to the number in the whole circumference as the time employed by the star in describing *na* or *nb* is to the time in which it completes a revolution. The time occupied by the star in completing its revolution is called a sidereal day; and the uniformity of the diurnal revolution enables us to calculate the angle CP*s*, which is measured by C*a*, without having recourse to any other observation than that of the star's meridional passage. Denoting a sidereal day by T, the interval of time which elapses while the star describes the arc *ns* by *t*, and the angle at the pole by P, we shall have the analogy $\text{T} : t :: 360 : \text{P}$; therefore $\text{P} = 370° \frac{t}{\text{T}}$; a formula which gives the angle at P, or its measure C*a*. The angles CP*s*, CP*s'*, and *s*P*s'* are called *Hour Angles*, because the arcs which they intercept on the star's parallel of declination correspond to the hours and fractions of an hour into which the sidereal day is divided. For example, if the hour angle *s*P*s'* contain 15°, the two planes passing through *s* and *s'* will intercept on *mn*, the diurnal circle of the star, an arc equal to 15°; consequently there will be 24 such arcs in the whole circumference, each of which will be described in the 24th part of a sidereal day, or in one hour of sidereal time. In consequence of this perfect uniformity of the diurnal motion, the arc which a star describes on its parallel is conveniently measured by the time of its description; and the sidereal day, or the interval between two successive returns of the same star to the plane of the meridian, offers the most perfect *unit of time*, inasmuch as it is exactly the same to all the inhabitants of the earth, and remains absolutely unalterable in all ages, being one of the very few invariable elements of the system of the world.

Theoretical Astronomy.

Fig. 4.

Hour angles.

In fixing the position of a point on a plane surface, geometers usually refer it to two straight lines at right angles to each other, the positions of which are supposed to be known. The same practice is imitated by astronomers, who refer the position of any point on the surface of the sphere to two great circles, which are employed as a system of rectangular co-ordinates, and from which all distances are measured. The equator being a circle of the sphere not subject to any arbitrary condition, but determined by the very nature of the spherical revolution, is obviously well adapted for this purpose. It is therefore universally employed as a term of comparison in assigning the places of the celestial bodies. Suppose an hour circle passing through the star *s* to intersect the equator at *a;* the arc *sa*, which measures on the sphere the distance of *s* from the equator, is called the *Declination* of the star. All other stars situated on the same parallel *mo* have the same declination; and it is invariable for all places of the earth, because it is not affected by the diurnal motion which is performed in the parallel *mo*. The declination is *northern* or *southern*, according as the star is situated in the northern or southern hemisphere. It is expressed in degrees from 0 to 90, proceed-

Method of determining the situations of points on the sphere.

Fig. 4.

Declination.

Theoretical Astronomy.

ing from the equator to the pole. The polar distance Ps is the complement of the declination, because $Ps + sa = 90°$. In order to distinguish s from all other stars which may be situated on the same parallel, we must also know the point a of the equator to which it corresponds; and for this purpose it is necessary to select a point γ of the equator for the origin of the co-ordinates. This point ought to be independent of the diurnal motion, otherwise its position could only be determined for a single instant of time; and it must be such that it can be readily found, in whatever part of the earth the observer may be situated. Astronomers have agreed to employ for this purpose the point determined by the intersection of the equator with another very remarkable circle of the sphere, of which we shall speak hereafter, and to count the degrees on the equator, setting out from γ, from 0 to 360, in the direction opposite to that of the diurnal motion, or from west to east. The arc γa, which measures the distance between γ and a, is called the *Right Ascension* of the star s: it is also the right ascension of any other star situated in the hour circle PsP'. It is measured by the interval of time which elapses between the transit of the star s over the meridian, and that of the point γ, which has been chosen as the point of departure. It may be remarked that the point γ is also the origin of sidereal time; that is to say, the time is counted 0 hour 0 min. 0 sec. when that point passes the meridian.

Right Ascension.

From these definitions it is easy to conceive the general method of forming a catalogue of stars. A clock being regulated to sidereal time, and marking 0 hour at the instant of the transit of the point γ (or any star chosen arbitrarily), the hours, minutes, and seconds, are noted at which the stars successively pass the axis of the transit instrument, together with their respective altitudes at the same instant. These observations give the right ascensions and declinations; for the time is easily converted into degrees, at the rate of 15° an hour, or by the formula given above for determining the hour angle. If the star s pass the meridian one hour after s', the arc $a\,b$, which measures the distance between their horary circles, PaP', PbP', is 1 hour or 15°; and the declination of a star s which moves in the parallel kl (fig. 2) is $Æl = H'l - H'Æ$, that is, equal to the difference between its meridional altitude and the complement of the altitude of the pole H P. Modern celestial charts are constructed on the principle of assigning to each star the place indicated by the values of these two co-ordinates; and as observation proves that the mutual distances and relative positions of the stars scarcely undergo any sensible variation, a globe or chart once constructed will serve to represent the state of the heavens for at least a long series of ages.

Fig. 2.

Explanation of the phenomena.

Having now considered the general phenomena of the diurnal revolution, and explained the terms that are technically employed in assigning the positions of the celestial bodies, we may next proceed to inquire how these phenomena are to be accounted for,—whether the stars are really in motion, as they seem to be, or if the apparent motion is only an illusion occasioned by the revolution of our own earth. The perfect uniformity of the motions of the different stars renders it exceedingly improbable that they are disconnected; hence the simplest view of the phenomena is obtained by substituting for each star its projection on the celestial sphere, at an infinite distance, and supposing this sphere, with the projections of all the stars, to revolve in 24 hours from east to west round an immovable axis. But it is easy to see that the phenomena will be equally well explained by supposing that the starry firmament is absolutely at rest, and that the earth revolves in the same time, round the same axis, but in an opposite direction, from west to east. In both cases the stars remain immovable, the phenomena are exactly the same, and, relatively to *Spherical Astronomy*, in which we only concern ourselves with the *apparent* motions, it is absolutely indifferent which of the two hypotheses we adopt. They are both only modes of explaining certain appearances; and the one may be employed which renders the explanation most simple and perspicuous. The proofs of the earth's motion will go on accumulating as we proceed. At present we need only remark, that as the organ of sight makes us acquainted with the existence of relative, and not of absolute motion, it is impossible to decide, merely from appearances, whether the motion we perceive is real or otherwise; for whatever motion one body may have in respect of another, it is always possible to explain the phenomena by supposing it to be perfectly at rest, and the other to move in an opposite direction. The conclusions which we draw from the *optical* effects of motion afford no mathematical certainty with regard to the cause of that motion. The hypothesis of the revolution of the sphere is attended with innumerable and insurmountable difficulties. The distance of the nearest fixed star from the earth is not less than 350,000 times the distance of the sun; a distance which light, prodigious as its velocity is, would not traverse in less than five years. This immense line, therefore, supposing the heavens to revolve round the earth, would form the radius of a circle, the circumference of which, six times larger, would be passed over by the star in the space of 24 hours; its velocity must therefore be $6 \times 5 \times 365 = 10950$ times greater than that of light. This velocity, which is nearly equivalent to 2100 millions of miles in a second of time, is so enormous that it baffles the utmost efforts of the imagination to form any conception of it; and the supposition of its existence will appear still more revolting when we reflect that the distance of the nearest star is probably many thousand times less than that of the Milky Way. If we ascribe the motion to the earth, its velocity, though it may still be supposed great, is moderate in comparison of many well-known phenomena of nature. A point on the equator will describe in 24 hours a circle of about 25,000 miles, or about 17 miles in a minute; a velocity somewhat exceeding that of sound, but 7400 millions of times less rapid than the preceding.

Theoretical Astronomy.

In all that has hitherto been said respecting the apparent motion of the starry sphere, we have only had regard to the innumerable multitude of stars which constantly maintain the same relative situations, and which are in consequence called *Fixed Stars*. There are, however, several other bodies, some of them remarkable on account of their splendour, which, besides participating in the general motion, have peculiar motions of their own, and are incessantly shifting their positions among the fixed stars. An attentive observation of the state of the sky during a few successive evenings, will suffice to show that there are some stars which have in the mean time changed their places; and, on continuing to observe them, they will be found to separate themselves from particular constellations, and gradually but imperceptibly to approach others, till they at length appear, after unequal intervals of time, in an opposite quarter of the heavens. From this circumstance they were designated by the Greeks *Planets*, that is, *wandering stars*, in contradistinction to those which obey only the law of the diurnal motion. Besides the sun and moon, there are five discernible by the naked eye, and which have consequently been known from the remotest ages. These are Mercury, Venus, Mars, Jupiter, and Saturn. Twenty-eight others, including Neptune, Uranus,

Theoretical Astronomy

and the small planets, have been discovered by the aid of the telescope. Astronomers, with a view to abbreviate their descriptions, have appropriated a certain symbol to each of these planets, as well as to the sun and moon: thus, for the older planets, in the order of distance from the sun, the names and characteristics are as follows:—

The Sun	☉	Ceres	⚳
Mercury	☿	Pallas	⚴
Venus	♀	Jupiter	♃
Mars	♂	Saturn	♄
Vesta	⚶	Uranus	♅
Juno	⚵		

The Earth, which, as we shall afterwards see, is also a planet, and takes its place between Venus and Mars, has for its symbol ⊕, and the moon ☽. Venus, Jupiter, and sometimes Mars, are distinguished by their extraordinary brilliancy. Mercury, on account of his proximity to the sun, is rarely visible to the naked eye. Uranus, discovered by Sir W. Herschel in 1778, can with difficulty, by reason of his great distance, be perceived without a telescope. Ceres, and the other planets discovered since 1801, are extremely small in size, and can only be seen with the aid of the telescope.

Motions of the sun and moon.

Of all the celestial bodies, the most interesting to us are the sun and moon; and their peculiar motions have accordingly, in every age of astronomy, been studied with the greatest attention. The proper motion of the moon is particularly remarkable. In the course of a single night she separates herself very sensibly from the stars in her vicinity, moving over a space nearly equal to her own breadth in an hour, and completing a whole circuit in about 27 days. The sun moves with much less velocity, but his motion is still sufficiently apparent. If we take notice of the stars which immediately follow him when he sinks under the horizon, we shall find that in the course of a few nights they will be no longer visible. Others which, some time previously, did not set till long after him, have taken their places and now accompany the sun. In the morning similar appearances present themselves, but in a contrary order. The stars which appear in the eastern horizon at sun-rise, are, after a few days, considerably elevated above it at the same time. Thus the sun seems to fall daily behind the stars, by insensible degrees, till at last he appears in the east when they are about to set in the west. To account for these appearances, the ancients supposed the sun's diurnal motion to be really slower than that of the stars; hence they supposed him to be attached to a different sphere. For like reasons they ascribed particular spheres to the moon and each of the planets; and as no trace of these imaginary spheres is perceptible in the heavens, they next supposed them to be crystalline and transparent. The appearances are explained equally well, and with infinitely greater simplicity, by ascribing to the sun a proper motion, in a direction opposite to that of the diurnal rotation of the sphere, in consequence of which he advances to meet the stars, instead of falling behind them.

The greater part of the observations of the early astronomers had for their object the determination of the positions of the stars relatively to the sun at his rising and setting, by which they fixed the seasons, and regulated the operations of agriculture. They distinguished all these phenomena by technical terms, which occur very frequently in the works of the ancient poets, particularly in Hesiod and in Ovid's *Fasti*. A star which rises at the same time with the sun is effaced by his light, and is said to rise *cosmically* (*ortus cosmicus*). Soon after, when the sun by his proper motion has advanced so far to the east that the star can be perceived on the eastern horizon in the morning twilight, it disengages itself from the sun's rays, and is said to rise *heliacally* (*ortus heliacus*). At the end of six months, the sun being diametrically opposite to the same star, it sets as the sun rises, and in this case it is said to set *cosmically* (*occasus cosmicus*): at nearly the same time it rises when the sun sets, and is said to rise *acronically* (*ortus acronyctus*). The sun afterwards begins to approach the star, till he advances so near that it is again about to be effaced by his light; it is now said to set *heliacally*, or just so long after the sun as to be visible when he has disappeared (*occasus heliacus*). At the end of a year, the star again rises and sets at the same moment with the sun; it is now said to set *acronically* (*occasus acronyctus*). These distinctions, and the ancients had several others of the same kind, which are all defined by Ptolemy, are now scarcely ever mentioned. They have lost the whole of their interest since, in the progress of astronomy, more certain methods have been discovered of determining the commencement of the year and the seasons.

Theoretical Astronomy.

Stations and retrogradations.

The proper motions of the planets are in general, like that of the sun, in a direction opposite to the diurnal motion, or from west to east, among the stars: but they do not preserve the same character of uniformity; the planet sometimes becomes stationary among the fixed stars, and even advances from east to west in the direction of the diurnal motion. In this case it is said to *retrograde*. This retrograde motion is, however, not of long continuance. After having been accelerated during a short time, it begins to relax. The planet again becomes *stationary*, and then resumes its *direct* motion from west to east. These phenomena were observed in the remotest antiquity, and their explanation formed the principal part of the rational astronomy of the Greeks and the Arabians.

Comets.

Besides the planets, other bodies occasionally make their appearance in the heavens, which, by reason of the extraordinary phenomena they exhibit, have been frequently contemplated with terror and dismay, and regarded by superstitious ignorance as harbingers of calamity, and precursors of the divine vengeance. These bodies shoot down, from the remote regions of space, with inconceivable velocity, towards the sun. At their first appearance they are small; their light is feeble and dusky; and they are generally accompanied by a sort of nebulosity or luminous tail, from which they have derived their appellation of *Comets* (*coma*, hair). As they approach the sun, their apparent magnitudes and brilliancy greatly increase, and the nebulosity sometimes occupies a large portion of the heavens, presenting a magnificent and astonishing spectacle. Having attained the point of their orbits nearest the sun, they again recede to enormous distances, and vanish by insensible degrees. They differ from the planets not only by the appearances they present, but also by the diversity of their motions; for, instead of being confined to a particular zone, and moving from west to east, they traverse the sky indifferently in all directions. They are visible only in a small part of their orbit, which, being near the sun, is passed over with prodigious rapidity. They seldom continue visible longer than six months. Their number is entirely unknown, but during the last two centuries upwards of 170 have been observed, and their orbits computed.

Thus we recognise three distinct classes of celestial bodies; the planets, the comets, and the fixed stars. It is the business of the astronomer to determine the positions of these bodies in the heavens; to observe their motions, and measure them with precision; to discover the laws by which their courses are regulated; and from these laws to assign the past or future state of the heavens

Theoretical Astronomy.

at any given instant of time. The fixed stars form infinitely the most numerous class; but their motions being sensibly uniform, and their mutual distances invariable, the principal object with regard to them is to determine their places and relative positions. The comets in general return only after long periods; and observations are not yet sufficiently numerous to allow any certain deductions to be made with respect to their nature and constitution. The planets present a great variety of curious phenomena; they are always within our view; observations on them may be multiplied indefinitely; and for this reason, as well as on account of their proximity, and their forming a system of which the earth constitutes a part, they present by far the most interesting objects of astronomical study.

Sect. II.—*Of the Globular Form of the Earth, Parallax, and Refraction.*

Having now considered the general phenomena of the diurnal motion, we proceed next to inquire into the form of the earth, and our situation with respect to the centre round which the celestial sphere appears to revolve. The plane of the horizon seems to be stretched out indefinitely till it actually meets the sky; but this illusion is quickly dissipated by transferring ourselves from one place to another on the surface of the earth, and attending to the phenomena which such a change of place gives rise to. Let an observer, for example, set out from any given point in the northern hemisphere, and proceed directly south. In proportion as he advances, the stars in the southern region of the heavens will be elevated more above the horizon, and describe larger segments of their diurnal circles, while new ones come into view which were invisible at the station he left. On the other hand, the polar star, with those in its vicinity, will be depressed, and some stars which before continued above the horizon during the whole time of their revolution will now rise and set. The planes of the diurnal circles become also more perpendicular to the horizon, so that the aspect of the heavens is entirely changed. If, instead of advancing in the direction of the meridian, the spectator proceeded towards the east or west, he would in this case also remark that his horizon constantly shifted its position. A star will pass his meridian sooner as he advances eastward, or later as he travels westward; in short, by a change of place in any direction whatever, the perpendicular to the horizon, or the plumb-line, will correspond to a different point of the heavens. The plane of the horizon is therefore variable, and its variation by insensible degrees indicates with the greatest evidence the rotundity of the earth. Experience also shows that a spectator sees more of the terrestrial surface in proportion as he is elevated above it; and that on a mountain surrounded by the sea, or standing in the middle of a level plain, the horizon appears equally depressed all round, which is the distinctive feature of a spherical curvature. In fig. 5 let O be the place of a spectator on the summit of a mountain, the straight line H H will represent his horizon, and O*h*, O*h'* the directions of visual rays to the remotest visible points on the surface of the earth. The inclinations of these lines to the plane of the horizon, or the angles HO*h*, H'O*h'* are called the *apparent depression*; and these being always observed to be equal to each other, it follows that the curve *h*A*h'* is a circle. On the Peak of Teneriffe, Humboldt observed the surface of the sea to be depressed on all sides in an angle of nearly 2°. The sun arose to him 12 minutes sooner than to an inhabitant of the plain; and from the plain, the top of the mountain appeared enlightened 12 minutes before the rising or after the setting of the sun. The same phenomena, though on a smaller scale, are observed with regard to every mountain or elevation on the earth. Another familiar illustration of the globular figure of the earth is derived from the successive and gradual disappearance of a ship which leaves the shore and stands out to sea. The hulk disappears before the sails and the rigging, and the top of the mast is the last part that is visible. The ship thus appears gradually to sink under the horizon, exactly in the same manner as she must necessarily do on the supposition that the surface of the sea is spherical. The appearance of the moon at the time she is eclipsed is also demonstrative of the roundness of the earth. When the moon penetrates the shadow of the earth, the line which separates the illuminated from the eclipsed portion of the disk is circular; evidently proving the conical form of the shadow, and consequently the roundness of the body by which the shadow is projected. From all these considerations, it is inferred with the highest certainty that the earth with its waters forms a round mass, isolated in space.

Theoretical Astronomy.

The globular form of the earth is a property common to it with the other bodies which compose the planetary system. The sun and moon are evidently round bodies; and when the planets are examined through a telescope their disks appear sensibly circular; and as they are known to have a motion of rotation, in consequence of which they successively present different points of their surfaces to the earth, the uniform roundness of their disks may be taken as a conclusive proof of their sphericity. We shall by and by have occasion to remark other striking analogies between the planets and the earth.

Sensible and rational horizon.

Since the figure of the earth is spherical, the horizontal plane cannot coincide with any considerable portion of its surface. It may be defined to be the plane which touches the earth at any given point, and is perpendicular to the vertical line, or the direction of gravity at that point. The *Sensible Horizon* of any place is the plane which passes through the eye of the spectator, perpendicular to the plumb-line at that place. The *Rational Horizon* is a plane parallel to this, passing through the centre of the earth. The particular phenomena of different places depend on the position of their horizon with respect to the planes of the apparent diurnal motion of the sun and stars. The rational horizon of a place on the equator passes through the poles, and divides equally the equator and its parallels. Hence the days and nights are always equal in such places, and each of the stars performs one half of its revolution above, and the other below its horizon. The circles of diurnal motion are all perpendicular to the horizon, and therefore the inhabitants are said to be under a *Right Sphere*. If a spectator could place himself directly under the pole, his horizon would coincide with the equator, and the whole of the northern celestial hemisphere would be within his view, while no part of the southern hemisphere would be visible to him, on account of its being always beneath the horizon. The circles of the diurnal motion being parallel to the equator, and consequently also to the horizon, the fixed stars would never either rise or set. A spectator thus situated is said to be under a *Parallel Sphere*. In intermediate places the circles of the diurnal motion are oblique to the horizon, one pole being always elevated above it, and the other equally depressed below it. The stars whose distances from the elevated pole are not greater than the arc of its elevation above the horizon never set, while those within the same distance of the depressed pole never rise. These phenomena belong to all places situated between the equator and the poles, and the inhabitants of such places are said to be under an *Oblique Sphere*.

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The situation of a place on the surface of the earth is determined by two co-ordinate circles, in the same manner as that of a star on the celestial sphere. Let Z (fig. 2) be a place of which the position is required to be assigned with reference to circles of the terrestrial sphere, analogous to those which we have described as belonging to the sphere of the heavens. Since the axis of the celestial sphere passes through the centre of the earth, we may suppose the poles of the world, the equatorial circle, and the meridians, to be transferred to the earth's surface, so that the same figure may represent either the celestial or terrestrial sphere. The intersection of the plane P Z Æ with the surface of the earth is the terrestrial meridian of the place Z, and the straight lines C Z, C Æ, in that plane, intercept an arc of the terrestrial meridian between Z and the equator, containing as many degrees as the arc of the celestial sphere which measures the declination of the zenith of the place Z. The angle Æ C Z which is measured by the meridional arc Æ Z is called the *Geographical Latitude* of Z. But in order to particularize the point at which the equator is intersected by the meridian, it is necessary to assume some point of the equator to which all the other points of that circle may be referred. The meridian passing through the assumed point is called the *First Meridian;* and the angular distance between the planes of the first and any other meridian measured by the equatorial arc intercepted by these planes on the equator, is called the *Geographical Longitude* of the place through which the last meridian passes. The longitude is said to be *east* or *west*, according as the degrees of the equator are counted from the first meridian towards the east or west. It is usual to reckon the degrees towards the east, all round the globe, or from 0 to 360°. From these definitions it is evident that the geographical latitudes and longitudes are exactly analogous to the declinations and right ascensions on the celestial sphere. The first point of the terrestrial equator cannot be determined by any star or fixed point in the heavens, on account of the diurnal motion; it is therefore necessary to fix its position by means of known places on the earth; and geographers are in the habit of assuming as the first meridian that which passes through the capital city or principal observatory of their country. The choice is of no importance; for in geography, as in astronomy, what is essential to be known is only the *difference* of longitudes or meridians, in order to reduce the situation of a place, or observations which have been made at it, to any indicated meridian.

Fig. 2.

Magnitude of the earth.

The length of the terrestrial radius is a very important element in astronomy, inasmuch as it furnishes the observer with the only scale by which he can estimate the distances of the sun, moon, and planets. On the supposition that the figure of the earth is perfectly spherical, the general principles on which its magnitude may be determined are sufficiently obvious; but the accurate determination of its actual dimensions is attended with great practical difficulties, which can only be overcome by the perfect instruments and refined science of modern times. Eratosthenes seems to have been the first who made use of astronomical methods to determine the circumference of the earth, or the length of the meridian. He remarked that, at Syene, in the Thebais, the sun on the meridian, at the time of the summer solstice, was vertical; and that at Alexandria, at the same time, his zenith distance was 7° 12′. Now let S (fig. 6) be the sun, vertical to M, and Z the zenith of Alexandria, C being the centre of the earth, and O Alexandria. The angle Z O S is the sun's zenith distance, which was observed to be 7° 12′. But $ZOS = ZCS + OSC$; whence, as the angle O S C, which is extremely small on account of the sun's great distance, may be neglected in the calculation, the angle Z C S at the centre is also equal to 7° 12′, and therefore the whole circumference equals $\frac{360°}{7° 12'} \times M O$. To obtain the length of the meridian, it is therefore only necessary to measure the arc M O. Eratosthenes assumed the distance between Syene and Alexandria to be 5000 stadia; hence the circumference of the earth $= \frac{360°}{7° 12'} \times 5000$ stadia $= 250{,}000$ stadia. The uncertainty which exists respecting the length of the Egyptian stade prevents us from deriving any precise information from this rude attempt to estimate the dimensions of the globe.

Fig. 6.

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The method which has just been described takes for granted that the meridian is exactly circular,—an assumption which, even supposing the method perfect in all other respects, would lead to erroneous results, especially in an arc of so great a magnitude as seven degrees. In a small arc, of 1° for example, the error arising from the non-sphericity of the earth will be insensible; for it is certain, from the phenomena before explained, that the deviation from the spherical figure is not very considerable; and besides, whatever the nature of the meridional curve may be, it will sensibly coincide with its osculating circle, throughout the extent of an arc of 1°. It has been found by numerous and accurate experiments, that the lengths of arcs of 1° on the same meridian are longer in proportion as we advance nearer the pole. Hence, on account of the similarity of the isosceles triangles of which these arcs form the bases, their sides, or the terrestrial radii, must also be longer, and consequently the convexity of the earth is less towards the pole than at the equator. The surface of the earth is extremely irregular, even independently of the inequalities occasioned by mountains and cavities; yet it has been discovered that the meridional curves differ almost insensibly from ellipses; whence it is concluded that the figure of the earth is an ellipsoid of revolution about its shortest axis. In comparing the results of the various measurements which have been made with the formulæ belonging to the dimensions of such a body, this conclusion has been fully verified; and the lengths of the arcs, the ellipticity, the distance of the pole from the equator, and, in short, all the elements of the spheroid, have been determined. The results of theory and observation give an ellipticity amounting very nearly to $\frac{1}{305}$; that is to say, the equatorial is to the polar diameter in the ratio of 306 to 305. The following may be regarded as a very near approximation to the dimensions of the earth in English miles:—

Semidiameter of the equator	3963·7
Semidiameter of the pole	3949·8
Semidiameter at the latitude of 45°	3956·2
Ellipticity $\frac{1}{305}$	13
Length of 1° of the meridian	69·06
Quarter of the meridian of Paris	6214·47

The figure of the earth is one of the most difficult and most important questions of astronomy; and as our limits will not permit us to treat it in this place with all the details which its importance renders necessary, we shall reserve, for a separate article, an account of the different geodetical operations which have been undertaken with a view to determine it, together with the development of the mathematical theory of its equilibrium. See FIGURE OF THE EARTH.

In describing the phenomena of the diurnal revolution, we have supposed the eye of the spectator to be placed

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in the centre of motion, on which supposition the apparent and true places of the celestial bodies will be the same. This, however, as is evident, can only be rigorously true in respect of one point of the earth's surface, and is therefore most probably not true of any. Astronomers have on this account agreed to refer all the motions to the centre of the earth; that is, to consider the centre of the earth as the centre of the celestial sphere, and to regard as the true geocentric place of a star, that at which it would appear to a spectator placed at the centre. But the spectator is necessarily placed at the surface. In order, therefore, to render observations made at different stations on the earth's surface comparable with one another, we must consider what changes will be produced in the apparent positions of the celestial bodies, in consequence of their being observed from a point not situated in the centre of motion.

Fig. 6. Parallax.

Let O′ and O (fig. 6) be two stations on the earth's surface on the same meridian, from both of which a star S is observed at the same time. As an object is always seen in the direction of the visual ray, the spectator at O will refer the star S to a certain point I on the surface of the celestial sphere, while the spectator at O′ will refer it to a different point I′ in the direction O′ I′; and the difference of the apparent places I and I′ depends on the magnitude of the angle OSO′, which is subtended by the chord of the arc OO′. If a third spectator could be placed at C, the centre of the earth, the same star would appear to him in the direction CS, and be referred to its true place on the sphere at Q. Now, the difference between the angles ZOS and ZCS, that is, the angle OSC, under which the radius of the earth is seen by an observer at S, is called the *parallax* of S. On account of the great distance of the fixed stars, this angle is insensible with regard to the least distant of them; it is, however, very sensible in the case of the moon, with regard to which it amounts to about 1°. The greatest parallax of the nearest planets does not exceed 30″.

From the definition which has just been given, it appears that the parallax of an object is the angle comprised between two lines drawn from the object, the one to the centre of the earth, and the other to any point whatever on its surface. But it is evident, that while the distance of S from the earth remains constant, the angle OSC will vary with the angle ZOS, that is, with the distance of the star from the zenith, or its altitude above the horizon.

Fig. 7.

Let OH (fig. 7) represent the horizon. It is easy to see that the angle OSC will have its greatest value when OS touches the surface of the earth, or coincides with the horizon OH, that is, when the angle ZOS = 90°. It is equally evident that the parallax OSC vanishes entirely when the line CS coincides with CZ, that is, when the object is in the zenith of the observer at O; hence the parallax depends on the altitude of the object, according to a law which we now proceed to determine.

Fig. 7.

In the triangle OSC (fig. 7), we have sin. OSC : sin. SOZ : : CO : CS, whence sin. $OSC = \frac{CO}{CS}$ sin. SOZ. Let the angle SOZ, or the zenith distance of the object = Z, the semidiameter of the earth OC = a, the distance of the object CS = r, and the parallax OSC = p, we have then sin. $p = \frac{a}{r}$ sin. Z. On account of the smallness of the angle p, which, as we have mentioned, in no case exceeds 1°, the arc may be substituted for the sine (for their difference even in an arc of 1° does not exceed 0″·18): the above expression therefore becomes $p = \frac{a}{r}$ sin Z; that is to say, the parallax of an object is proportional to the sine of its zenith distance. At the zenith, Z = 0, therefore sin. Z = 90, and the parallax vanishes: at the horizon, Z = 90°, and sin. Z = 1; the parallax, therefore, becomes equal to $\frac{a}{r}$. In this case it is at its maximum, and is denominated the *Horizontal Parallax;* in all other cases it is called the *Parallax of Altitude.* Denoting the horizontal parallax by P, we have $P = \frac{a}{r}$, whence

$$p = P \sin. Z;$$

that is to say, *the parallax of altitude is equal to the horizontal parallax, multiplied by the sine of the apparent zenith distance.* It is evident that the apparent altitude SOH is always less than the true altitude SBH, by the whole amount of the parallax; the effect of the parallax is therefore to depress the object, or increase its zenith distance; hence, if θ be the apparent altitude of the star, and θ' its true altitude, θ' will be found from the equation $\theta' = (\theta + P)$ sin. Z.

From the above results it is manifest, that if the horizontal parallax can be by any means determined, the parallax at any other altitude will be found at the same time. The determination of the horizontal parallax is, however, attended with considerable difficulty, and various methods have been proposed and practised to ascertain its exact amount, modified by particular circumstances in the cases of the different celestial bodies. The method, however, which serves as the basis of all the others is extremely simple, and exactly analogous to that by which the distance of a remote object is determined on the surface of the earth. Suppose two observers to be stationed at the points O and O′ (fig. 6), of which the latitudes are known, and which are both situated on the same meridian, and let them simultaneously observe the zenith distances of the star S; these observations will give the angles ZOS, Z′O′S, whence their supplements SOC and SO′C become known at the same time. A third angle of the quadrilateral figure SOCO′, namely OCO′, is also known, being measured by the meridional arc OMO′, the difference or sum of the latitudes of the two observers, according as they are on the same or opposite sides of the equator. The two sides also, CO and CO′, being semidiameters of the earth, are supposed to be known; every part of the quadrilateral figure is therefore determined, and its diagonal CS may be calculated by the rules of plane trigonometry. But when CS is determined, the horizontal parallax is obtained immediately from the formula $P = \frac{a}{r}$, that is, $P = \frac{CO}{CS}$. On this principle the horizontal parallax of the moon was determined by Lacaille and Lalande, the former observing at the Cape of Good Hope, and the latter at Berlin; and the parallax of Mars by Lacaille at the Cape, and Wargentin at Stockholm.

Fig. 6.

Let us suppose two lines to be drawn from the centre of a planet touching the surface of the earth in points diametrically opposite; the inclination of these two straight lines is the double of the horizontal parallax; but the same angle also measures the diameter of the earth as seen from the planet: hence the horizontal parallax of a planet is equal to the apparent semidiameter of the earth at the distance of the planet. From this consideration the true diameter, and consequently the volume, of a planet may be found by measuring its apparent diameter, that is, the optical angle under which its diameter appears when seen from the earth Let d be the apparent, and D the true diameter of a planet; the angle $\frac{1}{2}d$ is comprised between two straight lines drawn from the

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earth, the first of which is directed to the centre of the planet, and the last is a tangent to it: hence $\frac{1}{2}$ D = r tan. $\frac{1}{2}d$ or r sin. $\frac{1}{2}d$, according as r is the line which touches the planet or that which is directed to its centre. Now, on account of the smallness of the angle $\frac{1}{2}d$, the sine and tangent are sensibly equal to the arc; we may therefore suppose in all cases D = $r\,d$. Combining this with the equation $P = \frac{a}{r}$, we deduce $\frac{D}{a} = \frac{d}{P}$; which gives the ratio between the true diameters of the planet and the earth in terms of the apparent magnitude and horizontal parallax of the planet. It follows also from this last equation that $\frac{d}{P}$, or the ratio of the apparent diameter and parallax of a planet, is constant; the horizontal parallax may therefore be found at any time whatever by measuring the planet's diameter.

From the equation $P = \frac{a}{r}$, we have $r = \frac{a}{P}$; that is, the distance of a planet from the earth is known in terms of its parallax and the earth's semidiameter. The parallaxes, therefore, give the ratio of the distances of all the planets from the earth, and consequently of their distances from one another, and from the sun; hence the radius of the earth furnishes the scale by which the astronomer measures the dimensions of the whole solar system, and the magnitudes or volumes of all the bodies of which it is composed. On this account the accurate determination of the parallaxes of the celestial bodies is a problem of great importance in practical astronomy.

Fig. 7.

It is evident from the mere inspection of the figure, that the plane in which the straight lines C S and O S are situated is the vertical plane passing through S, consequently the whole effect of the parallax is to diminish the altitude of a planet in its vertical circle. When the observation, therefore, is made in the meridian, the effect of the parallax is to alter the declination, without producing any change whatever in the right ascension of the planet. Out of the meridian it is necessary to have regard to the azimuth or hour angle, as well as to the altitude, in calculating the correction due to the parallax. When we suppose the earth to be spherical, the formulæ for the calculation of the parallax are extremely simple, because the radius is constant, and the vertical line, or perpendicular to the surface of the earth, passes through its centre. But in the case of the true or elliptical figure of the earth neither of these circumstances takes place. The radius in this case is variable, and must be determined by a particular process of computation for every point on the meridian; and the vertical line, with reference to which the latitude of the place and the altitudes are determined, does not pass through the centre of the earth, but makes different angles with the axis. These circumstances render the calculation of the parallax a matter of much greater complication and difficulty.

The term parallax in its general signification properly denotes *change* of place. There are consequently various kinds of parallaxes, such as parallax of right ascension, of declination, longitude, latitude, &c. In what has preceded, we have supposed the earth to be at rest in the centre of the universe, and therefore have had regard solely to the variations produced in the apparent diurnal motions by the eccentric position of the observer on the surface of the earth, and which are comprehended generally under the denomination of the *diurnal* parallax.

The effects of the diurnal parallax are only sensible with regard to those bodies of which the distance from the earth is not so great as to be incomparable with the earth's semidiameter. That the apparent place of an object must be changed in consequence of a change in the situation of the observer, is a simple geometrical truth which no experiment was required to discover. The first observers must accordingly have anticipated a parallax in all the celestial bodies; and it was doubtless only after considerable experience that they admitted the existence of any exception to the general law. There is, however, another cause of variation in the apparent positions of the celestial bodies also connected with the earth, the existence of which could not be known *a priori*, but must have been discovered by experience alone. We allude to the refraction of the rays of light in passing through the earth's atmosphere.

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Refraction.

The angular distance between two stars is found to undergo very sensible variations at different hours of the day. This phenomenon cannot be explained by any proper motion of the stars, because it evidently depends on their altitude above the horizon; and the differences are found to be the same daily at the same altitude. It is most striking when we compare a star which, without setting, passes the meridian twice a day, once near the zenith, and the second time near the horizon, with another star situated very near the pole, and of which the altitude is consequently nearly invariable. It will be found that at the time of the first transit the distance between the two stars is greater than at the second by nearly half a degree. It is evident, therefore, that the phenomenon consists in diminishing the distance between a star situated in the horizon and the visible pole, that is to say, in elevating the stars, whereas the effect of the parallax is to depress them. The refraction also takes place in an equal degree with regard to the fixed stars, and even the moon and planets, without being in any degree modified by the great differences in the distances of the celestial bodies, contrary in this respect likewise to the parallax, which depends entirely on the distance. The reason of this will be evident from the consideration of the physical cause of the phenomenon.

Theory of refraction.

According to the known principles of optics, a ray of light, in passing obliquely from one transparent medium into another of a different density, does not hold on in its rectilinear course, but is refracted, or bent towards the denser medium. Now, the atmosphere which surrounds the earth may be regarded as composed of an infinity of concentric spherical strata, the densities of which are greater in proportion as they are nearer to the earth's surface. When a ray of light, therefore, proceeding from a star enters the atmosphere, it is inflected towards the earth, or bent so as to form a smaller angle with a perpendicular to the surface of the earth; and this inflection will be increased by every successive stratum of the atmosphere through which the light passes. In fig. 8, let Fig. 8. AA′, BB′, CC′, represent the boundaries of the successive strata, which, for the sake of illustration, we here suppose to have a finite thickness. A ray of light proceeding from S comes in contact with the highest stratum of the atmosphere AA′ at a. The molecular attraction of this atmospherical stratum, acting in the direction of a normal to AA′ at a, causes the luminous ray to deviate from the direction S x, and assume another, $a\,y$, in which it would continue to move if the atmosphere were equally dense from AA′ to the earth. But in the course of its progress the ray penetrates another denser stratum at b, and consequently suffers another inflection; so that instead of proceeding in the direction $a\,y$, it is bent into a new direction $b\,z$, more nearly perpendicular to the concentric strata. A similar effect is produced at c, so that the luminous ray, when it finally reaches the observer at O, has as-

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sumed the direction *c* O. In its progress from *a* to O, it has therefore successively moved in the direction of the sides of the polygon *a*, *b*, *c*, O; and to the spectator at O, the star from which it proceeded, instead of appearing in its true place at S, will appear to be at S′, or in the last direction of the visual ray. Now, if A A′ is the most elevated stratum of the atmosphere into which the ray enters in the direction S *a*, it is clear that the whole effect is produced by the atmospherical strata situated below A A′, and that the length of S *a* is perfectly indifferent; hence the refraction is entirely independent of the distance of the stars, provided they are beyond the limits of the earth's atmosphere.

The decrease of the density of the atmosphere, from the surface of the earth upwards, follows the law of continuity, or takes place by insensible degrees; so that the luminous ray, in traversing the atmosphere, enters at every instant into a denser medium, and is therefore continually brought nearer and nearer to the vertical direction. Hence the true path of the ray is curvilinear, and concave towards the earth, as represented in fig. 9. This is equivalent to the supposition that the thickness of the different concentric strata of uniform density is infinitely small, and that the light, as it successively penetrates each, deviates from its former path by an infinitely small angle, which may be considered as the differential of the refraction, the total amount of which will therefore be obtained by integration. The direction of the ray, when it reaches the eye of the observer, is the tangent to the last portion of its curvilinear path; and the apparent zenith distance of the star will be ZOS′, while the real zenith distance is ZOS. The difference of these two angles, namely S′OS, is what is denominated the *Astronomical Refraction*. It is evident that the whole path of the ray is confined to the vertical plane, in which the star and the eye of the observer are situated; for the earth and its atmosphere being very nearly spherical, that plane will divide the strata symmetrically; there will therefore be no displacement in a lateral direction, or no refraction out of the vertical plane. When the observed star is due north or south, the vertical plane is the plane of the meridian; hence, in meridional observations, the whole of the refraction, like that of the parallax, takes place in declination, while the right ascension remains unaltered.

Fig. 9.

Law of refraction.

It is evident that the amount of the refraction is greater in proportion as the observed star is nearer to the horizon; for in this case the luminous rays strike the tangent planes of the atmospherical strata more obliquely, and have besides to traverse a greater extent of atmosphere before they arrive at the eye of the observer. On determining by experiment the refraction at every altitude from zero to 90°, tables of *Refraction* may be constructed, which will furnish the means of discovering the law of its diminution; but as such a process would be exceedingly tedious, and likewise subject to lead to erroneous results on account of the inevitable errors of observation, it is found more convenient to assume some hypothesis for a basis of calculation, and to verify the results which it leads to by comparing them with observation. In regard to media which may be said to be permanent, such, for instance, as water and glass, the determination of the refraction is not attended with great difficulty; but the circumstances are greatly altered when we come to make experiments on the atmosphere. In this case the difficulty arises from the incessant changes which the atmosphere is undergoing relatively to its refringent powers; changes which it is impossible for the observer fully to appreciate, inasmuch as he can only determine its physical state within a short distance of the earth, while that of the upper strata remains wholly unknown to him. The refringent power of the atmosphere is affected by its density and temperature. The effects of the humidity are insensible; for the most accurate experiments seem to prove that the watery vapours diminish the density of the air in the same ratio as their refractive power is greater. It is therefore only necessary, even in delicate experiments, to have regard to the state of the barometer and thermometer at the time the observation is made. At a medium density, and at the temperature of melting ice, it was found by Biot and Arago, from a great number of exact experiments, that at any altitude between 10° and the zenith the refraction is very nearly represented by the formula $r = 60''{\cdot}6 \tan. (Z - 3{\cdot}25 \times r)$, in which r is the refraction corresponding to a given zenith distance Z. With the exception of the numerical co-efficients, this formula was first given by Bradley; but whether it was deduced from theory by that great astronomer, or was only empirical, is uncertain. Bradley's formula was $r = 57''$ tan. $(Z - 3 \times r)$. When the direction of the luminous rays makes a smaller angle than 10° with the horizon, it becomes indispensable to take into account, in the calculation of the refraction, the law of the variation of the density of the atmosphere at different altitudes; a law which is subject to incessant variation, from the operation of winds, and other causes which agitate the atmosphere, as well as the decrease of temperature in the superior regions. For this reason all astronomical observations which have not refraction directly for their object, or which are by their nature independent of its influence, are made at an elevation exceeding 10°. For lower altitudes, it is to be feared that no theory will ever be found sufficiently exact to entitle the observations to much confidence.

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First observations of refraction.

The existence of the atmospherical refraction was not unknown to the ancient astronomers; but it is only in modern times that the subject has been studied with the requisite care to admit of its influence being calculated in the reduction of observations. Ptolemy does not allude to the subject in the *Almagest*, but he has given a sufficiently exact idea of it in his work on *Optics*. He mentions experiments made to ascertain how far a ray of light is bent from its rectilinear course in passing from air into glass and water; and observes that the astronomical refraction brings a star nearer to the zenith, and that it is feebler in proportion as the star is more elevated. He likewise indicates a method of measuring its effects, although he does not seem to have attempted to practise it. The same notions, but in a less precise form, were reproduced in the *Optics* of Alhazen. Walther began to estimate the effects of refraction near the horizon; and Tycho, a century after, found the means of measuring them with greater accuracy, and was thereby enabled to construct a table. Tycho estimated the horizontal refraction at 34′, and supposed it to vanish at the altitude of 45°; which proves that his ideas on the subject were less accurate than those of Ptolemy, who says expressly that it vanished only at the zenith. Dominic Cassini was the first who proposed an hypothesis for calculating the refraction at any altitude; and he computed a table, which was published in 1662. Since that time the subject of refraction has been investigated, theoretically and practically, with the most scrupulous and delicate attention, and tables constructed to exhibit its amount at every altitude, and at the different seasons of the year. (See *Mécanique Céleste*, tom. iv. p. 231; Mr Ivory's Paper in the *Phil. Trans.* for 1823, p. 409; Delambre, *Astronomie du xviii. Siècle*, p. 774.)

The refringent power of the atmosphere gives rise to a number of curious phenomena. When the sun appears in

Oval appearance of the sun and moon in the horizon.

the horizon, the rays of light which issue from the extremities of his vertical diameter are refracted unequally on account of the difference of altitude, so that the disk, at other times circular, then assumes an oval appearance; and on measuring the horizontal and vertical diameters by means of the micrometer, the former is sometimes found to exceed the latter by four or five minutes of a degree. This effect is particularly remarkable when the sun is observed at his rising or setting from the top of a mountain, or an elevation near the sea-shore, in which cases the difference of the two diameters sometimes, in particular states of the atmosphere, amounts to upwards of 6′, or a fifth of the whole apparent diameter of the sun. In the case of the moon this oval appearance is seldom so perceptible; for unless she happens to be exactly full, or in opposition, at the same time that she is in the horizon—and this can rarely be the case—the defect of the illumination of her disk reduces her figure to those rounder but somewhat irregular shapes which it often exhibits. The horizontal refraction being equal to the apparent diameter of the sun or moon, it happens also that either of these luminaries, and consequently any other of the celestial bodies, may be entirely visible above the plane of the horizon, when in fact it has set below it. A curious instance of this was observed at Paris in 1750. The moon rose eclipsed, while the sun, whose place at the time of a lunar eclipse is diametrically opposite to that of the moon, still appeared above the horizon. Another phenomenon occasioned by the refraction of the atmosphere is the appearance of the moon when she is eclipsed, or immersed in the earth's shadow, and consequently receives no light directly from the sun. On these occasions her disk continues distinctly visible, and is of a dusky red colour, exhibiting the appearance of tarnished copper, or iron nearly red-hot. This phenomenon occasioned great perplexity to the ancient astronomers who were unacquainted with the refractive powers of the atmosphere; and some of them ascribed it to the native light of the moon, in virtue of which she continues visible when hid from the sun's rays. Plutarch ingeniously supposed it to be occasioned by the light of the stars reflected from the dark surface of the moon; but the quantity of this light is greatly too small to produce the effect in question. It is now explained by the scattered beams of light bent into the earth's shadow by refraction in their passage through the atmosphere.

The refraction of the rays of light in traversing the earth's atmosphere is the cause of *Twilight*, which sensibly lengthens the duration of the day, and prevents a sudden transition from light to darkness on the disappearance of the sun. When the sun is more than 33′ below the horizon, the refraction is not powerful enough to bring his rays sufficiently near the earth to reach our eyes; they pass over our heads, and are irregularly reflected by the molecules of the atmosphere. By this means a portion of the celestial vault is enlightened, while the sun is invisible. This illumination of the upper regions is called the twilight. It commences as soon as objects can be distinguished before sun-rise, and terminates when they cease to be visible after the sun has set. The time, however, at which the twilight commences and terminates cannot be assigned with any degree of precision. It is generally supposed to be limited by the depression of the sun 18° below the horizon. Lacaille found the limit in the torrid zone to be between 16° and 17°. According to Lemonnier, it varies in France between 17° and 21°. The duration of the twilight will evidently be longer or shorter according as the inclination of the plane of the sun's orbit to the horizon is more or less oblique.

To assign the time at which it is a maximum or minimum, or of a given length at a given latitude, is a problem of pure geometry, which has been frequently solved since the time of the Bernoullis.

Scintillation of the stars.

The scintillation or twinkling of the stars is another phenomenon produced by certain modifications of atmospherical refraction. The atmosphere is at all times more or less agitated; and on this account the clusters of molecules of which it is composed are constantly undergoing momentary compressions and dilatations, which occasion minute differences of refraction, and consequent changes in the directions of the luminous rays. The minute and rapid variations thus occasioned in the apparent places of the stars produce the twinkling or tremulous appearances which, in certain states of the atmosphere, particularly on the approach of rain after a long drought, are very remarkable. The agitations of the atmosphere are manifest to the eye in the tremulous motion of the shadows cast from high towers, and in looking at objects through the smoke of a chimney, or over beds of hot sand. The scintillation of the planets is much less than that of the stars. This proceeds from the magnitude of their disks, which, although apparently very small, are still far greater than those of the fixed stars, and indeed so considerable, that the accidental variations in the directions of the rays of light are too minute to displace them entirely. The borders of their disks are affected only by a slight undulation; whereas the stars, which are merely brilliant points of insensible magnitude, undergo a total displacement.

Horizontal moon.

The apparent enlargement of the sun and moon in the horizon is an optical illusion, connected in some measure with the atmosphere, of which various explanations have been given since the time of Ptolemy. According to the ordinary laws of vision, the celestial bodies, particularly the moon, which is nearest to the earth, ought to appear largest in the meridian, because their distance is then less than when they are near the horizon; and yet daily experience proves that the contrary takes place. To an observer placed at E (fig. 10), the visual angle subtended by the moon in the horizon at M is somewhat less than that under which she appears in the zenith at O; and this fact, a consequence indeed of her circular motion, is proved by accurate measurements of her diameters in those circumstances by the micrometer. The mean apparent diameter of the moon, at her greatest height, is 31′ in round numbers, but in the horizon she seems to the eye two or three times larger. The commonly received explanation of this phenomenon was first given by Descartes, and after him by Dr Wallis, James Gregory, Malebranche, Huygens, and others, and may be stated as follows. The opinion which we form of the magnitude of a distant body does not depend exclusively on the visual angle under which it appears, but also on its distance; and we judge of the distance by a comparison with other bodies. When the moon is near the zenith there is no interposing object with which we can compare her, the matter of the atmosphere being scarcely visible. Deceived by the absence of intermediate objects, we suppose her to be very near. On the other hand, we are used to observe a large extent of land lying between us and objects near the horizon, at the extremity of which the sky begins to appear; we therefore suppose the sky, with all the objects which are visible in it, to be at a great distance. The illusion is also greatly aided by the comparative feebleness of the light of the moon in the horizon, which renders us in a manner sensible of the interposition of the atmosphere. Hence the moon, though seen under nearly the same angle, alternately appears very large and very small. Desaguliers illustrated the doctrine of the horizontal moon on the

Fig. 10.

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supposition of our imagining the visible heavens to be only a small portion of a spherical surface, as *mnop* (fig. 10), in which case the moon, at different altitudes, will appear to be at different distances, and therefore seem to vary in magnitude, as at *m*, *n*, *o*. It is evident, however, that this affords no explanation of the phenomenon; for why does the sky, it may be asked, appear to be a smaller segment than a hemisphere? In the solution of this question the whole difficulty is contained.

Fig. 10.

It may be remarked that these illusions disappear as soon as the intermediate objects are concealed from view. They may be destroyed by regarding the moon through a tube, which permits her disk alone to be seen, and in this manner she will appear no larger at the horizon than near the zenith. The same effect may be produced by viewing her through a smoked glass, because the dark tint permits only the luminous object to be seen, and conceals all the rest. The only precaution necessary to be observed in making this experiment, is to place the eye in such a position that the surrounding bodies may not be visible.

CHAP. II.

OF THE SUN.

SECT. I.—*Of the Apparent Circular Motion of the Sun in the Ecliptic, and Position of the Ecliptic in Space.*

The consideration of the diurnal motion common to all the celestial bodies, and the succession of day and night resulting from it, forms the first object of astronomy. The second is to pass from the diurnal motion of the sphere to the proper motion of the sun, and from the vicissitudes of the day to the seasons of the year. The sun, as has already been remarked, is constantly shifting his place among the stars. If we observe the altitude of any star, or group of stars, above the eastern horizon at sun-set, we shall find, on making the same observation a few days afterwards, that its elevation is considerably increased, and that it has approached nearer to the meridian. At the end of three months it will appear at sun-set on the meridian, and from that time continue to advance nearer and nearer to the sun, till it is at last concealed by the splendour of his rays. After remaining for some time invisible, it will again make its appearance in the morning to the westward of the sun, and its distance from him will continue to increase daily, till, at the end of a year, it has made a complete circuit of the sky, and regained the position it occupied at the time of the first observation. The earliest observers explained this phenomenon by supposing the diurnal motion of the sun to be less rapid than that of the stars, in consequence of which he constantly falls behind them. This supposition would be admissible if the sun remained constantly in the plane of the equator; but as he deviates considerably from that plane, on both sides of it, it is infinitely more simple to ascribe to the sun a motion of his own, independent of the diurnal motion, and performed in a contrary direction, in virtue of which he traces an oblique route among the stars.

Sun's course in the heavens.

The oblique path of the sun may be determined by observing the positions of the stars near which he successively passes in the course of the year. The same object is however accomplished with much greater precision by the modern practice of observing his declinations and right ascensions, that is to say, his distances from the equator, and an arbitrary meridian. In this manner his place may be accurately assigned every day; and, by a repetition of similar observations, a series of points will be obtained on the surface of the celestial sphere, which mark out his annual course. The result of constant experience shows, that the declination reaches its maximum on the south side of the equator about the 22d of December, when it amounts to 23·465 degrees. From this time it gradually diminishes till about the 21st of March, when the sun reaches the plane of the equator. At this time the days and nights are of equal length all over the earth, and the instant of time at which the sun's centre is in the equatorial plane is called the instant of the equinox. The sun then appears on the opposite side of the equator, and his declination or meridional altitude continues to increase till about the 22d of June, when he becomes stationary, and then again shapes his course towards the equator. His maximum declination on the north side of the equator is exactly equal to that on the south, amounting to 23°·465. The sun now continues to approach the equator till about the 24th of September, when he again reaches that plane, and a second equinox succeeds. Continuing still to move in the same direction, he declines from the equator southward, till he reaches his former limit about the 22d of December, after which he resumes his former course.

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The two small circles of the sphere, parallel to the equator, which pass through the two points where the declination is great, are called the *Solstices*, or the *Tropics*; that on the northern hemisphere is called the *Tropic of Cancer*, and the other is called the *Tropic of Capricorn*. These two parallels, which mark the extreme limits of the sun's declination, are, as has just been stated, equally distant from the equator, with regard to which the variations of declination on either side are perfectly symmetrical and uniform.

Tropics.

If at the time of the vernal equinox we remark the stars which set in the true west while the sun is rising in the east, and which are then separated from him by a semicircumference, it will be found that the difference of their right ascensions, and the right ascensions of those which have precisely a similar situation relatively to the sun at the time of the autumnal equinox, is exactly 180°. It follows, therefore, that the solar orbit intersects the equator in two points diametrically opposite; but we have seen that its northern and southern declinations are equal; hence the orbit projected on the sphere must be a great circle, provided it lies wholly in the same plane. Whether this is the case or not it will be easy to prove by means of a few observations, in the following manner.

Let AQ (fig. 11) be the equator, AE the orbit of the sun, PSM, PTN two circles of declination, drawn through any two points S and T of the orbit. If the sun's path is confined to a plane, then AE must be a great circle, and we shall have the equation $\sin. AM = \frac{\tan. MS}{\tan. MAS}$, according to the well-known properties of spherical triangles. Let the cotangent of the unknown but constant angle $MAS = n$, the declinations $MS = D$, $NT = D'$, the right ascensions $AM = Æ$, $AN = Æ'$; then, according to the above formula, we must have $\sin. Æ = n \tan. D$, and $\sin. Æ' = n \tan. D'$, at whatever points of the orbit S and T may be situated. From these two last equations there result also $\cos. Æ = \sqrt{1 - n^2 \tan.^2 D}$, $\cos. Æ' = \sqrt{1 - n^2 \tan.^2 D'}$, which, being substituted in the trigonometrical formula $\sin. (Æ' - Æ) = \sin. Æ' \cos. Æ - \cos. Æ' \sin. Æ$, we shall have $\sin. (Æ' - Æ) = n \tan. D' \sqrt{1 - n^2 \tan.^2 D} - n \tan. D \sqrt{1 - n^2 \tan.^2 D'}$. The observations of the meridional altitudes will give the declinations D and D'; and the difference of right ascensions, Æ'—Æ, will be found by comparing the time of the sun's culmination, or transit over

Fig. 11

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the meridian, with that of a star. If, therefore, it is found that, by assigning a certain constant value to n, this equation will satisfy all the observations, combined by pairs, of the sun's right ascensions and declinations, it will follow that the plane determined by any two points in the sun's course and the point in which it intersects the equator, has always the same inclination to the equator; in other words, all the planes so determined are identical.

Now the observations of the sun's right ascensions and meridional altitudes, which have been made daily during so great a number of years, and under so many different meridians, are found to conform entirely with the preceding formulæ: they therefore furnish so many proofs that the projection of the sun's orbit is a great circle of the celestial sphere, and that the orbit itself is wholly confined to the same plane.

Ecliptic.

The great circle which the sun describes in virtue of his proper motion is called the *Ecliptic*. It has received this name from the circumstance that the moon, during eclipses, is either in the same plane or very near it. These phenomena can in fact only happen when the sun, earth, and moon are nearly in the same straight line, and, consequently, when the moon is in the same plane with the earth and the sun. The angle formed by the planes of the ecliptic and equator, and which is measured by the arc of a circle of declination intercepted between the equator and tropic, is called the *Obliquity of the Ecliptic*. The two points in which the equator and ecliptic intersect each other are called the *Equinoctial Points:* they are also denominated the *Nodes of the Equator;* and the straight line conceived to join them is the *Line of the Equinoxes*, or the *Line of the Nodes*. The node through which the sun passes on coming from the south to the north of the equator is called the *Ascending Node*, and is usually distinguished by the character ☊; the opposite node is the *Descending Node*, and is marked by ☋. A straight line passing through the centre of the earth, perpendicular to the plane of the ecliptic, is called the *Axis*, and the points in which its prolongation meets the sphere are called the *Poles, of the Ecliptic;* these denominations being analogous to those of the axis and poles of the equator. The two small circles of the sphere which pass through the poles of the ecliptic, and are parallel to the equator, are called the *Polar Circles*.

Nodes.

Signs of the zodiac.

The ecliptic has been divided by astronomers, from time immemorial, into twelve equal parts, called *Signs*, each of which consequently contains 30 degrees. The names and symbols by which they are characterized are as follows:—

North of the Equator.		South of the Equator.	
Aries	♈	Libra	♎
Taurus	♉	Scorpio	♏
Gemini	♊	Sagittarius	♐
Cancer	♋	Capricornus	♑
Leo	♌	Aquarius	♒
Virgo	♍	Pisces	♓

In each of these signs the ancients formed groups of stars, which they denominated *asterisms*, *constellations*, *animals* (ζωδια), not confined to the ecliptic, but included within an imaginary belt, extending 8° on each side of it, to which they gave the name of *Zodiac* (ζωδιακος κυκλος, *circle* or *zone of the animals*). The term *sign* is now employed only to denote an arc of 30°, and will probably soon be banished entirely from the astronomical tables. It is already confined to the tables of the planets. Thus, to denote that the longitude of a planet is 276° 12′, it is usual to write 9ˢ 6° 12′. Formerly it was usual to employ the characteristic symbol, and to write ♑ 6° 12′, meaning that the planet was 12′ in the 6th degree of Capricornus, or the tenth sign. This inconvenient practice is now laid aside, and the signs, when they are employed, are simply distinguished by the ordinal numbers.

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As the greater part of the celestial phenomena connected with the planetary system take place either in the ecliptic or in planes not greatly inclined to it, it is found to be most convenient to refer the positions of the planets, and frequently those of the stars also, to that plane. The first point of Aries, which is the technical expression for the intersection of the ecliptic and equator, or the place of the sun at the vernal equinox, is assumed as the origin from which the degrees of the equator, as well as of the ecliptic, are counted from west to east, or in the direction of the sun's annual motion. The angular distance of the sun from this point is called his *Longitude;* and the longitude of a star is the arc intercepted on the ecliptic between the same point and a great circle passing through the star perpendicular to the ecliptic. The arc of this circle intercepted between the star and the ecliptic, or, which is the same thing, the complement of the star's distance from the pole of the ecliptic, is called the *Latitude* of the star; so that longitude and latitude are with regard to the ecliptic what right ascension and declination are with regard to the equator. Thus, let O♈Q (fig. 12) be the equator, I♈L the ecliptic, P and E the north poles of these two circles respectively, and S the place of a star. Having drawn through the pole of the ecliptic and the star the great circle ESM perpendicular to the ecliptic in M, then ♈M is the longitude of S, counted on the ecliptic from the vernal point ♈ towards the east; and SM, the distance of the star from the ecliptic, is its latitude; and for this reason all great circles passing through the poles of the ecliptic are called *Circles of Latitude*. The place of a star is thus determined by its longitude ♈M, and its latitude SM, as well as by its right ascension ♈R, and its declination SR; and when the angle L♈Q is known, it is easy to pass from the one system of co-ordinates to the other by means of the formulæ of spherical trigonometry. These formulæ are of constant use, for it is the declinations and right ascensions only which are directly observed.

Fig. 12.

Obliquity of the ecliptic.

The plane of the sun's orbit will be determined completely when its inclination to the equator and the position of the line of the nodes in space have been made known by observation. The declination of the sun twice a year, namely, at the summer and winter solstice, is equal to the obliquity of the ecliptic; whence, if the solstice happened exactly at mid-day, the obliquity would be given directly by an observation of his meridional altitude. This circumstance, however, can happen only for one terrestrial meridian; but as the declination of the sun when he approaches the tropics varies little from one day to another, his greatest observed declination will be a very near approximation to the obliquity, at whatever part of the earth the observation may have been made. It is easy, however, to correct the error which results from the observation being made on a meridian different from the solstitial colure. Taking an example from Woodhouse, let us suppose the sun's declination to be observed on three successive days (the 20th, 21st, and 22d of June), and found to be on these days respectively,

23° 27′ 37″, 23° 27′ 41″, 23° 27′ 20″;

then it is obvious, that if the middle observation gave the greatest inclination exactly, the other two would differ from it equally, which they do not. The maximum declination is therefore a quantity somewhat different from 23° 27′ 41″; and it is easy to conclude, from the inspection of the numbers, that it is nearer to 23° 27′ 41″ than to either of the other two. It is obvious, therefore, that that observation must have been made within 12 hours of the

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time when the sun was exactly in the solstitial point. In order to form an exact notion of the amount of error which may possibly arise from this circumstance, let S (fig. 13) be the place of the sun at the time of the observation, and X the true but as yet unknown solstitial point, and S s, X x meridional arcs intersecting the equator in s and x. The arc S X must be less than 30′, for in 12 hours the variation of the sun's longitude does not exceed an arc of that magnitude. Suppose it 30′: then, by Napier's rules,

Plate LXXVII. Fig. 13.

$$\text{sin. S } s = \text{sin. } \curlyvee \times \text{sin. S } \curlyvee,$$
$$\text{and sin. X } x = \text{sin. } \curlyvee \times \text{sin. X } \curlyvee;$$

whence, on eliminating sin. $\curlyvee$, and observing that sin. X $\curlyvee$ = sin. 90° = 1, we shall have

$$\text{sin. X } x = \frac{\text{sin. S } s}{\text{sin. S } \curlyvee} = \frac{\text{sin. S } s}{\text{cos. S X}}.$$

By taking, according to the observation, S s = 23° 27′ 41″, and S X = 30′, we shall find from the logarithmic tables X x = 23° 27′ 44″·5. It will be observed that 30′ is the maximum error in longitude; if instead of 30′ it had been supposed only 3′, the corresponding error in declination would have amounted only to 0″·035. In the example chosen, the error of longitude is about 20′, whence the error of declination is 1″·5 nearly, and consequently the resulting obliquity differs little from 23° 27′ 42″·5. This result is, however, to be understood of the *apparent* obliquity, which is subject to slight variations, depending on the longitudes of the moon's nodes: the *mean* obliquity, deduced from the comparison of a great number of observations, both of the summer and winter solstice, may be regarded as amounting to 23° 27′ 41″ at the commencement of the year 1830. We shall see, when we come to speak of the *Nutation*, in what the difference between the apparent and mean obliquity consists. Theoretical Astronomy

When the mean value of the obliquity of the ecliptic, as determined by the delicate instruments of the present day, is compared with that given by ancient observations, it appears to have undergone a progressive diminution, and is always greater as the observation is more remote The ancient observers were not, indeed, possessed of the means of determining an element of this sort with great precision; but as all the observations recorded in history agree in making the obliquity greater in former times than it is now, the probability is almost infinite that the angle formed by the planes of the equator and ecliptic has really diminished; for, had the differences of the values assigned to it arisen solely from errors of observation, they would have been in excess and defect indifferently, instead of being, as they are, uniformly in excess. The various observations and traditions by which the progressive diminution of the obliquity is confirmed have been collected by Bailly; in the following table we have inserted those which appear to be the best authenticated, and have added the results of some recent observations, from which can be deduced the present value of the obliquity, and the rate of its diminution.

Year.	Name of Observer.	Obliquity.			Year.	Name of Observer.	Obliquity.		
Before Christ.					After Christ.				
200	Eratosthenes, confirmed by Hipparchus and Ptolemy	23°	51′	15″	1690	Flamsteed	23°	28′	48″
160	The Chinese	23	45	52	1703	Bianchini	23	28	35
					1736	Condamine	23	28	24
					1743	Cassini de Thury	23	28	26
After Christ.					1750	Lacaille	23	28	19
					1755	Bradley	23	28	15
827	Arabians at Bagdad	23	33	52	1756	T. Mayer	23	28	16
880	Albategnius	23	35	40	1769	Maskelyne	23	28	10
1150	Almansor	23	33	30	1780	Cassini	23	27	54
1278	The Chinese	23	32	12	1800	Maskelyne	23	27	56·6
1437	Ulugh Beigh	23	31	58		Piazzi	23	27	56·3
1490	Walther	23	29	47		Delambre	23	27	57
1590	Tycho	23	29	52	1813	Pond	23	27	48·66
1646	Riccioli	23	30	20	1815	Bessel	23	27	47·46
1660	Hevelius	23	29	10	1816	Dr Brinkley	23	27	49·21
1672	Cassini	23	29	00	1825	Dr Pearson	23	27	44·01

Secular rate of diminution.

Although the comparison of these observations with one another gives very discordant results relatively to the law according to which the obliquity varies, their totality places the fact of its progressive diminution beyond all manner of doubt. Lacaille, who was followed by the greater number of astronomers, estimated the diminution of 44″ in a hundred years; a result to which he was led chiefly by a comparison of his own observations with those of Walther. Lalande, after comparing an immense number of modern observations with those of the 17th, 16th, and 15th centuries, and also with those of the Arabians and Chinese, found the secular diminution to be 50″. Bessel, rejecting the ancient observations as too uncertain, and comparing those only which have been made since the time of Bradley, has fixed the secular diminution at 45″·7, which differs inconsiderably from the determination of Lacaille. It cannot yet be determined by observation whether this diminution is uniform, or accelerated, or retarded; but so slow is the rate at which it proceeds, that it may, without any sensible error, be regarded as uniform for many centuries to come.

The gradual diminution of the obliquity of the ecliptic might lead us to suppose that a time will ultimately arrive when that plane will coincide with the equator, and the earth be deprived, in consequence, of the agreeable vicissitude of the seasons. But the theory of universal gravitation, which has revealed the cause of the diminution, has also shown that there are certain limits which the angle of the two planes can never exceed, and between which it must continue for ever to oscillate. Geometers have not yet ventured to assign the precise extent of these limits, but their existence is certain; and the planes of the ecliptic and equator, which have been approaching to each other during the last 2000 years, will, in the course of some thousands of years more, begin to recede.

Displacement of the ecliptic.

In what has yet been said respecting the diminution of the obliquity of the ecliptic, no fact has been mentioned from which it can be inferred, whether the phenomenon is

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occasioned by the displacement of the plane of the ecliptic or that of the equator. This question may also be decided by a comparison of modern with ancient observations; for it is evident, that if the inclination of these two planes becomes less, the stars which are situated between them, particularly those near the solstitial colure, will appear to approach to that plane which changes its position; so that if the ecliptic is displaced, the latitudes of those stars will be diminished, or their declinations if the displacement belongs to the equator. It was first observed by Tycho, and the observation has been confirmed by succeeding astronomers, that the latitudes of the southern stars situated near the solstitial colure, that is, of those stars whose longitudes are nearly 90°, have diminished upwards of 20′ since the time of Hipparchus and Ptolemy, while the latitudes of the northern stars have undergone a corresponding augmentation. From this fact it is proved that the diminution of the obliquity is occasioned by the displacement of the ecliptic; and theory has shown that the cause of the displacement is the action of the planets, particularly of Jupiter and Venus, on the earth, by virtue of which the plane of the earth's orbit is drawn nearer to the planes of the orbits of these two planets. This, however, though by far the most considerable, is not the sole cause of the phenomenon; for theory also shows that a slight motion of the plane of the equator is produced by the attraction of the sun and moon, but so very minute that its effects will only become appreciable after a long series of ages.

Precession of the equinoxes.

After determining the inclination of the plane of the ecliptic to that of the equator, the only element requisite to fix its position absolutely in space, is the situation of the straight line formed by its intersection with that plane, that is to say, the line of the nodes. The longitudes of the stars, as has already been mentioned, are counted on the ecliptic from the vernal equinox; and therefore, if the line of the equinoxes, which is the same as the line of the nodes, is invariable, the longitude of any star will always be the same, whatever interval of time may elapse between two observations of that longitude. But on comparing the actual state of the heavens with the observations recorded by ancient astronomers, it is perceived that the longitudes of all the stars are considerably increased; whence we must infer, either that the whole firmament has advanced in the order of the signs, or that the equinoctial points have gone backwards, or retrograded. The latter supposition is infinitely the more probable; for it is inconceivable that the innumerable multitude of stars should have a common motion relatively to points which depend solely on the motion of the earth. The phenomenon is therefore to be explained by attributing to the equinoctial points a retrograde motion from east to west, in consequence of which, the sun, whose motion is direct, arrives at them sooner than if they remained at rest; and therefore the equinoxes, spring, autumn, and the other seasons, happen before the sun has completed an entire circuit. On this account the motion has been denominated the *Precession of the Equinoxes*. As this motion is extremely slow, its exact amount can be discovered only by a comparison of observations separated from each other by long intervals of time; but the imperfection of instruments prior to the sixteenth century renders the ancient observations of little authority where quantities so minute are concerned, and therefore some discrepancies may be expected in the different determinations of the amount of the precession. The comparison of modern observations with those of Hipparchus gives its annual amount equal to 50⅔ seconds, and with those of Ptolemy somewhat greater. The mean result of the observations of Tycho, compared with those of Lacaille, gives 50″⅛. On comparing modern observations with one another, we find 50″·06. Delambre, in his solar tables, supposes the annual precession to be equal to 50″·1. According to this estimate the equinoctial points go backwards at the rate of one degree in 71·6 years nearly, and therefore will make a complete revolution of the heavens in about 25,868, or nearly 26 thousand years.

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The discovery of the precession of the equinoxes is generally attributed to Hipparchus, who, on comparing his own observations with those of Timocharis, more ancient by 160 years, perceived that in this interval the longitudes of the stars had been augmented by about two degrees. It would seem, however, from many proofs collected by Bailly, that this motion, slow as it is, was known to all the ancient nations who cultivated astronomy, long before the time of Hipparchus. It is indeed easy to conceive, from the great attention which they gave to the heliacal risings of the remarkable stars, that they might observe a gradual change of the seasons at the occurrence of these phenomena, from which they would necessarily be led to conclude a variation of the star's longitude. In consequence of this regression of the equinoctial points, the sun's place among the zodiacal constellations at any given season of the year is now greatly different from what it was in remote ages. Some time prior to Hipparchus, the first points of Aries and Libra corresponded to the vernal and autumnal equinoxes; those of Cancer and Capricorn to the summer and winter solstices: at present these constellations have separated 30 degrees from the same points of the ecliptic. The vernal equinox now happens in the constellation Pisces, the summer solstice in Gemini, the autumnal equinox in Virgo, and the winter solstice in Sagittarius. Astronomers, however, still count the signs from the vernal equinox, which, therefore, always corresponds to the first point of the *Sign* of Aries. On this account it is necessary to distinguish carefully between the *Signs* of the Zodiac, which are fixed with regard to the equinoxes, and the *Constellations*, which are movable with respect to those points.

Physical cause of the precession of the equinoxes.

The diminution of the obliquity of the ecliptic arises from the displacement of the ecliptic itself; the precession of the equinoxes is, on the contrary, occasioned by the continual displacement of the plane of the terrestrial equator. This displacement results from the combined action of the sun and moon (for the influence of the planets amounts only to a fraction of a second, and is consequently scarcely sensible,) on the mass of protuberant matter accumulated about the earth's equator, or the matter which forms the excess of the terrestrial spheroid above its inscribed sphere. The attracting force of the sun and moon on this shell of matter may be resolved into two; one parallel to the plane of the equator, the other perpendicular to it. The tendency of this last force is to diminish the angle which the plane of the equator makes with that of the ecliptic; and if the earth had no motion of rotation, it would soon cause the two planes to coincide. In consequence, however, of the rotatory motion of the earth, the inclination of the two planes remains constant; but the effect produced by the action of the force in question is, that the plane of the equator is constantly shifting its place, in such a manner that the line of the equinoxes advances in the direction of the diurnal motion, or contrary to the order of the signs, its pole having a slow angular motion about the pole of the ecliptic, so slow indeed, that it requires nearly 26,000 years to complete its revolution.

Nutation.

If the sun and moon moved in the plane of the equator, there would evidently be no precession; and the effect of

their action in producing it varies with their distance from that plane. Twice a year, therefore, the effect of the sun in causing precession is nothing; and twice a year, namely at the solstices, it is a maximum: on no two successive days of the year is it exactly the same, and consequently the regression of the equinoctial points, which results from the sun's action, must be unequable. On this account the obliquity of the ecliptic is subject to a semi-annual variation; for the sun's force, which tends to produce a change in the obliquity, is variable, while the diurnal motion of the earth, which prevents the change from taking place, is constant. Hence the plane of the equator is subject to an irregular motion, which is technically called the *Solar Nutation*. The existence of the solar nutation is, however, only a deduction from theory, for its amount is too small to be perceptible to observation; but a similar effect of the moon's action is sufficiently appreciable, and was, in fact, discovered by Dr Bradley before theory had indicated its existence. Its period, however, is different, and depends on the time of the revolution of the moon's nodes, which is performed in 18 years and about 7 months. During this time the intersection of the lunar orbit with the ecliptic has receded through a complete circumference; and the inequality of the moon's action will consequently, in the same time, have passed through all its different degrees. Bradley observed that the declinations of the stars continued to augment during nine years, that they diminished during the nine years following, and that the greatest change of declination amounted to 18″. He remarked further, that this motion was connected with an irregularity of the precession of the equinoxes, which followed exactly the same period; whence he concluded that the motion of the poles of the equator, occasioned by this vibration of its plane, was not confined to the solstitial colure. A series of observations on stars differently situated proved that all the phenomena could be explained on the hypothesis that the pole of the equator describes in 18 years a small circle of 18″ diameter, contrary to the order of the signs; or that the axis of the earth, following the circumference of this circle, describes the surface of a cone, the axis of which forms with its side an angle of 9″. This apparent vibratory motion is significantly denominated the *Nutation of the Earth's Axis*.

Path described in space by the pole of the equator.

In consequence of the two motions which occasion the precession and the nutation, the true path of the pole of the equator round that of the ecliptic is an epicycloidal curve, which will be understood by referring to fig. 14. Let E be the pole of the ecliptic, round which the pole of the equator P describes, in virtue of the precession, and in a direction contrary to the order of the sines, the circle PQR, of which the radius EP is equal to the obliquity of the ecliptic, or the mean distance of the two poles. While P, the mean place of the pole, moves in the circle PQR, with a velocity equal to the regression of the equinoctial points, or at the rate of 50″·1 a year, the *true* pole *p* describes at the same time round P a small circle of 18″ diameter in the same direction *pqr*. The true path of the pole is therefore along the circumference of a circle *pqr*, the centre of which retrogrades on the circumference of another circle, and consequently moves in an epicycloid *abcdefg*, the curve which results from the composition of the two motions. Suppose the mean pole at Q, the true pole at *a*, and *a*Q=9″. In the course of nine years the mean pole will have retrograded from Q to R, making QR=9×50″·1, while the true pole will have accomplished a semi-revolution in its circle. It will therefore be at *c* (R*c* being=9″), and have described the epicycloidal arc *abc*, the greatest distance of which from the circle PQR is at *b*, and equal to 9″. At the end of the following nine years the mean pole has retrograded from R to S, or 9×50″·1, and the true pole has returned to the same point *a* of its epicycle; it will therefore be found at *e*, S*e* being =9″. In this interval it has necessarily been within the circle PQR, its greatest distance from which at *d* is 9″, so that in 18 years it has traced the curve *abcde*. But *ac* = QR + *a*Q + R*c* = 9 × 50″·1 + 18″ = 7′ 49″, and *ce*=RS—R*c*—S*e* = 9×50″·1—18″ = 7′ 13″. From *a* to *c* the motion of the true pole in the epicycle is in the same direction as that of the mean pole; from *c* to *e* it is in an opposite direction, but as it is always much slower, being only about 3″ in a year, while that of the mean motion is 50″·1, the true motion which results from the combination of both will always be in the direction *ce*, and at *d* its velocity will be equal to their difference. At *b* and *d* the difference between the latitudes of the true and mean pole is a maximum, while the difference of their longitudes is nothing; in other words, the correction of the obliquity is greatest when that of the precession vanishes: at *a*, *c*, and *e* the correction of the obliquity vanishes, and that of the precession is a maximum.

Fig. 14.

Pole describes an ellipse.

Dr Bradley remarked that the effects of the nutation would be represented still more accurately by supposing the curve described by the pole of the equator about its mean place to be an ellipse instead of a circle, the transverse and conjugate axes being 18″ and 16″ respectively. This is also confirmed by theory, from which Laplace calculated the semi-axes of the ellipse at 9″·63 and 7″·17. The semi-transverse axis of the ellipse described by the pole in virtue of the sun's action alone does not exceed half a second, and is consequently totally inappreciable. The sensible part of the nutation, therefore, follows exactly the period of the revolution of the nodes of the moon. By 603 observations of Polaris, observed at Dorpat between 1822 and 1838, M. Peters has determined the semi-axis major of the ellipse to be 9″·2361, and gives, for his definitive result, 9″·2231.

It is now easy to see the reason of the distinction drawn above between the *mean* and the *true* or *apparent* obliquity. The mean obliquity is represented by the radius EP of the deferent circle PQR, along the circumference of which the centre of the small circle or ellipse is carried, while the true obliquity is that quantity increased or diminished by the nutation. The calculation of the mean obliquity from the true is performed by the aid of the astronomical tables.

The progressive diminution of the mean obliquity and the nutation of the earth's axis are inequalities distinguished from each other, not only by their being derived from different and distinct causes, but still more by the very great difference of time required for their full development. Almost every other element of the planetary system is affected in a similar manner by inequalities of two kinds, which are distinguished by the terms *secular* and *periodic*. The secular inequalities proceed with extreme slowness, and continue progressive in the same sense during many centuries; while the periodic are much more rapid in their march, and run through the whole period of their changes in comparatively short intervals of time. The inequalities of the first kind are also periodic; but their periods are vastly longer, and may be reckoned by centuries instead of years; and from this circumstance they derive their name of *secular inequalities*.

Sect. II.—*Of the Orbit of the Sun.*

Having now considered the situation of the plane in which the sun is observed to move relatively to the fixed stars, and also the small secular and periodic variations

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to which it is subject, we proceed next to inquire into the nature of his orbit, or the curve which he describes on that plane. The means which we have of determining the solar orbit are the observed variations of the sun's angular velocity, and of his distance from the earth; hence two kinds of observations are necessary,—the first, of his daily meridional altitudes, from which, as the inclination of the orbit is known, his angular velocity is easily found; and the second, of his apparent diameter, the variations of which follow the inverse ratio of his distance.

That the angular velocity of the sun's motion in his orbit is not uniform, is obvious from the fact that he remains $7\frac{2}{3}$ days longer in the northern than in the southern signs, or, which is the same thing, that the interval between the vernal and autumnal equinoxes is $7\frac{2}{3}$ days longer than the interval between the autumnal and vernal. It is proved by numerous observations that the sun moves with the greatest velocity when at a point situated near the winter solstice; while at the opposite point of the orbit, or near the summer solstice, his velocity is the least. At the first point the diurnal motion is 1°·01943, and at the second only 0°·95319. It is constantly varying between these two points; and the variation is observed to be nearly proportional to the sun's angular distance from the point of his orbit where his velocity is a maximum or minimum. The mean velocity is 0°·98632, or nearly 59′ 11″, which is the rate of the sun's daily motion about the beginning of April and October.

The point of the solar orbit, which is the most remote from the earth, is called the *apogee* (απο γης, away from the earth); that which is nearest is called the *perigee* (περι γης, near the earth). The same points are also called respectively the superior and inferior *Apsis* of the orbit, and the straight line which joins them is called the *Line of the Apsides.*

Diameter of the sun.

The exact determination of the sun's diameter is a problem which engaged the earliest astronomers, but of which, before the invention of the telescope and micrometer, it was impossible to obtain a solution sufficiently accurate to make known its variations. Archimedes, by an extremely ingenious though imperfect method, demonstrated that it must be included between the limits $\frac{1}{200}$ and $\frac{1}{164}$ of a right angle, that is, between 27′ and 32′ 55″·7. The Egyptians, by observing the time which the sun takes to rise above the horizon, found it to be between a 750th and a 700th part of a circumference, that is, between 28′ 48″ and 30′ 51″·5. Aristarchus of Samos supposed it to be 30′. The precision of modern observations shows that the apparent diameter is greatest about the time of the winter solstice, and least about the summer solstice; but there is some discrepancy among the results of different astronomers with respect to its actual magnitude. According to the tables of Delambre, its greatest value is 32′ 35″·6, and its least 31′ 31″; the mean apparent diameter, or the diameter at the sun's mean distance, is equal to 32′ 2″·9. According to Bessel, the mean diameter is 32′ 1″·80, as derived from 1698 transits, and the result from the Greenwich observations is 1″·84 greater than this.

From these remarks it is obvious, that if the orbit of the sun be a circle, the earth is not situated in the centre of that circle, otherwise the distance of the sun from the earth would remain always the same, which is contrary to fact. It is possible, however, that the variation in his angular velocity may not be *real*, but only apparent. Thus, in fig. 15, let AMPN be the orbit of the sun, C the centre of that orbit, and E the position of the earth at some distance from the centre. It is obvious that P is the sun's perigee, and A his apogee. Now, as the sun's apparent orbit is a circle having the earth in its centre, it is evident that this orbit must be *a*M*p*N, and that the angular motion of the sun will be measured upon that circle. Suppose now that the sun in his apogee moves from A to A′, it is obvious that his apparent or angular motion will be the segment *a a′* of the apparent orbit, considerably smaller than AA′; so that at the apogee the angular motion of the sun will be less than his real motion. Again, let the sun in his perigee move from P to P′, describing a segment precisely equal to the segment AA′. This segment, as seen from the earth, will be referred to *p p′*, which in that case will be the sun's angular motion, evidently considerably greater than his real motion.

Fig. 15.

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Hence it is obvious, that even on the supposition that the sun moved equably in his orbit, his angular motion as seen from the earth would still vary, that is, would be smallest at the apogee and greatest at the perigee, and that the angular and real motion would only coincide in the points M and N, where the real and apparent orbits intersect each other. From the figure, it is obvious also that the angular velocity would increase gradually from the apogee to the perigee, and diminish gradually from the perigee to the apogee, which likewise corresponds with observation.

Sun's motion varies.

But if the variation in the angular motion of the sun were owing alone to the eccentric position of the earth within the solar orbit, it is easy to demonstrate that in that case the diminution of his angular velocity would follow the same ratio as the diminution of his diameter. The fact however is, that the angular velocity diminishes in a ratio twice as great as the diameter of the sun does. The variation of the angular velocity cannot then be owing to the eccentricity alone. Hence it follows that the variation of the motion of the sun is not merely apparent, but real, and that its velocity in its orbit actually diminishes as his distance from the earth increases. Two causes, then, combine to produce the variation in the sun's angular velocity; namely, 1. the increase and diminution of his distance from the earth, and, 2. the real increase and diminution of his velocity in proportion to this variation of distance. These two causes combine in such a manner that the daily angular motion of the sun diminishes as the square of his distance increases, so that the product of the angular velocity multiplied into the square of the distance is a constant quantity.

The observation, that the sun's angular motion in his orbit is inversely proportional to the square of his distance from the earth, is due to Kepler. The discovery was made by a careful comparison of the sun's diurnal motion with his apparent diameter, which is inversely proportional to his distance from the earth. Let ASB (fig. 16) be the sun's orbit, E the earth, and S′ the sun. Suppose a line ES joining the centres of the earth and sun to move round along with the sun. It is obvious that when S moves to S′, ES, moving along with it, is now in the situation ES′, having described the small sector SES′. In the same time that S performs one revolution in its orbit, the radius vector ES will describe the whole area ABS inclosed within the sun's orbit. Let SS′ be the sun's angular motion during one day. It is evident that the small sector SES′ is proportional to the square of ES, multiplied by SS′; for the radius vector is the sun's distance from the earth, and SS′ his angular motion. Hence this sector is a constant quantity, whatever the angular motion of the sun be; and the whole area SEA increases as the number of days which the sun takes in moving from S to A. Hence results that remarkable law, first pointed out by Kepler, that *the areas described by the radius vector are proportional to the times of description.* Suppose the sun to describe SS′ in one day, and SA in twenty days; then

Fig. 16.

Describes areas proportional to the times.

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the area SES′ is to the area SEA as 1 to 20, or the area SEA is 20 times greater than the area SES′.

The knowledge of these facts enables us to draw upon paper, from day to day, lines proportional to the length of the radius vector of the solar orbit, and having the same relative position. If we join the extremity of these lines, by making a curve pass through them, we shall perceive that this curve is not exactly circular. Let E (fig. 17) represent the earth, and E *a*, E *b*, E *c*, E *d*, E *e*, &c. the position and length of the radius vector during every day of the year; if we join together the points *a*, *b*, *c*, *d*, *e*, *f*, *g*, *h*, *i*, *k*, *l*, *m*, *n*, *o*, by drawing the curve *a e i m* through them, it is obvious that this curve is not a circle, but elongated towards *a* and *i*, the points which represent the sun's greatest and least distance from the earth. The resemblance of this curve to the ellipse induced Kepler to compare them together; and he ascertained their identity, and thus proved that the orbit of the sun is an *ellipse*, having the earth in one of its foci.

Fig. 17.

Having arrived at the knowledge of the true nature of the sun's orbit, it becomes necessary, in the next place, to determine its position on the plane of the ecliptic, that is, to assign the position of the transverse axis, or line of the apsides, with reference to some other straight line given by position on that plane. The line which it is most convenient to assume for this purpose is the line of the equinoxes; and the position of the apsides may be determined from observations of the time which the sun occupies in performing a semi-revolution, counting from different points of his orbit. Thus, if among the observations of the sun's longitude made daily during the course of a year, we compare, two and two, all those which are diametrically opposite, or which differ by 180°, it will be found that the interval between them will be somewhat less than half a year, if the sun, during that interval, has passed through his perigee, or longer if he has passed through his apogee; and that the time between the two observations will differ less from half the time of a whole revolution, in proportion as the sun's place, at the time of the two observations, was nearer to the apsides. If the difference of time between the two observations is exactly half a year, then the place of the apsides would be obtained at once, because the sun must have been in those points when the observations were made. The probability is, however, infinitely small, that this can ever happen exactly; but as the position of the apsides is known very nearly from the diurnal observations of the variation of the sun's angular velocity, the necesssary corrections can easily be supplied by computation.

From the comparison of observations made in different ages, it appears that the position of the apsides is not fixed on the plane of the ecliptic, but that the greater axis of the solar ellipse revolves in the direction of the sun's annual motion. The observations of Hipparchus, compared with those of the present times, show that the apsides have a direct motion at the rate of 65″ in a year. According to the observations of Walther, the longitude of the apogee in 1496 was 93° 57′ 57″; and according to Lacaille, the same element in 1750 was 98° 37′ 28″; whence, dividing the difference by 254, the interval between the two epochs, the annual motion of the line of the apsides amounts to 66″. Delambre found, by the comparison of a great number of modern observations, that the annual motion is 61″·95 a year. The theory of attraction, which, in respect of such slow and minute variations, must be considered as giving more accurate results than can be obtained directly by observation, gives 61″·9 for the yearly progressive motion of the apsides.

In the above determination, the position of the apsides is referred to the line of the equinoxes, and their motion compared with the sun's tropical revolution. But if we wish to determine their motion with reference to the fixed stars, it is necessary to have regard to the retrograde movement of the equinoctial points; for it is obvious, that if the line of the equinoxes is not fixed, the displacement of the apsides with respect to the stars will be increased or diminished by the whole amount of its motion, according as the two motions are in the same or opposite directions. Now the motion of the line of the apsides is direct, and has just been stated to amount to 61″·9 in a solar year; that of the equinoxes is, on the contrary, retrograde, and amounts to 50″·1 in the same time. Hence the displacement of the apsides, with reference to a star or fixed point in the ecliptic, is 61″·9 — 50″·1 = 11″·8 a year, in the direction of the sun's annual motion. The time, therefore, in which the solar perigee completes a revolution in the heavens, or returns to the same star, is $\frac{360°}{11''.8}$, equal nearly to 110,000 years.

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Since the greater axis of the solar ellipse has a progressive motion on the plane of the ecliptic, it forms a variable angle with the line of the equinoxes, and at distant epochs will coincide with that line, or be perpendicular to it. The epochs at which these phenomena happen may be easily found by simple proportions, when the longitude of the perigee at any given time, and its annual motion, are known. According to the observations of Lacaille, already quoted, the longitude of the perigee in 1750 was 278° 37′ 28″; but when the longitude of the perigee was 270°, the greater axis of the solar ellipse must have been perpendicular to the line of the equinoxes. The difference of these two longitudes is 8° 37′ 28″, and the number of years requisite to describe that arc, at the rate of 61″·9 annually, is $\frac{8° 37' 28''}{61''.9}$ = 500 years nearly; whence the major axis was perpendicular to the line of the equinoxes in the year 1250, when the perigee of the orbit coincided with the winter solstice.

Suppose it were required to assign the epoch at which the major axis coincided with the line of the equinoxes. At the occurrence of this phenomenon the longitude of the perigee was 180°, consequently from that time to 1750 the perigee had advanced 278° 37′ 28″ — 180° = 98° 37′ 28″. Now $\frac{98° 37' 28''}{61''.9}$ = 5735; therefore 5735 is the number of years intervening between the occurrence of the phenomenon and 1750. Hence about 4000 years before the commencement of our era, the transverse axis of the solar orbit coincided with the line of the equinoxes; and it is a singular coincidence that this epoch is considered by chronologists to be that of the beginning of the world, or, to speak more correctly, of the first traces of the existence of the human race; for numerous physical circumstances attest that the earth itself has existed during an infinitely longer period. The same phenomenon will again occur when the longitude of the perigee shall have reached 360°, or become zero; and by calculating as above, this will be found to take place in the year 6485 of our era. The solar perigee will then coincide with the vernal equinox; in the former case it coincided with that of autumn.

By reason of the progressive motion of the perigee, the length of the seasons is continually varying. Let AP (figs. 18, 19, 20) represent the line of the apsides, S and W the summer and winter solstices, V and O the vernal and autumnal equinoxes. When the greater axis was perpendicular to the line of the equinoxes, as happened in the year 1250 of our era, the perigee P (fig. 18) coincided

Seasons vary in length.

Fig. 18.

with W the winter solstice; and on that account the time between the autumnal equinox O, and the winter solstice W, was equal to the time between W and V, or between the winter solstice and the vernal equinox. But in this position the equator, which is here represented by VO, divides the ellipse into two unequal portions, the smaller of which must be described in less time than the greater, because the times of description are proportional to the spaces passed over. The summer was therefore, at that time, longer than the winter, and both were divided into equal parts by the solstices. In any other position the seasons differ in length from each other. In the time of Hipparchus, the longitude of the perigee was less than in 1750 by 32°·292, or was 246°·330. The position of the ellipse with regard to the equinoxes was therefore such as is represented in fig. 19, the angle PEW being 270° — 246°·33 = 23° 40′ 12″. The interval between V and S was then 94½ days, and that between S and O only 92½ days. The spring was therefore at that time longer than the summer, and the winter longer than the autumn. The position of the ellipse in 1800 is represented in fig. 20. The angle PEW was then 9° 29′, and the following were nearly the lengths of the seasons:—

Fig. 19.

Fig. 20.

	Days.	Hours.	Min.
from V to S	92	21	45
S to O	93	13	35
O to W	89	16	47
W to V	89	1	42
length of the year, nearly	365	5	49

The spring is therefore at present shorter than the summer, and the autumn longer than the winter.

Eccentricity of the solar orbit.

After describing the position of the transverse axis of the solar ellipse on the plane of the ecliptic, we come next to consider the species of that ellipse, or its eccentricity, on which depend the apparent inequalities of the sun's angular motion. It is evident that this element will be made known if we can by any means determine the ratio of the two segments into which the major axis is divided by the focus. This ratio might seem to be obtainable without any difficulty by comparing the sun's apparent diameters at the perigee and apogee, to which the distances are inversely proportional; but such observations, on account of the irradiation and other difficulties, are liable to considerable uncertainty: it is therefore necessary to have recourse to other methods of estimating the eccentricity, and the variations to which it is subject. These methods are derived from the fundamental law of the elliptic motion, namely, the proportionality of the areas described by the radius vector to the times of description, by which the inequalities of motion and the ellipticity of the orbit are connected with each other; so that when the inequalities are made known by direct observation, the species of the ellipse can be computed from the principles of geometry. It will, however, be necessary to attend more closely than we have yet done to the phenomena resulting from the eccentric position of the earth in the sun's orbit, and to explain some terms technically employed by astronomers to abbreviate and simplify their descriptions.

The sun's motion may be regarded as composed of two distinct parts, namely, a circular uniform motion, which constitutes the principal part of it; and a correction depending on the deviation of the orbit from a circle, which modifies the first, and alternately accelerates and retards the mean angular velocity. To illustrate this, let E (fig. 21) be the earth, PSA the orbit of the sun, AP the line of the apsides, and ♈ ♎ the intersection of the plane of the orbit with that of the equator. While the true sun S moves round his elliptic orbit, describing areas proportional to the times, conceive a fictitious sun *s* to move round the earth in the circumference of a circle of which the radius is equal to EP the sun's distance at the perigee, and with a uniform motion such, that if the two suns set out at the same instant from P, they may also return to the same point together, after having completed each a revolution. At the perigee the radius vector of the real sun is a minimum; his velocity is consequently a maximum, and he therefore advances before the fictitious sun. But his motion relaxes in proportion as his distance from P becomes greater; and at a certain point S of the orbit it becomes equal to that of the fictitious sun, which has then only reached the point *s*. After passing the point S, the angular distance SE*s* continues to diminish on account that the motion of the real sun continues to relax, and it vanishes altogether when he reaches his apogee at A, the fictitious sun arriving at *a* in the same straight line with A and E at the same instant of time. From the apogee to the perigee the phenomena are reversed. The motion of the real sun being then the slowest possible, he at first falls behind the fictitious sun; but his motion continuing to be gradually accelerated, he has again acquired the same velocity when he reaches S′, after which his motion is more rapid than that of the fictitious sun, which he at last overtakes at P. If, therefore, we conceive a radius vector to be drawn from the earth to each of the two suns, those lines will form with each other a variable angle, having its maximum value when the velocities are equal, and vanishing at the perigee and apogee. This angle, namely, SE*s*, is called the *Equation of the Centre*, or *Equation of the Orbit*. It is the correction necessary to be made to the longitude of the sun deduced from his equable motion, in order to have his real longitude. Those quantities which form the difference between the true and mean results are, in astronomy, denominated equations. The ancients employed the term *Prosthaphæresis* in the same sense.

Equation of the centre.

From the perigee to the apogee, the true longitude of the sun is found by adding the equation of the centre to the mean longitude, and in the other half of the orbit by taking the difference of the same quantities. The equation of the centre is a maximum when the sun is at the points S and S′, or when the mean and true motions are equal; and if its value can be obtained from observation at those times, the eccentricity of the orbit may be deduced by means of the geometrical properties of the ellipse. Now the points S and S′ may be found very nearly by observing when the diurnal velocity of the sun is equal to the mean motion, or to 0·985647 parts of a degree. By these observations the angle SES′, which is the difference of the real longitudes of the sun, or of his distances from ♈, will be given. But *s* E *s*′ is also given; for it is the angle which would be described by the sun, in virtue of his mean motion, during the interval between the two observations. Hence the difference between *s*E*s*′ and SES′ is given, being equal to twice SE*s* the maximum equation of the centre, in consequence of the symmetrical position of the points S and S′, and also of *s* and *s*′, in respect of the line of the apsides AP. The accuracy of a result obtained in this manner may appear questionable, on account of the impossibility of determining by observation the exact moment at which the sun's true motion in longitude is equal to his mean motion; but as the real motion varies very little during a few days before and after that epoch, the equation of the centre will be scarcely affected by a slight error in the time. Besides, any error in the result is corrected by taking the mean of a great number of similar observations.

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By a comparison of numerous observations of this kind, Delambre found that the greatest equation of the centre, in the year 1776, amounted to 1°·9254, or 1° 55′ 31″·4. In 1801 the same equation was 1° 55′ 27″·3. (See Baily's *Astronomical Tables*, p. 66.)

Having obtained the value of the greatest equation of the centre, the eccentricity of the orbit may be computed from the first two terms of the following series,

$$e = \tfrac{1}{2}\mathrm{E} - \frac{11}{2^8 \cdot 3}\mathrm{E}^3 - \frac{587}{2^{16} \cdot 3 \cdot 5}\mathrm{E}^5 - \&c.$$

in which e represents the eccentricity, and E the greatest equation of the centre. By reversing the series the following expression is found for the greatest equation in terms of the eccentricity, viz.

$$\mathrm{E} = 2e + \frac{11}{2^4 \cdot 3} e^3 + \frac{599}{2^{10} \cdot 5} e^5 + \&c.$$

For an investigation of the above formulæ the reader may consult Biot, *Astronomie Physique*, tom. ii. p. 185.

Secular diminution of the eccentricity of the solar orbit.

It has been discovered by observation, that the equation of the centre of the sun's orbit is subject to a nearly uniform secular diminution. This fact is confirmed by theory, from which also the secular diminution has been assigned. It amounts to 8°·0047 in a century. This phenomenon implies a corresponding diminution of the eccentricity of the solar orbit amounting to ·000037495 in the same time, the semiaxis major being unit. This will be conceived more distinctly by converting the above fraction into some familiar expression of linear magnitude. Supposing the mean distance of the sun to be 96,000,000 of miles, the fraction ·000037495 will represent nearly 3700 miles, so that the annual diminution of the eccentricity is nearly at the rate of 37 miles,—a line which is considerable on the surface of the earth, but which has scarcely an appreciable ratio to the immense distance of the sun. If, however, this diminution, small as it is, were to be continued indefinitely, the eccentricity would ultimately vanish, and the sun's orbit would be changed into a circle; but the theory of universal gravitation proves that, like all the other variations of the elements of the solar system, the variation of the eccentricity is subject to periodic laws. After having continued during a certain time to diminish, the eccentricity will again begin to increase, and will successively pass through all its former values. Thus it will continue to oscillate within certain limits, of which the extent, though not precisely known, cannot be very great: and the solar orbit will eternally preserve its elliptic form, unless the application of some external force shall derange the system of the world, or modify the laws by which it is at present governed.

Determination of the sun's place in his orbit.

Kepler's problem.

The true nature of the solar orbit being known, together with its situation on the plane of the ecliptic, and the amount of its eccentricity, as also the time of a revolution, the sun's longitude may be determined at any assigned epoch. This determination is what is usually termed *Kepler's Problem*, having been first proposed by that great astronomer on the hypothesis of an elliptic orbit. Its solution, which is not susceptible of being exhibited under a finite form, is derived from the principle of the equable description of areas. Let ASP (fig. 22) represent the semi-orbit of the sun, C the centre of the orbit, E the focus occupied by the earth, and let the time and motion be counted from the perigee P. On AP describe a semicircle, on the circumference of which let a point M be supposed to move uniformly, and to describe the semicircle PMA, in the same time in which the sun describes the semi-ellipse PSA. Now, suppose that at the end of a given time t, the sun has moved from P to S; then, denoting by T the time of a complete revolution, and putting π for the semi-circumference, the place of M, at the end of the same time t, will be given by the equation $\mathrm{PM} = \frac{t}{\mathrm{T}} 2\pi$. Through S let a perpendicular be drawn to AP, meeting the semicircle in D and AP in N, and join EM, ES, ED, CM, and CD. The different angles of this figure have received certain technical names, which it is necessary to explain. Then S being the true place of sun, the angle PES is called the *True Anomaly*; PEM is called the *Mean Anomaly*, and PCD is denominated the *Eccentric Anomaly* This last is measured by the arc PMD, which is the perigean distance of a body describing a circle circumscribed about the solar ellipse, and having constantly the same abscis PN as the sun. The word *anomaly* originally signified *inequality*; it now simply designates the angular distance of a planet from its perihelion, seen from the sun, or, as in the present case, the angular distance of the sun from his perigee.

Theoretical Astronomy. Fig. 22.

According to the law of the equable description of areas, we have the sector PCM to PES as the surface of the semicircle to the surface of the semi-ellipse; that is, as the semi-transverse to the semi-conjugate axis, or as ND to NS, according to a well-known property of the ellipse. Hence PCM : PES : : PED : PES, and therefore PCM = PED = PCD — ECD. Now, if we express the arc PM by z, PD by x, the eccentricity EC by e, and make the radius equal to unity, we shall have the sector $\mathrm{PCM} = \frac{1}{2}z$, the sector $\mathrm{PCD} = \frac{1}{2}x$, and the triangle $\mathrm{ECD} = \frac{1}{2}e$. $\mathrm{DN} = \frac{1}{2}e \sin. x$. Substituting, therefore, these expressions in the above equation, it will become, on multiplying both sides of it by 2,

$$z = x - e \sin. x \ldots\ldots\ldots\ldots\ldots\ldots (1.)$$

where z denotes the mean, and x the eccentric, anomaly.

If in this equation x and e were both known, it would be easy to deduce from it the mean anomaly z; but the data are z and e, and the value of x can only be obtained in a series, the equation being a transcendental one. Its resolution gives the value of the eccentric in terms of the mean anomaly; and if another equation can be found in which the eccentric anomaly is expressed in terms of the true, it will only remain to put these two expressions equal to one another in order to have an equation between the mean and true anomaly.

For this purpose it will be necessary to equate two values of the radius vector ES, expressed in terms of the eccentric and true anomalies respectively. Putting $\mathrm{ES} = r$, we shall have, in the first place,

$$r^2 = \mathrm{EN}^2 + \mathrm{NS}^2;$$

but if the semiaxis minor is represented by b, the common equation of the ellipse gives

$$\mathrm{NS}^2 = \frac{b^2}{a^2}(a^2 - \mathrm{CN}^2) = b^2 - \frac{b^2}{a^2}\mathrm{CN}^2;$$

and we have also

$$\begin{aligned}\mathrm{EN}^2 &= \mathrm{EC}^2 + 2\,\mathrm{EC} \,.\, \mathrm{CN} + \mathrm{CN}^2 \\ &= e^2 a^2 + 2ea \,.\, \mathrm{CN} + \mathrm{CN}^2;\end{aligned}$$

therefore, by addition,

$$\mathrm{NS}^2 + \mathrm{EN}^2 = b^2 + e^2 a^2 + 2ea \,.\, \mathrm{CN} + \left(1 - \frac{b^2}{a^2}\right)\mathrm{CN}^2.$$

Now, $b^2 + e^2 a^2 = a^2$, and $1 - \frac{b^2}{a^2} = e^2$; therefore

$$\mathrm{NS}^2 + \mathrm{EN}^2 = r^2 = a^2 + 2ea \,.\, \mathrm{CN} + e^2 \mathrm{CN}^2;$$

consequently

$$r = a + e \,.\, \mathrm{CN}.$$

But $\mathrm{CN} = -a \cos. x$; therefore ultimately

$$r = a(1 - e \cos. x) \ldots\ldots\ldots\ldots\ldots (2.)$$

To obtain a second value of r, let SF be drawn from S to the other focus of the ellipse, and let $SF = r'$. The rectangular triangles ESN, FSN give $SN^2 = r^2 - EN^2$, and $SN^2 = r^2 - (2ea - EN)^2$; therefore $r^2 - EN^2 = r'^2 - (2ea - EN)^2$, whence we derive $r^2 - r'^2 = 4ea \cdot EN - 4e^2a^2$. But by the property of the ellipse $r + r' = 2a$, from which it is easy to deduce $r^2 - r'^2 = 4a^2 - 4ar' = 4ar - 4a^2$; and hence, by equating these two values of $r^2 - r'^2$, $ea \cdot EN - e^2a^2 = ar - a^2$. Now, if we denote the angle PES, which is the true anomaly, by v, then $EN = -r\cos.v$, and consequently by substitution $-ear\cos.v - e^2a^2 = ar - a^2$, whence

$$r = \frac{a(1-e^2)}{1+e\cos.v} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3.)$$

If we now compare the two values of r given by the equations (2) and (3), we shall find

$$\cos.x = \frac{\cos.v + e}{1 + e\cos.v},$$

and therefore, $1 - \cos.x = (1-e)(1-\cos.v)$

$$1 + \cos.x = (1+e)(1+\cos.v);$$

whence, by dividing,

$$\frac{1-\cos.v}{1+\cos.v} = \frac{1+e}{1-e} \cdot \frac{1-\cos.x}{1+\cos.x};$$

consequently, by the trigonometrical formulæ,

$$\tan.\tfrac{1}{2}v = \sqrt{\left(\frac{1+e}{1-e}\right)} \cdot \tan.\tfrac{1}{2}x \quad \ldots\ldots\ldots (4.)$$

The equations (1) and (2) were first given by Kepler, the last is due to Lacaille. The problem of finding the sun's place after any given time is solved analytically by (1) and (4).

To express v the true anomaly, in a series involving the powers of x the mean anomaly, is a problem requiring the aid of the higher analysis, and which it is unnecessary to investigate here. The following are a few of the first terms of the series, in which nt is substituted for x, n being the mean motion in the unit of time, and t the time elapsed since the passage through the perihelion :—

$$v = nt + \left(2e - \tfrac{1}{4}e^3 + \frac{5}{96}e^5\right) \cdot \sin.nt + \left(\frac{5}{4}e^2 - \frac{11}{24}e^4 + \frac{17}{192}e^6\right) \sin.2nt + \left(\frac{13}{12}e^3 - \frac{43}{64}e^5\right) \sin.3nt + \&c.$$

DISTANCE OF THE SUN FROM THE EARTH.

	Semidiameters of the Earth.	English Miles.
In Perigee	23580	93280945
In Apogee	24388	96478967
At Mean Distance	23984	94879956
Greatest diameter of his orbit	47969	189759912

Sun's parallax and distance.

The form of the sun's orbit is discovered from the variations of his apparent diameter in passing from the perigee to the apogee; but in order to obtain a knowledge of its real dimensions, or of the mean distance of the sun from the earth, it is necessary to determine his parallax, that is to say, the angle subtended by the earth's semidiameter as seen from the sun. This angle is too small to be measured directly in the manner which was pointed out when treating of parallax; it is most accurately deduced from observations of the time occupied by an inferior planet in passing over the sun's disk, as will be explained afterwards. From such observations it has been found to be less than 9″, an angle of which the sine is to radius in the ratio of 1 to 23,000 nearly; whence the distance of the sun is about 23,000 times the semidiameter of the earth. The following table exhibits more accurately the numerical results of calculation.

Sun's volume.

When the sun's parallax is known, we are enabled not only to estimate his distance, but also to compare his diameter and magnitude with those of the earth. For example, the mean parallax of the sun is 8″·56; his mean apparent semidiameter, seen from the earth, is 961″·8; the semidiameters of the sun and earth are therefore to each other in the ratio of 961·8 : 8·56, or of 112 to unity nearly. Supposing the sun and earth to be both spherical bodies, which is a supposition sufficiently accurate for the present purpose, their volumes will be to one another as the cubes of their radii; hence the volume of the sun is to that of the earth as the cube of 112 to unity, or the sun's volume is about 1,405,000 times greater than that of the earth.

SECT. III.—*Of the Motion of Translation of the Earth, and the Aberration of Light.*

Hitherto we have regarded the sun as being actually in motion round the earth in an elliptic orbit, of which the earth occupies one of the foci. This supposes the motion which we observe to be real. But we have already seen that all the phenomena of the diurnal revolution of the celestial bodies may be equally well explained by supposing these motions to be only optical illusions, of the same nature as those by which a person sailing rapidly along a river, or the sea-shore, is almost irresistibly led to ascribe the motion to the banks on the shore, even when fully aware that the appearance is only occasioned by his own motion in a contrary direction. In the same manner all the phenomena of the annual motion are susceptible of an equally simple explanation, on the hypothesis that the earth revolves in an elliptic orbit, and that the sun is at rest in one of the foci of the ellipse. In fact, if there were no other bodies in the universe than the earth and the sun, it would be matter of absolute indifference which of the two hypotheses we should adopt in order to explain the appearances. Supposing, for example, the earth to revolve in a circular orbit (the eccentricity, on account of its smallness, being here neglected), and the sun to be placed at the centre; a spectator at E (fig. 23) sees the sun S in the heavens at the point A, and corresponding to the star a on the celestial sphere. If the earth now take the place of the sun, and the sun be placed on the curve at A, the spectator will still see the sun correspond to the star a. Let the earth be transferred from E to E′; the spectator will then see the sun in A′. The sun therefore appears to him to have moved from A to A′, which is exactly the same appearance as would be presented to a spectator at the centre by a real translation of S from A to A′; so that, in respect of the annual motion, the appearances, when referred to the celestial sphere, are precisely the same on either hypothesis. Fig. 23.

If we now consider the phenomena with reference to the earth, we shall find that they may be all equally well explained on the hypothesis of the earth's motion, and the immobility of the sun. The most remarkable phenomenon connected with the annual revolution is the variation of the seasons; and in order to explain their cause, it is only necessary to suppose that the earth, in describing its oblique orbit, always preserves its axis parallel to the same straight line. Let A, B, C, D (fig. 24) repre- Fig. 24.

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sent the earth in four different positions of its orbit, *n s* being its axis, and *n* and *s* its north and south poles respectively. While the earth goes round the sun in the order of the letters A, B, C, D, its axis *ns* preserves its obliquity, and always continues parallel to its first direction. At A the north pole inclines towards the sun, and brings all the northern places more into the light than at any other season of the year. But when the earth is at C, the opposite point of the orbit, the north pole declines from the sun, and a less portion of the northern hemisphere enjoys the blessings of his light and heat. At B and D the axis is perpendicular to the plane of the orbit, so that the poles are situated in the boundaries of the illuminated hemisphere, and the sun, being directly over the equator, makes the days and nights equal at all places. These phenomena are illustrated in fig. 25, which represents the situation of the north pole with regard to the limits of illumination, in eight different positions of the orbit. In this figure, Æ is the terrestrial equator, T the tropic of Cancer, the dotted circle the parallel of London, U the arctic or north polar circle, and P the north pole, where all the meridians or hour-circles meet. The spectator is supposed to be placed at the pole of the ecliptic.

Plate LXXVIII. Fig. 25.

When the earth is at the beginning of Libra, about the 20th of March, the sun, as seen from the earth, appears at the beginning of Aries in the opposite part of the heavens, the north pole is just coming into light, and the sun is vertical to the equator, which, with all its parallels, is divided into two equal parts by the circle which forms the boundary between the dark and illuminated hemispheres, and therefore the days and nights are equal all over the earth. As the earth moves in the ecliptic according to the order of the letters A, B, C, D, &c., the north pole P comes more and more into the light, and the days increase in length at all places north of the equator Æ. When the earth comes to the position between B and C, or the beginning of Capricorn, the sun, as seen from the earth, appears at the beginning of Cancer, about the 21st of June; and the north pole of the earth inclines towards the sun, so as to bring into light all the north frigid zone, and more of each of the northern parallels of latitude in proportion as they are farther from the equator. As the earth advances from Capricorn towards Aries, and the sun appears to move from Cancer towards Libra, the north pole recedes from the light, which causes the days to decrease and the nights to increase in length, till the earth comes to the beginning of Aries, and then they are equal as before; the boundary of light and darkness cutting the equator and all its parallels equally. The north pole then goes into the dark, and does not emerge till the earth has completed a semi-revolution of its orbit, or from the 23d of September till the 20th of March. All these phenomena will be readily understood from the bare inspection of the figure; and it will be perceived that what has been said of the northern hemisphere is equally true of the southern in a contrary sense, that is, at opposite seasons of the year.

The only objection against the annual motion of the earth, which at first sight creates some difficulty, is the enormous distance which, on account of the want of annual parallax, that hypothesis makes it necessary to assign to the fixed stars. Abstracting from the precession, which in the region of the poles amounts only to about 20″, the axis of the earth, in every part of its orbit, appears to be directed towards the same point of the starry sphere. It is certain, however, that the radius of the terrestrial orbit is upwards of 90 millions of miles; and therefore, when the earth is at opposite points of this immense circle, its pole ought to be directed to points in the heavens 180 millions of miles distant from each other. Suppose the sun to be at rest in S (fig. 26), the centre of the orbit E*ab*, and the earth to be at the point E. Suppose also A to be the projection of S on the sphere of the fixed stars, and ♈ the first point of the ecliptic. The longitude of A. as seen from E, is the angle A E♈; but when seen from S, the longitude of the same point is A S♈. This last is the *true* longitude of A; A E♈ is the *apparent* longitude, and their difference is the angle S♈E. Now, in the first half of the ecliptic, the apparent longitude will be less than the true, and in the second half greater; hence there ought to result an apparent annual inequality in the sun's longitude. But as such inequality is shown in very few cases, it becomes necessary either to abandon the hypothesis of the earth's motion, or to suppose the distance of the fixed stars to be so great, that, in comparison of it, the radius ES, which exceeds 90 millions of miles. is altogether insensible; and that the whole orbit of the earth, or the ellipse E*ab*, is a mere point in comparison of a great circle of the starry sphere.

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Fig 26.

The most convincing proof of the earth's motion is not to be found in any circumstance of which the senses can take immediate cognizance,[1] but is afforded by the full development of the planetary system, and the mutual connection of all the truths of rational astronomy,—by the clearness, simplicity, and coherence which this hypothesis gives to the most complicated phenomena,—and can therefore only be fully appreciated after an attentive study of the whole series of facts which astronomy makes known. There exists, however, one direct proof of the earth's annual motion, in a phenomenon discovered by the accurate observation and patient sagacity of Bradley, although it is one which, we are almost tempted to think, ought to have been perceived *a priori*, after Roemer's discovery of the progressive motion of light. It is known by the name of the *Aberration of Light*, and is manifested in a small difference between the apparent and true places of a star, occasioned by the motion of light combined with that of the earth in its orbit.

Aberration of light.

To illustrate this effect, conceive a body to move in the direction EE′ (fig. 27), and another to impinge on it in the direction SE. To find the direction of the resulting motion, take EC and EA proportional to the two velocities respectively, and, having completed the parallelogram EABC, draw the diagonal EB. The combination of the two motions produces an impression on the eye exactly similar to that which would have been produced if the eye had remained at rest in the point E, and the molecule of light had come to it in the direction ES′; the star, therefore, whose real place is at S, will appear to the spectator at E to be situated at S′. The difference between its true and apparent place, that is, the angle SES′, is the *aberration*, the magnitude of which is obtained from the known ratio of EA to EB, or the velocity of light to that of the earth in its orbit. Now, we know from the phenomena of the eclipses of Jupiter's satellites, that a ray of light describes a line equal to the mean radius of the ecliptic in 8 min. 18 sec. or 498 seconds of time. But the arc described by the earth in that time is found from the proportion

Fig. 27.

$$365^{d}\cdot256 : 498^{s} :: 360^{\circ} : x,$$

whence $x = 20''\cdot45$. It is evident, therefore, that when the directions of the two motions are at right angles, the star S always appears in advance of its real place, in a direction parallel to that of the motion of the earth, by a quantity equal to 20″·45. This quantity, 20″·45, is called the *Constant of Aberration*; but as it has been obtained on the assumption that the earth moves uniformly in a circular orbit, it is evidently not altogether exact, and recourse

[1] It may here be observed that the rotation of the earth *on its axis* has been satisfactorily demonstrated by means of the pendulum, in M. Foucault's celebrated experiment, an account of which will be found under the head PENDULUM.

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must be had to observation to determine its precise amount. Bradley supposed it to be 20″; Dr Brinkley, from the mean of 2633 comparisons of various stars has deduced the value 20″·37. From a series of observations made by M. Struve the Russian astronomer, the constant of aberration has been determined to be 20″·445, which is probably an exceedingly close approximation, and may be considered as one of the most certain determinations of astronomy. (*Sur le coefficient de l'aberration des étoiles fixes. Petersburg Memoirs*, vol. iii.)

It is easy to see that, on the same principles, there ought also to be a diurnal aberration; but the diurnal rotation of the earth being sixty-five times less rapid than the orbital motion, its effect in producing aberration does not amount to more than 0ˢ·0208, when reduced to seconds of time. It is, however, taken into account in reducing transit observations, and incorporated with the error of collimation.

The magnitude of the angle of deviation SES′ depends on the relative directions of the earth and the visual ray, and may have any value from 0 to 20″·4. Suppose, for example, we observe a star situated in the plane of the ecliptic. When the earth is at that point of its orbit, between the sun and the star, where the tangent to the orbit is perpendicular to the visual ray (which, on account that the star has no sensible parallax, always maintains a parallel direction), the apparent place of the star will be 20″·4 to the eastward of its true place. When the earth is in the opposite point of its orbit the same star will appear to be 20″·4 to the westward of its true place; so that it will appear to have an oscillatory motion on the ecliptic, the range of which is 40″·8, and the period exactly a year. Half-way between these two points the tangent of the orbit is parallel to the direction of the ray of light, and consequently there is no aberration. When the star is not situated in the ecliptic, it will suffer a displacement in latitude as well as in longitude. To render this more intelligible, let EEE (fig. 28) be the ecliptic, E the earth, and A the true place of a star situated at any altitude above the ecliptic. In the direction EA take E*a* to represent the velocity of light, *ab* that of the earth, and in a parallel direction, that is, parallel to the tangent to the ecliptic at E; the line E*b* will now be the apparent visual ray, and the star will seem to be situated at B. Suppose the earth to be placed at different points of its orbit; the lines E*a* will be all parallel to each other on account of the infinite distance of the star A; the lines *ab* will vary little in magnitude, because they are very small in comparison of E*a*, but their directions will undergo every possible change, being always parallel to the tangent at E. At the two points of the orbit where the tangent is parallel to EA, the two lines E*a* and *ab* coincide, and consequently there is no aberration. Let us next suppose the star to be situated in the pole of the ecliptic. In this case the visual ray is constantly perpendicular to the direction of the earth's motion, so that the star will always appear at a distance of 20″·4 from its true place, or appear to describe a small circle about the pole of the ecliptic. In all other situations, out of the ecliptic, the star's apparent path will be an ellipse, the major axis of which, parallel to the plane of the ecliptic, is always 40″·8, while the minor axis varies as the sine of the latitude.

Fig. 28.

The cause of the aberration being known, we have two methods of measuring its quantity, or the extent of the apparent oscillations, viz. by calculating the angle of deviation SAS′ (fig. 27), the tangent of which is to radius as AB to AE, that is, as 1 to 10,313; or, by direct observation, when the star is in opposition to the sun. The two methods give sensibly the same result, and the dimensions of the ellipse described by any star not situated in the ecliptic, in consequence of the aberration, are found to be the same when computed from theory or determined by direct observation. The motion of translation of the earth, therefore, receives a mathematical demonstration from this agreement; and the phenomenon of the aberration, otherwise unimportant on account of its minuteness, thus becomes one of the most interesting discoveries ever made in astronomy. The fact of the earth's orbital motion is, however, rendered so probable by other phenomena, that it must have been universally admitted, although the direct proof had never been discovered.

Fig. 27.

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SECT. IV.—*Of the Measure of Time. Equation of Time.*

The notion of time, or of succession, is generally said to be acquired from the aspect of natural phenomena; but from whatever source it may be derived, it is certain that time itself can only be measured by comparing it with something of which the senses can take cognizance. If we have a series of events, such as the oscillations of a pendulum, or the flux and reflux of the sea, uniformly succeeding each other, then time may be measured by the number of such events that have been observed. In like manner, if a body move uniformly in a certain direction, time may be measured by the spaces over which it successively passes. In strict language, motion and time, being heterogeneous quantities, cannot measure one another; but different times are compared with each other by means of the motions that have taken place in those times respectively; for the motions being supposed uniform, equal spaces are passed over in equal times, or, which is the same thing, the times are directly proportional to the spaces described. If, therefore, we assume for unit the time which is absolved while a certain uniform motion takes place, we may obtain, by a simple proportion, the corresponding time of any other similar motion. In this manner we find the ratio of one portion of time to another, although we can form no idea whatever of its absolute quantity.

In order that motion may be employed as a measure of time, it is indispensably requisite that it be perfectly uniform. The only motions having this property, with which we are acquainted, are those of the rotation of the celestial bodies about their own axes. The motion of the sun and planets in their orbits is irregular from various causes: even the successive returns of the fixed stars to the meridian are rendered unequal on account of the precession and nutation; but the diurnal rotation of the earth appears to be affected by no cause of irregularity whatever. Time, therefore, may be properly measured by this uniform motion; and the method of proceeding is as follows. The culmination of a star, or of a given point of the equator, marks the instant at which the day commences, and at any other instant its horary angle determines the portion of the day which has elapsed at the moment of the observation. In order, therefore, to determine the time of an observation, we must find the horary angle formed by the meridian of the observed star with that which passes through the given point where the motion is supposed to begin; in other words, it is necessary to determine the star's right ascension. This, however, when attempted by direct measurement, is a determination attended with difficulty, and liable to considerable uncertainty. Happily the invention of the pendulum has rendered it unnecessary; and astronomers, instead of deducing the time from the right ascensions, determine, on the contrary, the right ascensions by means of the time indicated by the clock. The clock, of which the motion is supposed to be perfectly regular, is adjusted in such a

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manner that its index describes 24 hours, while a point of the equator describes an arc of 360°, or makes a complete revolution. This is called a *sidereal day.* The sidereal hour is divided in the usual manner into minutes, seconds, &c.; whence the corresponding arcs are easily found at the rate of 15° to an hour. The point whose culmination marks the origin of time is arbitrary; but astronomers have agreed to choose for that purpose the equinoctial point of Aries, from which the right ascensions are reckoned, so that the hours of the clock and the degrees of the equator may commence at the same instant. This point, it is true, is not, and cannot be, permanently marked by any star; but the right ascension in time of any star whatever being the hour of its transit over the meridian, the star will be in the plane of the meridian at the instant denoted by its right ascension in time. On this account sidereal time expresses the actual right ascension of the zenith; or, as it is frequently termed, *the right ascension of the mid-heaven.*

We have already seen, that on account of the precession of the equinoxes, a star employs somewhat more time than the first point of Aries in returning to the meridian. It is therefore not without some violation of language that the interval between two successive transits of a given point of the equator over the meridian is called a *sidereal* day, which, in its strict acceptation, denotes the time which elapses between two successive transits of the same star; but in this case the difference is so small as to be totally inappreciable. The annual precession in longitude is = 50″·1, and that in right ascension is nearly the same, excepting in regard to the circumpolar stars, which, therefore, are not employed in regulating the clocks. This arc of 50″·1, converted into time, gives 3·3 seconds as the time in which a star will pass the meridian later than the equinoctial point, at the end of the year; and this small quantity being distributed over the whole year, is altogether insensible in short intervals of two or three days. The successive transits of a star, therefore, if we abstract from the nutation and aberration, will mark the sidereal day within the hundredth part of a second of time; and the sidereal year, though not immediately ascertainable by observation, becomes a quantity which may be easily computed. But the regularity of the motion of the stars is deranged by the effects of aberration and nutation; so that in order to measure time with the precision required by modern observers, it is necessary to be acquainted with the minute displacements of the stars. If they seem to return to the meridian after equal portions of absolute time, it is only because our organs are unable to distinguish the hundredths of a second.

The sidereal day is a measure of time which, on account of its uniformity and the facility of observing it, is excellently well adapted for astronomical purposes; but relatively to the ordinary wants of life it is not sufficiently marked;—the culmination of the stars is an event entirely unconnected with civil occupations, and which, for any given star, is even invisible during a great part of the year. The proper motion of the sun causes the sidereal day to commence sometimes by day and sometimes by night, so that great confusion and embarrassment would arise from regulating time and civil affairs by the motions of the stars. On this account the diurnal revolution of the sun has been universally adopted as the measure of time. This is called the *civil day*, and denotes the interval of time which elapses between two successive transits of the sun over the same hour-circle. Most nations have agreed in reckoning it from the inferior semicircle of the meridian, so that the civil day commences and terminates at midnight; but astronomers, in imitation of Hipparchus and Ptolemy, usually reckon the commencement of the day from the instant of the sun's culmination, that is, from noon; and count through the 24 hours from one noon to the following. Thus 9 o'clock in the morning of February 14th is by astronomers called February the 13th at 21 hours. The day thus determined is called the *astronomical* or *solar day;* and being regulated by the true motion of the sun, the time which is measured by it is called *true* or *apparent* time.

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Astronomical or solar days are not equal. Two causes, in particular, conspire to produce their inequality, namely, the unequal velocity of the sun in his orbit, and the obliquity of the ecliptic. The effect of the first cause is sufficiently sensible. At the summer solstice, when the sun's motion is slowest, the astronomical day approaches nearer the sidereal than at the winter solstice, when his motion is most rapid.

Days vary in length.

To conceive the effect of the second cause, it is necessary to have regard to the motion of the sun in reference to the equator. The sun describes every day a small arc of the ecliptic. Through the extremities of this arc suppose two meridians to pass; the arc of the equator, which they intercept, is the sun's motion for that day referred to the equator, and the time which that arc takes to pass the meridian is equal to the excess of the astronomical day above the sidereal. But it is obvious that at the equinoxes the arc of the equator is smaller than the corresponding arc of the ecliptic, in the proportion of the cosine of the obliquity of the ecliptic to radius: at the solstices, on the contrary, it is greater in the proportion of radius to the cosine of the same obliquity. The astronomical day is diminished in the first case, and lengthened in the second.

To have a mean astronomical day independent of these causes of inequality, astronomers have supposed a second sun to move uniformly on the ecliptic, and to pass over the extremities of the axis of the sun's orbit at the same instant with the real sun. This removes the inequality arising from the inequality of the sun's motion. To remove the inequality arising from the obliquity of the ecliptic, conceive a third sun to pass through the equinoxes at the same instant with the second sun, and to move along the equator in such a manner that the angular distances of the two suns at the vernal equinox shall be always equal. The interval between two consecutive returns of this third sun to the meridian forms the *mean astronomical day. Mean time* is measured by the number of the returns of this third sun to the meridian; and *true time* is measured by the number of returns of the real sun to the meridian. The arc of the equator, intercepted between two meridian circles drawn through the centres of the true sun and the imaginary third sun, when reduced to time, is what is called the *Equation of Time.* This will be rendered plainer by the following diagram.

Mean astronomical day.

Let Z♈z♎ (fig. 29) be the earth; ZFR*z* its axis; *abcde*, &c. the equator; ABCDE, &c. the northern half of the ecliptic from ♈ to ♎, on the side of the globe next the eye; and MNOP, &c. the southern half on the opposite side from ♎ to ♈. Let the points at A, B, C, D, E, F, &c. mark off equal portions of the ecliptic, gone through in equal times by the real sun, and those at *a*, *b*, *c*, *d*, *e*, *f*, &c. equal portions of the equator described in equal times by the fictitious sun; and let Z♈*z* be the meridian.

Fig. 29.

As the real sun moves obliquely in the ecliptic, and the fictitious sun directly in the equator, any point between ♈ and F on the ecliptic must be nearer the meridian Z ♈ *z*, than the corresponding point on the equator from ♈ to *f*, that is to say, than the point whose distance from ♈ is expressed by the same number of degrees; and the

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more so, as the obliquity is greater; and therefore the true sun comes sooner to the meridian every day whilst he is in the quadrant ♈F, than the fictitious sun does in the quadrant ♈ *f*; for which reason the solar noon precedes noon by the clock, until the real sun comes to F, and the fictitious to *f*: which two points being equidistant from the meridian, both suns will come to it precisely at noon by the clock.

Whilst the real sun describes the second quadrant of the ecliptic FGHIKL from Cancer to ♎, he comes later to the meridian every day than the fictitious sun moving through the second quadrant of the equator from *f* to ♎; for the points at G, H, I, K, L, being farther from the meridian, their corresponding points at *g*, *h*, *i*, *k*, *l*, must come to it later; and as both suns come at the same moment to the point W, they come to the meridian at the moment of noon by the clock.

In departing from Libra through the third quadrant, the real sun going through MNOPQ towards ♑ at R, and the fictitious sun through *mnopq* towards *r*, the former comes to the meridian every day sooner than the latter, until the real sun comes to R, and the fictitious to *r*, and then they come both to the meridian at the same time.

Lastly, as the real sun moves equably through STUVW, from R towards ♈, and the fictitious sun through *stuvw*, from *r* towards ♈, the former comes later every day to the meridian than the latter, until they both arrive at the point ♈, and then they make it noon at the same time with the clock.

Having explained one cause of the difference between true and mean time, we now proceed to explain the other cause of this difference, namely, the inequality of the sun's apparent motion, which is slowest in summer, when the sun is farthest from the earth, and swiftest in winter, when he is nearest to it.

If the sun's motion were equable in the ecliptic, the whole difference between the equal time as shown by the clock, and the unequal time as shown by the sun, would arise from the obliquity of the ecliptic. But the sun's motion sometimes exceeds a degree in 24 hours, though generally it is less; and when his motion is slowest, any particular meridian will revolve sooner to him than when his motion is quickest; for it will overtake him in less time when he advances a less space than when he moves through a larger.

Now, if there were two suns moving in the plane of the ecliptic, so as to go round it in a year, the one describing an equal arc every 24 hours, and the other describing in the same time sometimes a less arc, and at other times a larger, gaining at one time of the year what it lost at the opposite; it is evident that one of these suns would come sooner or later to the meridian than the other, as it happened to be behind or before the other; and when they were in conjunction, they would both come to the meridian at the same moment.

As the real sun moves unequably in the ecliptic, let us suppose a fictitious sun to move equably in a circle coincident with the plane of the ecliptic. Let ABCD (fig. 30) be the ecliptic or orbit in which the real sun moves, and the dotted circle *abcd* the imaginary orbit of the fictitious sun; each going round in a year according to the order of letters, or from west to east. Let HIKL be the earth turning round its axis in the same direction every 24 hours; and suppose the two suns to start from A and *a*, at the same moment, A and *a* being in the same straight line, and in the plane of the meridian EH. Suppose also that the real sun, when at A, is at his greatest distance from the earth, where his motion is slowest. In the time that the meridian revolves from H to H again, according to the order of the letters HIKL, the real sun has moved from A to F; and the fictitious sun with a quicker motion from *a* to *f*, through a larger arc: therefore the meridian EH will revolve sooner from H to *h* under the real sun at F, than from HE to *k* under the fictitious sun at *f*; and consequently it will then be noon by the sun-dial sooner than by the clock.

Fig. 30.

As the real sun moves from A towards C, the velocity of his motion increases all the way to C, where it is at its maximum. But notwithstanding this, the fictitious sun gains so much upon the real, soon after his departing from A, that the increasing velocity of the real sun does not bring him up with the equally-moving fictitious sun till the former comes to C and the latter to *c*, when each has gone half round its respective orbit; and then being in conjunction, the meridian EH, revolving to EK, comes to both suns at the same time, and therefore it is noon by them both at the same moment.

But the increased velocity of the real sun now being at its maximum, carries him before the fictitious one; and therefore the same meridian will come to the fictitious sun sooner than to the real; for whilst the fictitious sun moves from *c* to *g*, the real sun moves through a greater arc from C to G; consequently the point K has its noon by the clock when it comes to *k*, but not its noon by the sun till it comes to *l*. And although the velocity of the real sun diminishes all the way from C to A, and the fictitious sun by an equable motion is still coming nearer to the real sun, yet they are not in conjunction till the one comes to A and the other to *a*, and then it is noon by them both at the same moment.

Comparison of mean and sidereal time.

Mean solar time and sidereal time being both uniform, it is easy to compare the one with the other, and assign the number of degrees, minutes, &c. which the sun and a star will respectively describe in a given portion of side-real or mean solar time. In a mean solar day the sun's right ascension and mean longitude are increased by 59′ 8″·33; consequently 360° 59′ 8″·33 of the equator pass the meridian in 24 mean solar hours. The sidereal time corresponding to this period is 24 hours 3 min. 56·555 sec.; therefore 24 mean solar hours are equal to 24 hours 3 min. 56·555 sec. of sidereal time; and 24 hours of sidereal time are equal to 23 hours 56 min. 4·0907 sec. of mean solar time, or to 24 hours minus 3 min. 55·9093 sec. This difference of 3 min. 55·9093 sec. is called the *acceleration of the fixed stars* in mean solar time; and the preceding excess of 3 min. 56·555 sec. is the retardation of the sun in sidereal time. Hence the one species of time may be easily converted into the other; and the arc of the equator passed over by the meridian in a given mean time may be calculated. Thus,

$$\frac{360^\circ\ 59'\ 8''.33}{24} = 15^\circ\ 2'\ 27''.84708$$

is the arc described by a star in one hour of mean solar time.

But the process of converting sidereal or mean solar time into true or apparent time, or of computing from the instants of apparent time the corresponding mean solar and sidereal times, is attended with much greater difficulty. The reason is, that the interval between two successive transits of the sun over the meridian, which, in apparent time, measures the day, is a variable quantity; and hence there cannot exist any constant ratio between true and mean time, as there does between mean and sidereal time. The correction or equation by which apparent time is reduced to mean time, is technically called the *Equation of Time*, and is composed of the aggregate of the several variable terms which denote the inequalities of the sun's motion in longitude. Besides the eccentricity,

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the obliquity of the ecliptic, and the variations of that obliquity occasioned by the nutation of the earth's axis, it is affected also by the small alterations of the sun's right ascension, which result from the effect of the planetary perturbations on the earth; and hence the equation of time cannot be exactly computed without the aid of Physical Astronomy.

It will be evident, from what has preceded, that the equation of time expresses merely *the difference between the true and mean right ascensions of the sun*, reduced to time. Its different parts may be calculated numerically in the following manner. Let NA (fig. 31) represent the mean motion of the sun during a given interval, then NA is the sun's mean longitude, N being the first point of Aries. Let NA = M, and from this mean longitude subtract the longitude of the apogee, the remainder will be the sun's mean anomaly. From the mean anomaly let the equation of the centre be found and denoted by E. Take AB = E, then NB = M + E is the longitude corrected for the eccentricity.

Fig. 31.

Let us next suppose BC to be the small quantity by which the sun's longitude is increased in consequence of the perturbations of the planets, and let BC = P; then NC = M + E + P is the true and exact longitude of the sun. Through C let the arc CD be drawn perpendicular to the equator; the point D will be that point of the equator which passes the meridian at the same time with the sun. Let R = NC — ND = the reduction to the ecliptic; we have then the sun's right ascension = M + E + P — R.

Let NF = NA, and F will be the place which the sun would occupy in the equator at the same instant that he occupies the point A in the ecliptic, if he moved uniformly in the former circle; for NF as well as NA will represent the mean diurnal motion of 59′ 8″·33 multiplied by the number of days elapsed in the interval between the equinox N and the time of the observation. The mean sun would therefore pass the meridian with the point F, whereas the true sun passes it with the point D; therefore, at the instant of true noon, when the sun C and the corresponding point D are on the meridian, the mean sun is at a distance from D expressed by the arc FD = M + E + P — R — M = E + P — R. Now, the arc of the equator FD measures the horary angle between the mean and the true sun, or the angle at the pole between the meridian and the hour-circle passing through D; it is therefore converted into time by the following proportion:—

360° : FD :: 24 mean solar hours : time from true noon; consequently the difference between mean and true noon, or the equation of time,

$$= \frac{\text{FD} \times 24^h}{360^\circ} = \tfrac{1}{15}(\text{E} + \text{P} - \text{R}) = d\text{T}.$$

But this equation is not yet perfectly accurate: it requires to be corrected for the effects of nutation. Now it is known that the variation of the mean longitude of the sun, arising from the unequal precession of the equinoxes in consequence of the nutation occasioned by the inclination of the lunar orbit, is expressed by the formula 18″ sin. (360° — moon's node) = 18″ sin. N. This variation, reduced to the direction of the equator, will therefore be 18″ sin. N cos. *e* (*e* being the obliquity of the ecliptic). The difference between the two expressions is 18″ sin. N (1 — cos. *e*) = 36″ sin.^{2} $\frac{1}{2}e$ sin. N = 1″·4887 sin. N, which, reduced to time, becomes 0·09925 sec. × sin. N. This small correction, amounting to less than a tenth of a second, was long omitted in computing the equation of time. When it is included, that equation becomes

$$d\text{T} = \tfrac{1}{60}(\text{E} + \text{P} - \text{R}) + 0{\cdot}09925 \text{ sec.} \times \text{sin. N}.$$

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The quantities E, P, R, and N, are to be computed separately from the astronomical tables; and it must be observed, that the result will be expressed in *mean solar time*.

The cosine of the obliquity, that is, cos. 23° 28′, is equal to ·9173 = $\frac{11}{12}$ very nearly. Hence, since the equation of time is equal to the sun's true right ascension, diminished by his mean longitude and the effects of nutation in right ascension (= ND — NA $\mp$ 18″ sin. N cos. *e*), it may, on denoting the true right ascension by A, be expressed as follows:—

$$d\text{T} = \text{A} - \text{M} \mp 18'' \text{ sin. N} \times \tfrac{11}{12}.$$

This is the form under which the equation of time was expressed by Dr Maskelyne.

The equation of time is at its maximum about the 3d of November, when it amounts to 16′ 16″·7, and is subtractive. At four different times of the year it vanishes, namely, about the 25th of December, the 16th of April, the 16th of June, and the 1st of September. These epochs, however, do not remain constant; for, on account of the change which the line of the apsides is constantly undergoing in reference to the line of the equinoxes, the difference between the true and mean right ascensions of the sun—in other words, the equation of time—varies continually in different years.

Sect. V.—*Of the Spots of the Sun, his Rotation, and Constitution.*

The sun, the great source of light, heat, and animation, when beheld with the naked eye, appears only as a luminous mass of uniform splendour and brightness; but when examined with the telescope, his surface is frequently observed to be mottled over with a number of dark spots, of irregular and ill-defined forms, and constantly varying in appearance, situation, and magnitude. These spots are occasionally of immense size, so as to be even visible without the aid of the telescope; and their number is frequently so great that they occupy a considerable portion of the sun's surface. Dr Herschel observed one in 1779, the diameter of which exceeded 50,000 miles, more than six times the diameter of the earth; and Scheiner affirms that he has seen no less than 50 on the sun's disk at once. Most of them have a deep black nucleus, surrounded by a fainter shade, or *umbra*, of which the inner part, nearest to the nucleus, is brighter than the exterior portion. The boundary between the nucleus and umbra is in general tolerably well defined; and beyond the umbra a stripe of light appears more vivid than the rest of the sun.

The discovery of the sun's spots has been attributed to different astronomers. They appear to have been first taken notice of in a work of Fabricius, the friend of Kepler, which was published at Wittenberg in 1611, under the title of *Joh. Fabricii Phrysii de Maculis in Sole Observatis, et Apparente earum cum Sole Conversione Narratio.* It contains, however, nothing more than a few vague conjectures respecting the spots, the phenomena of which he could not have observed with any degree of accuracy, inasmuch as he seems to have been unacquainted with any method of protecting the eye by intercepting a portion of the solar rays; for he recommends to those who should repeat his observations, to admit into the telescope only a small portion of the sun at once, till the eye should by degrees become able to support the full blaze of light. About the same time the discovery was warmly disputed by the illustrious Galileo, and Scheiner, a German Jesuit, professor of mathematics at Ingolstadt. The whole circumstances connected with this dispute are narrated at great length by Galileo in his work entitled *Istoria e Di-*

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mostrazioni intorno alle Macchie Solari, e loro Accidenti, from which it appears certain that he observed the spots so early as April 1611. In a letter published by him in 1612, he remarks that the spots are situated on the surface of the sun, or that at least their distance from it is imperceptible; that the time of their continuance varies from 2 or 3 to 30 or 40 days; that their figures are irregular and variable; that some are seen to separate, and others to unite, even on the middle of the disk; that besides these peculiar motions, they have also a common motion, in virtue of which they traverse the disk in parallel lines. From this general motion he infers that the sun turns on an axis from west to east; and he adds as a curious remark, that the spots are confined within a zone extending only about 28 or 29 degrees to the north and south of the sun's equator. Galileo illustrates all these positions by mathematical reasoning, and by drawings of the spots made on many successive days.

Scheiner's observations were first announced in January 1612, in three letters addressed to his friend Marc Velser, a magistrate of Augsburg. In the first of these, the date of which is November 1611, he says that he had observed the spots seven months before, but that, having a different object in view, he had given little attention to them. He observed them again in the following October, and at that time imagined the appearance was owing to some imperfection of his telescope, till he was convinced by repeated observations that it was necessary to refer it to the sun. From these remarks it is pretty clear that Scheiner had formed no accurate notions respecting the spots before October 1611, that is, six months after they had been observed by Galileo. Scheiner made the observation of the solar spots his whole occupation during the following eighteen years, in the course of which he discovered the position of the solar equator, and formed a theory much more complete than that of Galileo. The account of his observations was published in 1630, under the title of *Rosa Ursina, sive Sol ex admirando Facularum et Maculorum suarum Phænomeno Varius*, &c.

The discovery of the solar spots has also been claimed for our countryman Harriot. Amidst these conflicting pretensions it is perhaps impossible to arrive at the truth; but the matter is of little importance; the discovery is one which followed inevitably that of the telescope, and an accidental priority of observation can hardly be considered as establishing any claim to merit.

The solar spots furnish an extensive subject of curious speculation, but in an astronomical point of view they are chiefly interesting on account of their establishing the fact, and affording the means of determining the period, of the rotation of the sun. In order to obtain a precise idea of the position of a spot, and the path which it describes, it is necessary to project that path on the plane passing through the centre of the sun, and perpendicular to the visual ray drawn from the earth to the sun's centre.

Fig. 32. Suppose the diameter of a circle ASB (fig. 32) to be divided into as many parts of unity as there are seconds in the apparent diameter of the sun. Let CP be taken equal to the number of seconds contained in the difference of the longitudes of the spot and the sun's centre, and the perpendicular PM equal to the number of seconds in the latitude of the spot; then M will represent its position on the surface of the sun. By repeating the same operation a number of days consecutively, a series of points M M′ M″, &c. will be obtained in the apparent path of the spot on the sun's disk, or rather in the projection of that path on the plane perpendicular to the visual ray. This projection is in general an oval slightly differing from an ellipse; and it is found that all the spots observed at the same time describe similar and parallel curves. They also return to the same relative positions in the same time, and their period is about 27⅓ days. Theoretical Astronomy.

The paths described by the spots undergo very considerable changes, according to the season of the year at which they are observed. About the end of November and beginning of December they appear simply as straight lines M*m*, M′*m*′, M″*m*″ (fig. 33), along which the spots move in the direction M*m*, that is, they enter on the eastern and disappear on the western edge of the sun's disk; and the points at which they disappear are more elevated, or nearer the north pole of the ecliptic, than those at which they enter. After a certain time the lines M*m* begin to assume a curved appearance, and form ovals, as represented in fig. 34. During the winter and spring the convexity of the ovals is turned towards the north pole of the ecliptic; but their inclination, or rather the inclination of the straight lines joining their extreme points, to the plane of the ecliptic continues to diminish, and about the beginning of March disappears; so that the points at which they seem to enter and leave the sun's disk are equally elevated, as in fig. 35. From this time the curvature of the ovals diminishes; they become narrower and narrower till about the end of May or beginning of June, when they again appear under the form of straight lines (fig. 36); but their inclinations to the ecliptic are now precisely in a contrary direction to what they were six months before. After this they begin again to expand, as in fig. 37, and their convexity is now turned towards the south pole. Their inclinations also vary at the same time, and about the commencement of September they are seen as represented in fig. 38; the points at which they enter and disappear being again equally elevated. After this period the ovals begin to contract and become inclined to the ecliptic, and by the beginning of December they have exactly the same direction and inclination as they had the previous year. Fig. 33. Fig. 34. Fig. 35. Fig. 36. Plate LXXIX. Fig. 37. Fig. 38.

These phenomena are renewed every year in the same order, and the same phases are always exhibited at corresponding seasons. Hence it is evident that they depend on a uniform and regular cause, which is common to all of them, since the orbits described by the various spots are exactly parallel, and subject in all respects to the same variations. The simplest method of explaining the phenomena is to suppose with Galileo that the spots are adherent to the surface of the sun, and that the sun uniformly revolves round an axis inclined to the axis of the ecliptic. If the axis of revolution were perpendicular to the plane of the ecliptic, the spots, supposing them to adhere to the sun's surface, would describe circles parallel to that plane, which, seen from the earth, would appear as so many parallel straight lines; but by supposing the axis to have a suitable inclination, all the phenomena become explicable in a very simple manner. While the sun is carried round in his orbit, his axis, constantly preserving its parallelism, will successively assume different positions relatively to the earth; and the planes of the circles described by the spots, which planes are always perpendicular to the axis, will consequently be presented to us under different inclinations; hence the variations of their apparent curvature. In two opposite points of the orbit the visual ray drawn from the earth to the centre of the sun is perpendicular to the axis of rotation. In these two positions the poles of the sun, or the points in which the axis meets the surface, are both visible at the same moment, and the spots appear to move in parallel straight lines. But as the axis retains this perpendicular position only for an instant, and declines from it very sensibly while the spot traverses the sun's disk, the path of

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the spots over the entire disk is neither a straight line nor an ellipse, one of which it would necessarily be if the sun, while revolving about his axis, did not change his place in his orbit. When the axis is not perpendicular to the visual ray, the path of the spots will appear to be a curve of which the concavity is turned towards that pole which is visible from the earth. This inclination of the solar axis to the plane of the ecliptic also explains the reason why the points of the disk at which the spots appear are more elevated during one half of the year, and more depressed during the other half, than those at which they disappear. It will also follow from the same hypothesis, that the curvature of the ovals must be the greatest possible when the straight lines joining their extremities are parallel to the ecliptic; and, on the contrary, least when the same straight lines are most inclined to the ecliptic; all which is exactly conformable to observation.

The various appearances which we have now described may be accurately represented by means of a common celestial or terrestrial globe. Let the wooden horizon of the globe, which is here supposed to represent the sun, be placed horizontally in the same plane with the eye of the spectator, and the pole be inclined about 7° from the zenith. The wooden horizon will now represent the ecliptic; and if the spectator walk round the globe, always keeping his eye in the plane of the wooden horizon, the circles of latitude will appear to him as ellipses of different inclinations and eccentricities: in two opposite points they will appear as straight lines, and, in short, exhibit in their various positions all the phenomena of the oval paths described by the spots of the sun.

The consequences deduced from the hypothesis of the rotatory motion of the sun are so perfectly conformable with observation, as to render the inference inevitable, that *the sun revolves from west to east, on an axis inclined about* 93° *to the plane of the ecliptic.* The plane which passes through the centre of the sun, perpendicular to the axis of rotation, is the *Equator* of the sun; the straight line joining the points in which it intersects the ecliptic is called the *Line of the Nodes* of the equator. The *Nodes* themselves are the two opposite points in which this straight line, produced indefinitely, meets the celestial sphere.

In order to determine the situation of the solar axis in space, it is necessary to find its inclination to the ecliptic, and the angle which the line of the nodes makes with any given line on the plane of the ecliptic, for example, with the line of the equinoxes. The requisite data for the solution of this problem are three different positions of the same spot, which must be obtained by observation.

Fig. 39. Let S (fig. 39) be the centre of the sun's disk, AB a parallel to the terrestrial equator, and M the place of a spot, the co-ordinates of which, as referred to AB, are SX and MX. In this figure the earth is supposed to be situated in a straight line passing through S perpendicular to the plane of the paper, and it is to be recollected that SX and MX are in fact arcs of the solar globe, though so small when seen from the earth that they may be regarded as straight lines. By comparing the times of the transits of B, the border of the disk, and the spot M, we shall find BX, from which, as SB the semidiameter of the sun is known, we shall have SX the difference of the right ascensions of the spot and sun's centre. The line CY, which is the difference of the declination of the border of the disk and that of the spot, is measured by the micrometer. This will give MX the declination of the spot.

Now, tan. $MSX = \frac{MX}{SX}$, and $SM = \frac{SX}{\cos. MSX}$; therefore SM is also a known quantity. Let EE be the ecliptic, e = obliquity of the ecliptic, and $\odot$ = the longitude of the sun. The angle BSE, which is technically called the *Angle of Position*, is the complement of the angle made by the ecliptic with the circle of declination passing through the sun, and is therefore given by the formula tan. BSE = tan. e cos. $\odot$: hence MSE (=MSX—BSE) is also given. On SE let fall the perpendicular Mm, then Mm = SM sin. MSE is the geocentric latitude of the spot, and Sm = SM cos. MSE is the difference between its geocentric longitude and that of the centre of the sun: the object is now to determine the angles subtended by these lines at the centre of the sun, that is, to convert the *geocentric* into *heliocentric* latitudes and longitudes.

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Suppose two straight lines to be drawn from the earth, one to the centre of the sun, and the other to the centre of the spot M, and let θ be their inclination, which is measured by SM, and is consequently known, being the geocentric distance of the spot from S, the centre of the sun's disk. Let R = distance of the sun's centre from the earth, r = semidiameter of the sun, φ = the angle made at the centre of the sun by the straight lines drawn from it to the earth and the spot M, and let ψ be the remaining angle of the triangle formed by the lines joining the earth, the centre of the sun, and the spot. We have then r : R : : sin. θ : sin. ψ, whence sin. $\psi = \frac{R}{r}$ sin. θ. But R : r as radius to the sine of half the sun's true diameter; therefore sin. $\psi = \frac{\text{sin. } \theta}{\text{sin. } \frac{1}{2} \text{ sun's diameter}}$.

Now $\varphi = 180° - \psi - \theta$, consequently we have the number of degrees, minutes, and seconds in φ, the heliocentric distance of the spot from the straight line which joins the centres of the earth and sun. Having thus obtained the hypothenuse SM in parts of a great circle of the solar orb, the sides Sm and Mm will be obtained in similar parts from the common trigonometrical formulæ for the resolution of a right-angled spherial triangle. These formulæ give

tan. Sm = tan. SM cos. MSE,
sin. Mm = sin. SM sin. MSE.

It will be remarked that Mm is the heliocentric latitude of the spot, Sm the difference of its longitude and that of the earth; and as the longitude of the earth is equal to 180° + that of the sun, the heliocentric longitude of the spot will be 180° + $\odot$ — Sm if the spot is behind or to the east of the centre of the sun, and 180° + $\odot$ + Sm if it precedes the centre.

Position of solar axis.

In this manner the heliocentric longitudes and latitudes of the spots are deduced from their observed right ascensions and declinations. The next step is to show how they are employed in determining the position of the solar axis. This problem is in practice somewhat laborious, although the principles on which its solution rests are sufficiently simple. The planes of the circles described by the spots are parallel to the sun's equator: if, therefore, the position of one of them can be found, the position of the equator, and consequently of the axis, will be found at the same time. Now, the position of a plane is determined by three given points through which it is required to pass; consequently, by three observations of the same spot, we shall have three points in its plane, and thence the plane itself. The problem is therefore one of pure geometry, and may be solved in various ways. The results of the most accurate observations make the inclination of the solar equator to the ecliptic amount to 7° 19′ 23″ or, 7°$\frac{1}{3}$ very nearly; and the heliocentric longitude of the ascending node, that is, the point in which the equator of the sun intersects the ecliptic, in passing from

south to north, 80° 7′ 4″. The position of the node seems to undergo no variation, except such as may be supposed to arise from the precession of the equinoxes.

It has already been mentioned that the mean time in which a solar spot returns to the same position, relatively to the earth, is 27·3 days. This, however, is not the time in which the sun makes a revolution about his axis. In the interval of 27·3 days the sun describes in the ecliptic an arc equal to 26°·91 (for 365ᵈ·25 : 27ᵈ·3 :: 360° : 26°·91), and by virtue of this motion alone he exhibits every day different points of his surface, the whole of which would be successively shown to the earth in the course of a year, independently of the motion of rotation. Hence results an apparent annual rotation round an axis perpendicular to the ecliptic, and we must abstract the effects of this optical illusion in order to arrive at the time of a real rotation. This apparent rotatory motion will be easily understood by referring to fig. 40, in which S is the sun, E the earth, and C the point in which the visual ray ES intersects the surface of the sun. Suppose the sun to have advanced in his orbit from S to S′, the visual ray drawn from the sun's centre to the earth will now meet the surface in a different point C′, and the angular distance between C and C′ will be found by drawing S′E′ parallel to SE; for the point *c* in which S′E′ meets the surface will correspond to C, and the arc C′*c*, or the angle E′S′E, will be the apparent rotation, while the sun advances in his orbit from S to S′. Now, the angle E′S′E is equal to S′ES, or the apparent rotatory motion is equal to the angular motion of the sun in his orbit; hence, since the real rotation is in a contrary direction, it is obvious that, if the axis were perpendicular to the plane of the ecliptic, when a spot appears to have made one revolution, it has in reality passed over an arc equal to 360° + 26°·91, or 386·91 degrees. By a simple proportion, therefore,

Fig. 40.

386·91 : 360 : : 27·3 : 25·4;

and consequently 25·4 days is the real time of the sun's revolution. This result is, however, not quite accurate, on account of its having been supposed that the axis of rotation is perpendicular to the ecliptic, whereas it differs from a perpendicular to that plane by 7°⅓; but the correction necessary on account of the difference is so small as to fall far within the limits of the errors to which the observations are liable; it is therefore unnecessary to have regard to it.

Observations liable to uncertainty.

Observations of the spots, from which the elements of the sun's rotation are deduced, are attended with a very considerable degree of uncertainty. The semidiameter of the sun, which at the surface of the earth subtends an angle of only 16′, or 960″, is equivalent to 90° at the centre of the sun. Hence the error of a single second (and it is impossible to answer for one or two seconds in observations of this sort) corresponds to about 338″, or 5′ 38″, on the surface of the solar globe. An observer may, therefore, notwithstanding the greatest care, be mistaken to the extent of 10′ with regard to the length of a heliocentric arc; and when to this we add, that the margins of the spots are ill defined, and even changeable, so that their centres, which it becomes necessary to observe, are not always the same, it will not appear surprising that a considerable discordance exists among the results of different observations. The uncertainty respecting the time of rotation amounts to no less than 10 or 12 hours. From a careful discussion of a numerous set of observations, Delambre found the time of rotation to be only 25·01154 days, instead of 25·4 given above, and he remarks that, in order to render the last-mentioned number admissible, it is necessary to suppose either an error of 2° 22′, which is scarcely possible, or else that the spot has a proper motion in the same direction as the motion of rotation of the earth and all the planets.

From four different combinations of equations, derived from eleven observations of the same spot, Delambre computed the following table of the elements of rotation.

	Node.	Inclination.	Revolution.	Synodic Revol.
1	80° 45′ 7″	7° 19′ 17″	25ᵈ 0ʰ 17ᵐ	26ᵈ 4ʰ 17ᵐ
2	79 21 35	7 12 37		
3	80 33 40	7 16 33		
4	79 47 55	7 29 4		
	80 7 4	7 19 23	Diurnal motion 14°·394	

With regard to observations on the sun's spots, Delambre remarks that he attaches little value to them, first, because it is impossible to make them well; and, secondly, because, even if they were sure, they only lead to results of little importance to astronomy. He discussed a hundred different spots, each observed at least three times by Messier, and deduced thirty different determinations of the elements of rotation. The more he multiplied his calculations, the more certain he became of the impossibility of a good solution; of which, indeed, there is no other chance than in a compensation of errors, little probable on account of their enormous magnitudes. These discrepancies render it probable that the spots, besides partaking of the general motion of the solar globe, have also proper motions either of displacement, or occasioned by a change of form, which may long prevent this part of astronomy from reaching a greater degree of exactness than it has already attained.

From the circumstance that the sun is incontestably endowed with a rotatory motion, Lalande concluded that, according to the rules of probability, he ought also to have a motion of translation in space. This idea was adopted by Herschel, and has since been sufficiently proved. It explains some, though not all, of the proper motions which have been supposed to be observed among the stars. If, indeed, the stars are so many suns, revolving like ours each on its own axis of rotation, it is extremely probable that they have also motions of translation; and thus, there being no fixed points in the heavens, the problem of their proper motions becomes so complicated as to be altogether insoluble.

The only interesting fact which has been deduced from the observations of the solar spots is the rotation of the sun. The curious appearances which they exhibit have, however, attracted great attention, and given rise to numerous theories respecting the constitution of that immense body which governs and vivifies the planetary system. We will now proceed to give a brief account of the appearances, and mention some of the theories that have been founded on them; premising, that after all that has been written on this subject, we are not yet, and probably never will be, in possession of any definite knowledge. The nature of the spots, and the physical constitution of the sun, afford fruitful subjects of harmless conjecture and speculation, but form no part of science.

Appearances of the spots.

The phenomena of the solar spots, as delivered by Scheiner and Hevelius, may be summed up in the following particulars. 1. Every spot which has a nucleus, or comparatively dark part, has also an umbra, or fainter shade surrounding it. 2. The boundary between the nucleus and umbra is always distinct and well defined. 3. The increase of a spot is gradual, the breadth of the nucleus and umbra dilating at the same time. 4. In like manner the decrease of a spot is gradual, the breadth of the nucleus and umbra contracting at the same time.

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5. The exterior boundary of the umbra never consists of sharp angles, but is always curvilinear, how irregular soever the outline of the nucleus may be. 6. The nucleus of a spot, whilst on the decrease, often changes its figure by the umbra encroaching irregularly upon it, insomuch that in a small space of time new encroachments are discernible, whereby the boundary between the nucleus and umbra is perpetually varying. 7. It often happens, by these encroachments, that the nucleus of a spot is divided into two or more nuclei. 8. The nuclei of the spots vanish sooner than the umbra. 9. Small umbræ are often seen without nuclei. 10. An umbra of any considerable size is seldom seen without a nucleus in the middle of it. 11. When a spot which consisted of a nucleus and umbra is about to disappear, if it is not succeeded by a *facula* or spot brighter than the rest of the disk, the place where it was is soon after not distinguishable from the rest.

In the *Philosophical Transactions*, vol. lxiv. Dr Wilson, late professor of astronomy at Glasgow, has given a dissertation on the nature of the solar spots, in which he mentions the following appearances. 1. When the spot is about to disappear on the western edge of the sun's limb, the eastern part of the umbra first contracts, then vanishes, the nucleus and western part of the umbra remaining; then the nucleus gradually contracts and vanishes, while the western part only of the umbra remains. At last this disappears also; and if the spot remains long enough to become again visible, the eastern part of the umbra first becomes visible, then the nucleus; and when the spot approaches the middle of the disk, the nucleus appears environed by the umbra on all sides, as already mentioned. 2. When two spots lie very near to one another, the umbra is deficient on that side which lies next to the other spot: and this will be the case, though a large spot should be contiguous to one much smaller; the umbra of the large spot will be totally wanting on that side next the small one. If there are little spots on each side of the large one, the umbra does not totally vanish, but appears flattened or pressed in towards the nucleus on each side. When the little spots disappear, the umbra of the large one extends itself as usual. This circumstance, he observes, may sometimes prevent the disappearance of the umbra in the manner above mentioned; so that the western umbra may disappear before the nucleus, if a small spot happens to break out on that side.

In the same volume, p. 337, the Rev. Dr Wollaston observes that the appearances mentioned by Dr Wilson are not uniform. He positively affirms that the faculæ or bright spots on the sun are often converted into dark ones. "I have many times," says he, "observed near the eastern limb a bright facula just come on, which has the next day shown itself as a spot, though I do not recollect to have seen such a facula near the western one after a spot's disappearance. Yet, I believe, both these circumstances have been observed by others, and perhaps not only near the limbs. The circumstance of the faculæ being converted into spots, I think I may be sure of. That there is generally, perhaps always, a mottled appearance over the face of the sun, when carefully attended to, I think I may be as certain. It is most visible towards the limbs, but I have undoubtedly seen it in the centre; yet I do not recollect to have observed this appearance, or indeed any spots, towards the poles. Once I saw, with a twelve-inch reflector, a spot burst to pieces while I was looking at it. I could not expect such an event, and therefore cannot be certain of the exact particulars; but the appearance, as it struck me at the time, was like that of a piece of ice when dashed on a frozen pond, which breaks to pieces and slides in various directions." He also observes, that the nuclei of the spots are not always in the middle of the umbræ, and gives the figure of one seen on the 13th of November 1773, which is a remarkable instance to the contrary. Theoretical Astronomy

The faculæ, or bright spots, were observed with particular attention by Messier, who frequently saw them enter on the eastern limb of the sun, disappear as they approached the centre of the disk, re-appear on the opposite limb, and continue visible, as they had done at the time of their first appearance, for about three days, till they were carried off the disk by the rotation of the sun. Spots frequently broke out in these faculæ, and when this did not happen, they were succeeded by spots which generally became visible on the following day; and from the regularity of this occurrence, he was enabled to predict the appearance of a spot 24 hours before it entered on the sun's disk. He observed, also, that the magnitude of the spots was proportional to the brightness of the antecedent faculæ. Like the spots, the faculæ are generally confined to the equatorial regions of the sun; but they have been occasionally observed by Schroeter on every part of the disk.

Theories regarding the spots.

To explain these singular appearances, numerous theories, more or less plausible, have been proposed, but all resting on many gratuitous assumptions, and subject to great difficulties. Scheiner imagined that the spots do not belong to the sun, but supposed them to be inferior planets revolving at no great distance from the central luminary. Galileo, Hevelius, and others, have supposed them to be scoriæ floating in the inflammable liquid matter of which they imagined the sun to be composed. This opinion, although it accounts for the appearance of the spots in the equatorial regions of the sun, to which such scoriæ would be carried by the centrifugal force resulting from his rotation, cannot be reconciled with the regularity with which the spots frequently re-appear on the eastern limb of the sun. Dr Wilson, having observed that the spots situated near the edge of the disk are narrow, and without a penumbra on the side next the centre, and that only the central spots are completely surrounded by a penumbra (appearances which would be exactly represented by a conical gulf or cavity presented to us under different aspects by the revolution of the sun), was led to adopt the opinion, that the appearances of the spots are occasioned by real excavations in the solar globe. He supposed the sun to consist of a dark nucleus, covered only to a certain depth by a luminous matter, not fluid, through which openings are occasionally made by volcanic or other energies, permitting the solid nucleus of the sun to be seen; and that the umbra which surrounds the spot is occasioned by a partial admission of the light upon the shelving sides of the precipice opposite to the observer. It is evident that, in proportion as these excavations are seen obliquely, their apparent dimensions will be diminished; one of the edges will disappear as it approaches the sun's limb, or come more into view as it advances towards the middle of the disk; when the spot is about to leave the disk, the bottom of the excavation, or the nucleus seen through it, will first disappear, but a sort of faint or obscure spot will remain visible as long as the visual ray penetrates the cavity. These appearances are all conformable to the laws of perspective; but Dr Wilson, wishing to give a still more palpable demonstration of the accuracy of his theory, fitted up a large globe, into which holes of the proper dimensions were inserted; and this machine being placed at a distance, and made to revolve, was found, when examined through a telescope, to exhibit in the course of its revolution all the phenomena of the solar spots.

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Dr Wilson's theory was keenly combated by Lalande, who adduced several observations of his own, and some by Cassini, that could not be explained by means of it; and urged with reason, that an hypothesis, founded on the uniformity of appearances which in reality are exceedingly variable, was entitled to little consideration. Lalande himself supposed the spots to be scoriæ which have settled or fixed themselves on the summits of the solar mountains; an opinion which he grounded on this circumstance, that some large spots which had disappeared for several years were observed to form themselves again at the identical points at which they had vanished.

Herschel's observations

The late Sir William Herschel, with a view to ascertain more accurately the nature of the sun, made frequent observations upon it from the year 1779 to the year 1794. He imagined the dark spots on the sun to be mountains, which, considering the great attraction exerted by the sun upon bodies placed at its surface, and the slow revolution it has upon its axis, he thought might be more than 300 miles high, and yet stand very firmly. He says that in August 1792 he examined the sun with several powers from 90 to 500, when it evidently appeared that the dark spots are the opaque ground or body of the sun, and that the luminous part is an atmosphere, through which, when interrupted or broken, we obtain a view of the sun itself. Hence he concluded that the sun has a very extensive atmosphere, consisting of elastic fluids that are more or less lucid and transparent, and of which the lucid ones furnish us with light. This atmosphere, he thought, cannot be less than 1843, nor more than 2765 miles in height; and he supposed that the density of the luminous solar clouds needs not be much more than that of our aurora borealis, in order to produce the effects with which we are acquainted. The sun, then, if this hypothesis be admitted, is similar to the other globes of the solar system with regard to its solidity, its atmosphere, its surface diversified with mountains and valleys, its rotation on its axis, and the fall of heavy bodies on its surface; it therefore appears to be a very eminent, large, and lucid planet, the primary one in our system, disseminating its light and heat to all the bodies with which it is connected.

Herschel supposed that there are two regions or strata of solar clouds; that the inferior stratum is opaque, and probably not unlike our own atmosphere, while the superior is the repository of light, which it darts forth in vast quantities in all directions. The inferior clouds act as a curtain to screen the body of the sun from the intense brilliancy and heat of the superior regions, and, by reflecting back nearly one half of the rays which they receive from the luminous clouds, contribute also greatly to increase the quantity of light which the latter send forth into space, and thereby perform an important function in the economy of the solar system. The luminous clouds prevent us in general from seeing the solid nucleus of the sun; but in order to account for the spots, he supposes an empyreal elastic gas to be constantly forming at the surface, which, carried upwards by reason of its inferior density, forces its way through the planetary or lower clouds, and mixing itself with the gases which have their residence in the superior stratum, causes decompositions of the luminous matter, and gives rise to those appearances which he describes under the name of *corrugations*. Through the openings made by this accidental removal of the luminous clouds, the solid body of the sun becomes visible, which, not being lucid, gives the appearance of the dark spots or nuclei seen through the telescope. The length of the time during which the spots continue visible renders it evident that the luminous matter of the sun cannot be of a liquid or gaseous nature; for, in either case, the vacuity made by its accidental removal would instantly be filled up, and the uniformity of appearance invariably maintained. Herschel supposed the luminous clouds to be phosphorescent.

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It would be a needless waste of time to enter into any discussion of a theory so entirely vague and fanciful, and so destitute of all solid foundation. Till we are better acquainted with the nature of light, fire, and heat, and have attained to the knowledge of every possible mode in which these elements can be produced and propagated, all hypotheses respecting the construction of the sun can only be gratuitous and conjectural. Some interesting questions, however, arise out of this subject. Whether the inferior stratum of solar clouds is sufficiently dense, as Herschel imagined, to protect the body of the sun from the scorching effects of the surrounding regions of light and heat, and render it a fit habitation for human beings, is a question of no importance to man, or to any thing pertaining to his planet; but it is interesting for him to know whether the light and heat dispensed by the sun are liable to any variation or secular diminution, either connected with the spots, or resulting from a decrease of the sun's volume.

Uncertainty respecting the constitution of the sun.

Those philosophers who adopt the hypothesis of the production of light and heat by the vibrations of an ethereal fluid, consider the mass of the sun to be invariable. Those, on the contrary, who attribute these effects to an emanation from the sun, think his mass and volume must be diminished by the incessant discharge of torrents of luminous particles from his surface. During the two thousand years which have elapsed since the first astronomical observations, no diminution of the sun's volume has been perceived; but it must be remarked that such an effect may have taken place, though not yet sensible to our instruments. The sun's diameter is nearly 2000″; and at the distance of 95,000,000 miles a second corresponds to 460 miles. Now, supposing the solar diameter to suffer a daily diminution of two feet, which may be considered as enormous, considering the vast magnitude of the sun, and the excessive rarity of light, the diminution would amount to 800 feet in a year, and to 460 miles, or 1″, in 3000 years. Thus, after thirty centuries, the diminution would still be imperceptible, inasmuch as our instruments are not sufficiently accurate to enable us to appreciate, in an observation of this sort, so small a variation as one second.

Mass of the sun undergoes no sensible diminution.

Some astronomers, after Herschel, have imagined that the existence of the solar spots has an influence on the temperature of the seasons. In 1823 the summer was cold and wet; the thermometer at Paris rose only to 23°·7 of Reaumur, and the sun exhibited no spots; whereas in the summer of 1807 the heat was excessive, and the spots of vast magnitude. The relation, however, between the temperature and the appearance of the solar spots is not so uniform as to give much weight to this opinion. Warm summers, and winters of excessive rigour, have happened in the presence or absence of the spots. The year 1783 was remarkable for its fertility and the magnitude of the solar spots; a dry fog enveloped the greater part of Europe, and was followed by the earthquake of Calabria. Another opinion entertained by Herschel was, that one hemisphere of the sun emits less light than the other, so that when viewed at a great distance he will resemble some stars of which the brilliancy is subject to periodical variations.

Connection of the solar spots with the temperature of the seasons.

By reason of the globular figure of the sun, his surface towards the border of the disk is seen obliquely, and therefore a much greater portion of it is comprehend-

Sun supposed to have an atmosphere.

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ed under a given visual angle, than when the ray proceeds from his centre. Now, as every point of the sun's surface is supposed to emit an equal quantity of light in all directions, it follows that the light ought to be much more intense near the circumference of the disk, because a greater number of rays will proceed from the larger surface, which forms the oblique base of the luminous cone. Bouguer, deceived by some imperfect experiments, thought the light more intense at the centre of the disk than towards the limb; a circumstance which could only be explained by supposing the light to be diminished by some cause which acts most powerfully with regard to the borders of the disk. Such would be the effect of a dense atmosphere surrounding the sun; for in this case the rays which proceed from the border must traverse a much greater extent of the solar atmosphere, and consequently be absorbed in greater proportion than those which proceed from the central parts and traverse it directly; just as the atmosphere of the earth renders the light of the stars at the horizon much feebler than at the zenith. It has been thought, however, that Bouguer's experiments were inaccurate, and that the light is equally intense at the border and the centre. The existence of a solar atmosphere cannot therefore be demonstrated in this manner; but it is clearly indicated by the faint light which is observable round the sun's limb during a total eclipse.

Zodiacal light.

Another very curious phenomenon connected with the sun, is the faint nebulous aurora which accompanies him, known by the name of the *Zodiacal Light.* This phenomenon was first observed by Kepler, who described its appearance with sufficient accuracy, and supposed it to be the atmosphere of the sun. Dominic Cassini, however, to whom its discovery has been generally but erroneously attributed, was the first who observed it attentively, and gave it the name which it now bears. It is visible immediately before sunrise, or after sunset, in the place where the sun is about to appear, or has just quitted, in the horizon. In total eclipses it is seen surrounding the sun's disk, and resembling the beard of a comet. It has a flat lenticular form, and is placed obliquely on the horizon, as represented in fig. 41, the apex extending to a great distance in the heavens. Its direction is always in the plane of the sun's equator, and for this reason it is scarcely visible in our latitudes, excepting at particular seasons, when that plane is nearly perpendicular to the horizon. When its inclination is great, it is either concealed altogether under the horizon, or at least rises so little above it, that its splendour is effaced by the atmosphere of the earth. The most favourable time for observing it is about the beginning of March, or towards the vernal equinox. The line of the equinoxes is then situated in the horizon, and the arc of the ecliptic SS′ S″ (fig. 42) is more elevated than the equator SEQ by an angle of 23½ degrees; so that the solar equator, which is slightly inclined to the ecliptic, approaches nearer to the perpendicular to the horizon, and the pyramid of the zodiacal light is consequently directed to a point nearer the zenith, than at any other season of the year. For example, at the summer solstice, S″T, a tangent to the ecliptic, is parallel to EQ the tangent to the equator, and the luminous pyramid is in a plane less elevated by 23°½ than at the time of the vernal equinox.

Fig. 41.

Fig. 42.

Different opinions regarding the zodiacal light.

Numerous opinions have been entertained respecting the nature and cause of this singular phenomenon. Cassini thought it might be occasioned by the confused light of an innumerable multitude of little planets circulating round the sun, in the same manner as the milky way owes its appearance to the light of agglomerated myriads of stars. Its resemblance to the tails of comets has been noticed by Cassini, Fatio Duillier, and others; and Euler endeavoured to prove that they are both owing to similar causes. Mairan, like Kepler, ascribed it to the atmosphere of the sun; and this hypothesis was generally adopted, till it was shown by Laplace to be untenable for the following reasons. The atmosphere of any planet, endowed with a motion of rotation, cannot extend to an indefinite distance: it can only reach to such a height that the centrifugal force is exactly balanced by the force of gravity. Beyond this height the atmosphere would be dissipated by the superior energy of the centrifugal force. Now the height above the sun at which the two forces are equal is that at which a planet, if placed there, would revolve about the sun in the same time in which the sun performs a revolution on his axis. But the orbit of such a planet would be greatly inferior to the orbit of Mercury; for the time in which Mercury makes a revolution in his orbit is eighty-eight days, while the sun revolves about his axis in twenty-five; it is therefore certain that the atmosphere of the sun cannot extend to the orbit of Mercury. Now, the greatest elongation of Mercury does not exceed 28°, and the zodiacal light has been observed to extend to above 100°, reckoning from the sun to the apex of the luminous pyramid. Hence the phenomenon cannot proceed from the sun's atmosphere. Laplace further remarks, that the ratio of the equatorial and polar axes of the solar atmospherical spheroid cannot exceed that of three to two; whence its form would not correspond with the lenticular appearance of the zodiacal light. But to whatever cause this luminous matter is to be attributed, it is certain that it is of extreme rarity, inasmuch as it does not intercept the light of the smallest stars which are seen through it without any diminution of splendour.

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On the subject of the solar spots and zodiacal light the following works may be consulted:—Galileo, *Istoria e Dimostrazioni intorno alle Macchie Solari,* Rome, 1613; Scheiner, *Rosa Ursina,* Bracciani, 1630; Hevelius, *Selenographia,* Gedani, 1647; Reutschius, *De Maculis et Faculis Solaribus,* Wittemb. 1661, 4to, Cassini, *Nouv. Observ. des Taches du Soleil;* Hooke, *Tractatus de Maculis Solaribus, et Lumine Zodiacali, in Oper. Posth.* Lond. 1705; Weidler, *De Coloribus Mac. Sol.* in his *Observ. Meteorol.* 1728–9, Wittemb. 1729; Boscovich, *De Mac. Sol.* Rom. 1736, 4to; De Lisle, *Mémoires pour servir à l'Histoire de l'Astr.* Petersb. 1738; Bernoulli, *Lettres Astronomiques,* 1771; Wilson, *Phil. Trans.* 1774, vol. lxiv.; *Ibid.* 1783; Wollaston, *Phil. Trans.* 1774; Lalande, *Phil. Trans.* 1776, *Mém. Acad.* 1776, and *Astronomie,* tom. iii. p. 277; Herschel, *Phil. Trans.* 1795 and 1801; Woodward *on the Substance of the Sun,* Washington, 1801; Biot, *Traité de l'Astronomie Physique,* tom. ii.; Bohn, *Disput. Astrom. de Fascia Zodiacali;* Cassini, *Mém. Acad. Par.* tom. vii. p. 119, and viii. p. 193; Mairan, *Traité Physique et Historique de l'Aurore Boreale,* 1731; Lalande, *Astronomie,* tom. i. p. 276; Laplace, *Exposition du Système du Monde*; Delambre, *Hist. de l'Astronomie Moderne,* tom. ii. p. 742.

CHAP. III.

OF THE MOON.

Next to the sun, the moon is to mankind the most important and interesting of all the celestial bodies. Her conspicuous appearance in the heavens, the variety of her phases, and the rapidity with which she changes her place among the fixed stars, have rendered her at all times an object of admiration to the vulgar; while her proximity to the earth, her physical effects on the ocean, the intricacy of the theory of her motions, and the vast importance of that theory to navigation and geography, have equally

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claimed the attention of the observer and mathematician; nor is there any other department of astronomy in which their researches have been crowned with more triumphant success, or been rewarded with more brilliant discoveries.

Sect. I.—*Of the Phases, Parallax, and Magnitude of the Moon.*

The different appearances or phases of the moon were probably the first celestial phenomena observed with any degree of attention. When the moon, after having been for some days invisible, is again seen on the eastern side of the sun, and at a distance of 20 or 30 degrees from him, she appears as a curved thread of silvery light; and her form is that of a crescent, the horns of which are turned towards the east. The breadth of the crescent increases continually in proportion as she separates herself from the sun, till, having obtained a distance of 90°, she appears under the form of a semicircle. At this point she is said to be in her *first quarter*. Continuing her motion to the eastward, the line which terminates the eastern side of her disk assumes the curvature of an elliptic arc, and her visible portion continues to increase till she has attained the distance of 180° from the sun, when she appears perfectly round. She is then *full*, and is said to be in *opposition*, rising as the sun sets, and consoling us by her pale light for the absence of the great luminary. Having passed this point, she begins to approach the sun; her western side now takes the form of the elliptic arc, and her luminous portion diminishes exactly in the same proportion as it increased through the first half of her orbit. About seven days after the full she again appears as a semicircle, the diameter of which is turned towards the west, and she is now at her *third quarter*, and at a distance of 90° from the sun. The semicircle after this changes into a crescent, and she continues to approach the sun, till, having advanced to within 20° or 30° from him, she again disappears, being lost in the splendour of his rays. These phases regularly succeed each other, and the time in which they run through all their changes is about 29½ days. When the moon passes the meridian at the same time with the sun, she is said to be in *Conjunction*. The two points of her orbit in which she is situated when in opposition or conjunction are called the *Syzygies;* those which are 90° distant from the sun are called the *Quadratures;* and the intermediate points between the syzygies and quadratures are called the *Octants*.

A slight attention to the lunar phases during a single revolution will be sufficient to prove that they are occasioned by the reflection of the sun's light from the opaque spherical surface of the moon. This fact, which was recognised in the earliest ages, will be made obvious by the help of a diagram. If the moon is an opaque body we can only see that portion of her enlightened side which is towards the earth. Therefore, when she arrives at that point of her orbit A (fig. 43) where she is in conjunction with the sun S, her dark half is towards the earth, and she disappears, as at *a*, there being no light on that half to render it visible. When she comes to her first octant, at B, or has gone an eighth part of her orbit from her conjunction, a quarter of her enlightened side is towards the earth, and she appears horned, as at *b*. When she has gone a quarter of her orbit from her conjunction, to C, she shows us one half of her enlightened side, as at *c*, and we say she is a quarter old. At D she is in her second octant, and by showing us more of her enlightened side she appears gibbous, as at *d*. At E her whole enlightened side is towards the earth, and therefore she appears round, as at *e*, when we say it is full moon. In her third octant, at F, part of her dark side being towards the earth, she again appears gibbous, and is on the decrease, as at *f*. At G we see just one half of her enlightened side, and she appears as a semicircle, as at *g*. At H we only see a quarter of her enlightened side, being in her fourth octant, when she appears horned, as at *h*. And at A, having completed her course from the sun to the sun again, she disappears, and we say it is new moon. Thus, in going from A to E, the moon seems continually to increase; and in going from E to A, to decrease in the same proportion, exhibiting like phases at equal distances from A and E.

Fig. 43.

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The magnitude of the visible portion of the moon's disk thus depends on the situation of the moon relatively to the sun and the earth, and is easily determined geometrically from her elongation or angular distance from the sun. Let ADBC (fig. 44) be the projection of the lunar orb on the plane which passes through the centres of the sun, moon, and earth; let S be the place of the sun, E that of the earth, M the centre of the projection, and AB, CD two diameters perpendicular to SM and EM respectively, and let EM meet the circumference in G. It is evident that AGDB represents the hemisphere illuminated by the sun, and CAGD that which is visible from the earth; the whole portion of the visible disk, therefore, is represented by AGD, or by AG and DG. Now, if we conceive the moon's surface to be projected on the plane which passes through her centre perpendicular to the visual ray, the illuminated portion of the disk DG will appear as a semicircle, while the part GA will appear as a semi-ellipse, the minor axis of which is to its major as MF to MC, AF being perpendicular to MC. The eye at E will therefore see the semicircle DMG, together with the semi-ellipse GMA, and the visible part will be to the entire disk as DF : DC, that is, as 1 + sin. AME : 2, or, as 1 + cos. φ : 2; φ being equal to EMS the elongation of the earth from the sun as seen from the moon. The geocentric elongation of the moon from the sun, or the angle MES = ψ, may be substituted instead of φ, when we know the ratio of the distances ES = r and MS = R; for sin. $\varphi = \frac{r}{R}$ sin. ψ, whence cos. $\varphi = \sqrt{1 - \frac{r^2}{R^2} \text{ sin.}^2 \psi}$, and the above proportion becomes

Fig. 44.

$$\text{DF} : \text{DC} :: 1 + \sqrt{1 - \frac{r^2}{R^2} \text{ sin.}^2 \psi} : 2.$$

When the moon is in opposition the angle $\varphi = 0$, whence 1 + cos. $\varphi = 2$, and the whole disk is visible. At the conjunction $\varphi = 180°$, and 1 + cos, $\varphi = 0$; the moon is consequently invisible.

The triangle EMS likewise furnishes the means of finding the distance of the moon when that of the sun is known; or reciprocally, the distance of the sun from that of the moon: but for this purpose it is necessary to observe accurately the limit of illumination, which is not easily done. Let ADBE (fig. 45) be the illuminated part of the moon ACBE. The distance between the cusps A and B, measured by the micrometer, gives the major axis of the ellipse ADB, and the semi-minor axis DM is found by measuring in the same manner the distance ED, and subtracting EM, half the semi-minor AB. This gives $\frac{\text{DM}}{\text{AM}}$ = cos. EMS (fig. 44), and therefore the angle EMS or M; and from SEM, which is given by observation, we have ESM or S = 180° — E — M; whence M and S are given angles; and from the property of the triangle we have EM = ES $\frac{\text{sin. S}}{\text{sin. M}}$, or ES = EM $\frac{\text{sin. M}}{\text{sin. S}}$. The calculation would be greatly facilitated if the observation

Fig. 45.

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were made at the exact instant when the moon is dichotomized, or in her first or third quarter, for the elliptic arc then becomes a straight line and the angle EMS=90°; so that sin. M = 1. In this case therefore we have EM = ES sin. S = ES cos. E, and $ES = \frac{EM}{\cos. E}$, which gives the ratio of the distances of the sun and moon. In this manner Aristarchus of Samos attempted to compare the distance of the two luminaries; and although his result was extremely erroneous, inasmuch as he found the distance of the sun to be only between eighteen and twenty times greater than that of the moon, whereas it is actually 380 times greater, yet the idea was an ingenious one, and the method perfectly accurate in theory. The error arose from the inaccuracy of the ancient instruments, and the impossibility of observing to within a few minutes the exact time of the dichotomy. Besides, as the angle at the sun is extremely small, a very slight error either with regard to the time or the angle has a great influence on the result.

Parallax of the moon.

The moon's absolute distance from the earth is obtained by means of her parallax, which, on account of her proximity, is very considerable, and can therefore be determined by the methods which were explained in chap. i. sect. 2. On comparing her parallaxes observed at different times, they are found to differ considerably in value. Thus, according to Lalande, the greatest horizontal parallax at Paris is 61′ 29″, the smallest 53′ 51″; and it assumes every possible value between these two extremes. The horizontal parallax being the angle which the earth's radius subtends at the moon, and consequently equal to the radius of the earth divided by the moon's distance, the perigean and apogean distances corresponding to the extreme parallaxes are respectively 55·916 and 63·842 semidiameters of the earth. The ratio of these two numbers, or of the extreme values of the parallax, is 1·1417, and denotes the greatest variations of the moon's distance from the earth. The ratio of the corresponding quantities in the case of the sun is only 1·034; hence the moon's distance is subject to much greater variations than that of the sun.

These differences in the value of the parallax arise from the variations of the moon's distance from the earth; but it is also observed to differ sensibly at different points of the earth's surface, even at the same instant of time. If the earth were spherical, the horizontal parallax of the moon, supposing her distance to be invariable, would be the same at whatever part of the earth it might be observed. The case is, however, different; for, on account of the spheroidal figure of the earth, the section made by every vertical plane gives a different ellipse, no one of which even passes through the centre of the earth, excepting indeed the cases in which the place of the observer is on the equator or under the pole; for in all other cases the perpendicular to the surface of the earth does not pass through its centre. Hence it is necessary, in speaking of the horizontal parallax, to specify the place of the observation.

Since the parallax of the moon is subject to incessant variation, it is necessary to assume a certain mean value of it, about which the true and apparent values may be conceived to oscillate. This is denominated the *constant* parallax. It is evident that it cannot be found by taking the arithmetical mean of the extreme values; for by reason of the disturbing force of the sun, the eccentricity of the lunar orbit, and consequently the perigean and apogean distances, are constantly varying; and as the quantity by which one of these distances is increased is not equal to that by which the other is diminished, it follows that the mean of the perigean and apogean parallaxes will not be a constant quantity, but different in successive revolutions of the moon. If we abstract from all the inequalities of the lunar orbit, and suppose the moon to be at her mean distance and mean place, the constant parallax will be the angle under which a given semidiameter of the earth is seen by a spectator at the moon in such circumstances. According to Lalande, the following are the values of the constant parallax:—

Under the equator	57′ 5″
Under the pole	56 53·2
For the latitude of Paris	56 58·3
For the radius of a sphere equal in volume to the earth	57 1

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Magnitude of the lunar orb.

The mean equatorial parallax being 57′ 5″, its double is 1° 54′ 10″, which expresses the angle subtended by the diameter of the earth at the distance of the moon. The angle subtended by the moon at the same distance is 31′ 26″; whence the diameter of the moon is to that of the earth as 31′ 26″ is to 1° 54′ 10″; that is, as ·524 to 1·903, or as 3 to 11 nearly. According to the tables of Burg, the accurate expression of the above ratio is 1 : 0·27293; hence the true diameter of the moon is 0·27293 diameters of the terrestrial equator. The surface of the moon is consequently $(0{\cdot}27293)^2 = 0{\cdot}0744908 = \frac{1}{13{\cdot}4243}$ of that of the earth, and its volume $(0{\cdot}27293)^3 = 0{\cdot}0203308 = \frac{1}{49{\cdot}1863}$, or, in round numbers, $\frac{1}{49}$th of the volume of the earth.

Sect. II.—*Of the Elements of the Lunar Orbit.*

1. *Nodes and Inclination of the Lunar Orbit.*—A few simple observations of the right ascensions and declinations of the moon suffice to show that her path is confined nearly to a plane, having only a small inclination to the plane of the ecliptic. If her path were rigorously confined to this plane, a single revolution would be sufficient to determine its inclination; but as numerous disturbing causes exist, which produce inequalities in all the elements of the lunar motion, it is only by taking the mean value of a great number of observations that these elements can be astronomically determined. In fixing the position of the plane of the orbit, the first object is to determine the straight line formed by its intersection with the plane of the ecliptic; that is to say, to determine the line of the *Nodes*. This would be at once accomplished if it were possible to observe the instant at which the moon's latitude is nothing; for at this instant her centre is in the plane of the ecliptic, and consequently her longitude is the same as the longitude of the node. But as the accuracy of modern practice requires that all important observations be made in the plane of the meridian, and as it could only happen by a very rare coincidence that the latitude deduced from the meridional right ascensions and declinations would be exactly zero, it is necessary to have recourse to a process of calculation to find the precise place of the node.

Let LNL′ (fig. 46) be a portion of the ecliptic, MNM′ of the lunar orbit, N the place of the node, and ML = λ, ML′ = λ′ be two latitudes on opposite sides of the ecliptic. The two right-angled triangles give, according to Napier's Rules,

Fig. 46.

$$\text{tan. N} = \frac{\text{tan. } \lambda}{\text{sin. NL}} = \frac{\text{tan. } \lambda'}{\text{sin. NL}'};$$

therefore,

$$\frac{\text{sin. NL}'}{\text{sin. NL}} = \frac{\text{tan. } \lambda}{\text{tan. } \lambda'};$$

whence,

$$\frac{\text{sin. NL} - \text{sin. NL}'}{\text{sin. NL} + \text{sin. NL}'} = \frac{\text{tan. } \lambda - \text{tan. } \lambda'}{\text{tan. } \lambda + \text{tan. } \lambda'};$$

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that is, by the trigonometrical formulæ,

$$\frac{\tan.\frac{1}{2}(NL-NL')}{\tan.\frac{1}{2}(NL+NL'} = \frac{\sin.(\lambda-\lambda')}{\sin.(\lambda+\lambda')}$$

$$\text{or } \tan.\tfrac{1}{2}(NL-NL') = \tan.\tfrac{1}{2}LL' \cdot \frac{\sin.(\lambda-\lambda')}{\sin.(\lambda+\lambda')}.$$

Having therefore obtained an expression for the difference of NL and NL′, and knowing also their sum LL, which is the difference of the longitudes of the moon at the time of the two observations, it is easy to deduce NL or NL ; consequently the longitude of the node is determined.

The *Ascending Node* of the lunar orbit is that point of the ecliptic through which the moon passes when she rises above the ecliptic towards the north pole: it is distinguished by the character ☊. The *Descending Node*, ☋, is the opposite point of the ecliptic, through which she passes when she descends below that plane towards the south pole. The nodes of the lunar orbit were anciently called the head and tail of the Dragon.

The position of the nodes is not fixed in the heavens. They move in a retrograde direction, or contrary to the order of the signs; and their motion is so rapid that its effects become very apparent after one or two revolutions. Regulus, a star of the first magnitude, is sometimes eclipsed by the moon; and as the latitude of this star is only about 27′ or 28′, it is certain that when that phenomenon occurs the moon is very near her node. Suppose it to be the ascending node: the month following it will be observed that the moon passes to the north of Regulus; and every succeeding month she will pass farther to the north of the same star, till at the end of four or five years, when her meridional altitude will be about 5° greater than that of Regulus. Her latitude on passing Regulus now begins to diminish; and, after a period of about nine years, Regulus is again eclipsed by the moon in her descent to the southern side of the ecliptic. The moon after this passes to the south of the star for the following nine years; and at the end of 18½ years the nodes have returned to their first position, after accomplishing a complete revolution. The same result is found from the observation of eclipses, the magnitude of which depends on the moon's latitude; and therefore, if the nodes remained fixed, the eclipses would always be of the same magnitude in the same quarter of the heavens. This, however, is not the case; and it is only after about 18½ years that they begin to return in the same order.

The mean retrograde motion of the nodes is found, by the comparison of observations made at distant epochs, to amount to 19° 19′ 42″·316 in a mean solar year, and the time in which they make a tropical revolution is consequently 6798·179 mean solar days. The longitude of the ascending node on the 1st of January 1801 was 13° 53′ 17″·7; hence its position at any other epoch is easily deduced, since we know the rate of its mean motion.

The inclination of the lunar orbit may be determined either by observing the moon's greatest latitudes, or it may be computed from the formula, $\tan. N = \frac{\tan \lambda}{\sin. NL}$, when her latitude and longitude are known. The angle N, or the inclination, is observed to vary between 5° and 5° 17′ 35″. The mean inclination may therefore be taken at 5° 8′ 48″.

The retrograde motion of the moon's nodes, as well as all the other inequalities of the lunar motion, is occasioned by the attracting power of the sun, which varies in intensity according to the positions of the earth and moon in their orbits. The principal inequality to which the inclination of the lunar orbit is subject, is proportional to the cosine of double the sun's distance from the moon's ascending node. In fact, the sun and earth being always in the plane of the ecliptic, when the moon is also in that plane the action of the sun will have no tendency to increase or diminish her latitude; it will only affect her radius vector, or distance from the earth. But if the moon is not in the plane of the ecliptic, the sun's attracting force will not only affect her distance from the earth, but also tend to bring her nearer to the ecliptic; and this action will be greater in proportion to her deviation from that plane. When the nodes are in quadratures, and the limits of latitude in the syzygies, the inclination is 5°, as was found by Ptolemy; but when the nodes are in the syzygies, and the limits in quadratures, the inclination is 5° 17′ 35″. It has therefore a mean value of 5° 8′ 48″, when the nodes and limits coincide with the octants. Denoting therefore the greatest deviation from the mean values by x, this deviation will pass through all its values between $+ x$ and $- x$ while the sun's distance from the ascending node varies from 0° to 90°. It may therefore be represented by a function which varies as the cosine of twice that distance, for the cosine of an angle runs through all its changes from + 1 to — 1 between 0 and 180°. Hence the equation which expresses the principal inequality of the moon's latitude is

(8′ 47″) cos. 2 ⊙'s distance from ☽'s ☊.

The co-efficient 8′ 47″ is called, in astronomy, the *Co-efficient of the Argument*, the argument itself being the function by which the inequality is represented.

This periodic inequality of the moon's latitude was discovered by Tycho Brahe, from a comparison of the greatest latitudes at different epochs with the correponding positions of the moon with reference to her nodes. He observed that these latitudes oscillate about the mean value of 5° 8′ 48″; and as the greatest latitudes give immediately the inclination of the moon's orbit to the plane of the ecliptic, it necessarily followed that the inclination is subject to similar variations. The motion of the node of the lunar orbit is also subject to an inequality, depending on the same angle as the preceding, but proportional to its sine. Tycho explained these two inequalities by a very simple hypothesis, similar to that by which we have explained the oscillations of the terrestrial equator, namely, a slight nutation of the earth's axis. In the present case it is only necessary to place the mean pole of the lunar orbit at the distance of 5° 8′ 48″ from the pole of the ecliptic, and to suppose the true pole to describe a small ellipse about the mean pole in the same time that the sun occupies in making a semi-revolution with regard to the nodes of the moon's orbit, that is, in 173·309 days.

There are various other inequalities which affect the latitude of the moon and the inclination of her orbit, to correct which, a large number of equations are given in the recent and most accurate tables. The greater part of them are, however, only known from theory, and are so small that even their accumulated effects are scarcely perceptible to observation.

Phenomenon of the harvest-moon.

The inclination of the lunar orbit to the plane of the terrestrial equator occasions considerable differences in the intervals between the moon's rising or setting on successive days, and gives rise to the phenomenon of the *Harvest Moon*. As the daily motion of the moon is about 13 degrees from west to east, it follows that if she moved in a plane parallel to the equator, she would rise 50 minutes later every successive evening, because her orbit would then make the same angle with the horizon at all seasons of the year, and the intervals between her consecutive risings would be constant. For the sake of explanation, we may here suppose the moon to move in the plane of

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the ecliptic. Now, the time in which a given arc of the ecliptic rises above the horizon depends on its inclination to the horizon. In our latitudes the inclination of the ecliptic at different points to the horizon varies so much, that at the first point of Aries an arc of 13° becomes visible in the short space of 17 minutes, while at the 23d of Leo the same arc will only rise above the horizon in one hour and 17 minutes. Hence, when the moon is near the first point of Aries, the difference of the times of her rising on two successive evenings will be only about 17 minutes; and as this happens in the course of every revolution, she will rise for two or three nights every month at nearly the same hour. But the rising of the moon is a phenomenon which attracts no attention, excepting about the time when she is full, that is, when she rises at sunset. In this case she is in opposition to the sun, and consequently, if she is in Aries, the sun must be in Libra, which happens during the autumnal months. At this season of the year, therefore, the moon, when near the full, rises for some evenings at nearly the same hour. This circumstance affords important advantages to the husbandman, on which account the phenomenon attracts particular attention.

It is obvious, that as this phenomenon is occasioned by the oblique position of the lunar orbit with regard to the equator, the effect will be greater than what has just been described if the plane of that orbit makes a greater angle with the equator than the plane of the ecliptic does. But we have seen that the plane of the moon's orbit is inclined to the ecliptic in an angle exceeding 5°; consequently, when her ascending node is in Aries, the angle which her orbit makes with the horizon will be 5° less than that which the ecliptic makes with the horizon; and the difference of time between her risings on two successive evenings will be less than 17 minutes, as would have been the case had her orbit coincided with the ecliptic. On the contrary, when the descending node comes to Aries, the angle which her orbit makes with the horizon will be greater by 5°, and consequently the difference of the times of her successive risings will be greater than if she moved in the plane of the ecliptic. If when the full moon is in Pisces or Aries the ascending node of her orbit is also in one of those signs, the difference of the times of her rising will not exceed one hour and forty minutes during a whole week; but when her nodes are differently situated, the difference in the time of her rising in the same signs may amount to $3\frac{1}{2}$ hours in the space of a week. In the former case the harvest-moons are the most beneficial, in the latter the least beneficial, to the husbandman. All the variations in the intervals between the consecutive risings or settings take place within the period in which the line of the nodes makes a complete revolution.

2. *Dimensions, Eccentricity, and Apsides of the Lunar Orbit; and the Inequalities of the Moon's motion.*—Since the moon moves in a plane orbit, the projection of her path on the surface of the celestial sphere will be a great circle. But the variations observable in the magnitude of her apparent diameter, and in the velocity of her motion, prove that if her orbit is a circle, the earth is at least not placed at its centre. The numerous perturbing causes which affect her motion render the exact determination of her orbit a matter of great difficulty; but observation shows that it deviates very little from an ellipse, of which the centre of the earth occupies one of the foci. It has also been found that the spaces passed over by the radius vector of the moon are very nearly proportional to the times of description; which is the distinctive character of the elliptic motion.

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In order to obtain a correct idea of the figure and position of the orbit, it is necessary to know its major axis, its eccentricity, and the position of its apsides. The major axis is equal to the sum of the greatest and least distances, and these have already been stated to be respectively 63·842 and 55·916 semidiameters of the earth; whence, supposing the earth's radius to be 4000 miles, the major axis of the lunar orbit will amount in round numbers to 480,000 miles. It may be here remarked that the moon's distance is an element which may be practically determined with great exactness. A variation of 1″ in the parallax would occasion an error of only about 67 miles in the determination of the distance; therefore, since the parallax is certainly known to within 4″, the greatest error in the distance deduced from it cannot exceed 280 miles out of about 240,000 miles.

An approximation to the eccentricity of the orbit of the moon is easily obtained from the variations of her apparent diameter. The moon's apparent diameter is observed to vary between 29′ 30″ and 33′ 30″ very nearly. Now, let D denote the mean, D′ the apogean, D″ the perigean diameter, and e the eccentricity. We shall then have

$$D' = \frac{D}{1+e} = 29'\ 30'',$$

$$D'' = \frac{D}{1-e} = 33'\ 30'',$$

$$\frac{D'}{D''} = \frac{1-e}{1+e} = \frac{29'\ 30''}{33'\ 30''};$$

whence we deduce

$$e = \frac{33'\ 30'' - 29'\ 30''}{33'\ 30'' + 29'\ 30''} = \frac{4}{63} = 0{\cdot}0635.$$

This eccentricity corresponds to an equation of the centre amounting to 7° 16′, and is much more considerable than that of the solar orbit, which, as we have before seen, amounts only to 0°·0168. The result just given is, however, only to be considered as approximative, and is, in fact, considerably too large. In the best and most recent tables the value assigned to the eccentricity of the lunar orbit is 0·0548442, and the corresponding equation of the centre 6° 17′ 12″·7. (See *Astronomical Tables and Formulæ*, by Francis Baily, Esq. London, 1827.)

The place of the apsides is likewise found from observations of the moon's apparent diameter, because at these points of the orbit the apparent magnitude has its maximum and minimum values. But as the apparent magnitude varies very slowly at the apsides, it is preferable, as Lalande remarks, to choose the points of mean distance where its variations are most rapid. Having selected two observations which give the same apparent diameter at two opposite points of the orbit, we shall have two points evidently at equal distances from the perigee, the longitude of which will therefore be given at the middle time between the two observations. In comparing the positions of the apsides thus determined at different epochs, it is found that they have a rapid progressive motion, that is, according to the order of the signs. In Mr Baily's tables the motion of the perigee is stated to be 4069°·046278, or 11 revolutions + 109° 2′ 46″·6, in 36525 mean solar days. Its mean motion in a mean solar day is consequently 6′ 41″; and in 365 mean solar days, 40° 39′ 45″·36. Hence the time in which it completes a sidereal revolution is 3232·575343 mean solar days. The period of a tropical revolution of the apsides is 3231·4751 mean solar days = 3231 days, 11 hours, 24 minutes, 0·8 seconds, or nearly 9 years. This mean motion of the lunar apsides is, however, subject to periodic inequalities of considerable magnitude, and therefore can only be determined accurately by means of observations separated from

each other by a long interval of time. In the tables just quoted, the epoch is the commencement of the present century, when the longitude of the perigee was in 266° 10′ 7″·5. From this and the rate of the mean motion, the mean longitude of the perigee at any other epoch may be easily computed.

Inequalities of the lunar orbit.

If the moon's place in her orbit were not subject to the influence of any disturbing force, her true longitude, or distance from the apsis, would be found at any instant from the theory of the elliptic motion, supposing her mean motion, or the time of a return to the same perigee or apogee, to be accurately known. Thus, supposing E to denote the maximum elliptic equation, which, as we have already stated, amounts to 6° 17′ 12″·7, we should have the true longitude = mean longitude + E sin. A, A being the moon's mean anomaly, and the longitudes counted from the perigee. This first equation or correction of the mean motion results solely from the circumstance that the moon moves in an elliptic orbit, according to the laws of Kepler, in the same manner as the sun and all the planets. Its argument is the mean anomaly A, and its period the anomalistic month. But the moon's longitudes, as determined in this manner, are far from agreeing with observation; and several other corrections must be applied, the accurate determination of which forms the principal object of the lunar theory.

Equation of the centre.

Evection.

After the equation of the centre, the most considerable of the inequalities of the moon's longitude is that to which Boulliaud gave the name of the *Evection*. It was noticed by Hipparchus; but it was Ptolemy who discovered its law, and gave a construction which represents its general effects with great accuracy. These effects are to diminish the equation of the centre when the line of the apsides lies in syzygy, and to augment it when the same line lies in quadratures. Thus, supposing the apsides to lie in syzygy, and that it is sought to compute the moon's true longitude about seven days after she has left the perigee, by adding the equation of the centre to the mean anomaly, the resulting longitude will be found to be above 80′ *less* than that which is given by observation. But if the line of the apsides lies in quadratures, the place of the moon at about the same distance, that is, 90° from the perigee, computed in the same manner, will be found to be before the observed place by above 80′; that is, the computed will be *greater* than the observed longitude, by more than 80 minutes. After a long series of observations, astronomers have found that the inequality in question is represented with great exactness, by supposing it proportional to the sine of twice the mean angular distance of the moon from the sun, minus the mean anomaly of the moon. In Baily's tables, its maximum value is stated to be 1° 20′ 29″·9; whence, representing the angular distance of the sun and moon by ☽ — ☉, and the mean anomaly as before by A, the correction due to the evection will be

(1° 20′ 29″·9) sin. [2(☽ — ☉) — A].

Variation.

A third inequality of the lunar motion, called the *Variation*, was discovered by Tycho Brahe, who found that the moon's place, calculated from her mean motion, the equation of the centre, and the evection, does not always agree with the true place, and that the variations are greatest in the octants, or when the line of the apsides makes an angle of 45° with that of the syzygies and quadratures. Having observed the moon at different points of her orbit, he found that this correction has no dependence on the position of the apsides, but only on the moon's elongation from the sun. Its maximum value is additive in the octants which come immediately *after* the syzygies, where the elongation is 45°, or 180° + 45°, and subtractive in the octants which *precede* the syzygies, where the elongation is 360° — 45°, and 180° — 45°. It vanishes altogether in the syzygies and quadratures where the elongation is 0°, 180°, 90°, or 270°; and on this account it was not perceived by the ancient astronomers, who only observed the moon in those positions. It will be readily perceived, from the limits between which it varies, that it is proportional to the sine of twice the angular distance between the sun and moon. Its maximum value, or the co-efficient of its argument, is 35′ 41″·9; hence the correction necessary on account of it is represented by the formula

(35′ 41″·9) sin. 2 (☽ — ☉).

Annual equation.

When this equation is added to the two preceding ones, the differences between the computed and observed places of the moon are brought within narrower limits; but they do not yet disappear altogether except in the months of June and December, and about the time of the equinoxes they are found to amount to eleven or twelve minutes. This inequality was observed by Tycho and Kepler, though neither of them determined its magnitude. They supposed it to be an equation of time peculiar to the moon; and under this form Horrox inserted it in his tables, assigning its maximum value at 11′ 16″, which differs only by four seconds from that which is obtained from the most accurate modern observations. On account that it is regulated by the seasons, and depends not on the lunar orbit, but the anomaly of the sun, Kepler gave it the name of the *Annual Equation*. By reason of this inequality the motion of the moon is slower than the mean motion during the winter months, when the motion of the sun is most rapid; and, on the contrary, is most rapid in summer, when the sun's motion is slowest. Hence its argument is the same as that of the equation of the centre of the sun, but with a contrary sign. It is therefore proportional to the sine of the sun's mean anomaly; its period is the anomalistic year, and its maximum value is found by observation to be 11′ 11″·9; hence it is expressed by the formula

(11′ 11″·9) sin. ☉'s mean anomaly.

If we now collect these equations we shall obtain the following corrected expression of the moon's true place:

☽'s true longitude = ☽'s mean longitude,

+ (6° 17′ 12″·7) sin. A
+ (1° 20′ 29″·9) sin. [2(☽ — ☉) — A]
— (35′ 41″·9) sin. 2 (☽ — ☉)
— (11′ 11″·9) sin. ☉'s mean anomaly.

For the physical cause of the three last-mentioned inequalities, viz. the evection, the variation, and the annual equation, see *Physical Astronomy*, sect. ii. par. 37, 38, and 39. They are the principal but not the only periodic inequalities which affect the longitude of the moon; for the profound investigations of modern science have detected many others, which, by reason of their small values, and the manner in which they are blended with one another, would have eluded all attempts to discover their period or their law by observation alone. Observation can make known only the joint effect of the independent equations, and thereby indicate their existence. In order to separate them and determine their respective values, it is indispensable to have recourse to the physical theory, from which alone the various circumstances of the lunar motion can be properly determined. Newton was the first who attempted to compute *a priori* the inequalities of the moon's motion, and thereby led the way in a research which was prosecuted with infinite ingenuity and profound analytical skill by D'Alembert, Clairaut, Euler, and other illustrious mathematicians of the last century, and which was only brought to a successful termination by the labours of Laplace. The formulæ given in the seventh

book of the *Mécanique Céleste*, for a great number of new inequalities derived from the theory of attraction, form the basis of the lunar tables of Burg and Burckhardt. It is to these theoretical researches that we are indebted for the precision with which the moon's motion is actually known, and the great advantages which thence result to geography and navigation. The recent tables contain no fewer than twenty-eight equations of longitude, all which may be regarded as corrections of the mean values of the four which we have explained, and which are themselves corrections of the mean motion. It is thus that astronomy approaches nearer and nearer, by every successive step, to the last term of a series which would represent the orbits and motions of the celestial bodies with absolute accuracy.

Acceleration of the mean motion of the moon.

The lunar inequalities which we have as yet considered are all of a periodic nature, are compensated in the course of a comparatively small number of years, and have passed through many complete revolutions since the commencement of the history of astronomical observations. But there are, as in the case of the sun, others of a different kind, the periods of which are so long that, with reference to the duration of human life, they may be considered as permanently affecting the elements of the lunar orbit. These are the *Secular Inequalities*, the most remarkable of which is the acceleration of the moon's mean motion.

On comparing the lunar observations made within the last two centuries with one another, there results a mean secular motion greater than that which is given by comparing them with those made by Ebn-Jounis, near Cairo, towards the end of the 10th century, and greater still than that which is given by comparing them with observations of eclipses made at Babylon in the years 719, 720, and 721 before our era, and preserved by Ptolemy in the *Almagest*. These comparisons, which have been made by different astronomers with the utmost care, prove incontestably the acceleration of the motion of the moon from the Chaldeans to the Arabians, and from the Arabians to the present times.

The acceleration of the moon's mean motion was first remarked by Dr Halley, and mentioned in his *Notes* on the observations of Albategnius, inserted in the *Philosophical Transactions* for 1693. It was fully confirmed by Dunthorne, who was led by the discussion of a great number of ancient observations of eclipses, to suppose that it proceeded uniformly at the rate of 10″ in a hundred years; a supposition which consequently gave him a correction for the mean longitude of the moon proportional to the square of the time, or of 10″ multiplied by the square of the number of years elapsed between 1700 and the epoch of the calculation. This was the first attempt to estimate the value of the secular equation, which had hitherto been confounded with the mean secular motion. By a similar discussion of ancient observations, Mayer was likewise led to a secular equation proportional to the square of the time, which, in his first *Lunar Tables*, published in 1753, he valued at 7″ for the first century, counting from the year 1700, but which he advanced to 9″ in his last tables, published in 1770. Lalande found it to amount to 9″·886, and therefore agreed with Dunthorne in estimating the acceleration at 10″ for the first century after 1700. Delambre subsequently undertook to determine accurately the actual motion of the moon in a century, from a comparison of the best modern observations. He found it to amount to 307° 53′ 9″ (rejecting the circumferences), while the most ancient observations agree in making it less by 3 or 4 minutes. The equation, which, in consequence of these comparisons, was empirically introduced into the tables, has been confirmed by the theory of gravitation; and the discovery of the physical cause, and of the law of the acceleration, due to Laplace, forms one of the most brilliant triumphs of modern science. In 1786 Laplace demonstrated that the acceleration is one of the effects of the attraction of the sun, and connected with the variations of the eccentricity of the earth's orbit in such a manner that the moon will continue to be accelerated while the eccentricity diminishes, but that it will disappear when the eccentricity has reached its maximum value; and when that element begins to increase, the mean motion of the moon will be retarded.

In order to take into account the effects of the acceleration in the determination of the mean longitude, M. Damoiseau has given the following formula for the secular variation; $10''{\cdot}7232\,n^2 + 0''{\cdot}019361\,n^3$, where n is the number of centuries from 1801; so that if L is the mean longitude of the moon on the 1st of January 1801, and m is the secular motion at that epoch, the mean longitude will be $L + mn + 10''{\cdot}7232\,n^2 + 0''{\cdot}019361\,n^3$ after n centuries. By means of this equation the tables satisfy the most ancient observations, and may be extended to at least a thousand years from the present epoch. It is only necessary to observe, that, in applying the formula, n must be taken negatively, if the epoch is anterior to 1801.

Secular inequalities of the perigee and nodes.

The same cause which gives rise to the acceleration of the mean motion, namely, the diminution of the eccentricity of the earth's orbit, also occasions secular inequalities in the motion of the perigee and nodes of the orbit of the moon. These two inequalities are, however, affected with opposite signs to that of the former; that is, while the mean motion of the moon is accelerated, the motion of her perigee and that of her nodes are retarded. They were deduced by Laplace from theory, and the equations by which they are expressed are connected with one another by a very simple proportion. If we take A to represent the secular acceleration of the mean motion, the secular variation of the perigee found by Laplace is — 4·00052 A, and that of the nodes — 0·735452 A. From this Laplace concluded that the three motions of the moon, with respect to the sun, to her perigee, and to her nodes, are accelerated, and that their secular equations are in the ratio of the above numbers. By pushing the approximations to a great length, MM. Plana and Carlini, and M. Damoiseau, in *Memoirs* which obtained the prize of the Academy of Sciences for 1820, have found different numbers; those of Damoiseau are 1, 4·702, and 0·612. These important results of theory are all confirmed by observation.

The three secular inequalities which have been pointed out will obviously occasion others; for all quantities depending on the mean motion, the motion of the perigee, or of the nodes, must be in some degree modified by them. Thus the mean anomaly, which is the difference of the mean longitude of the moon and the mean longitude of the perigee, is subject to a secular equation equal to the difference of the secular equations affecting the longitudes of the moon and the perigee. The radius vector, the eccentricity and inclination of the orbit, are affected by the secular inequality of the mean motion, which, although too minute to have been hitherto appreciable, will acquire sensible values in the course of ages. The major axis of the ellipse is the only element exempted from inequalities of this sort. It is not probable, however, that the utmost efforts of science will ever make us acquainted with all the irregularities to which the moon's motion is subject. They can only be developed by the complete integration of the differential equations of motion; an integration which is laboriously performed term by term, and which, when attempted to be carried beyond a certain point, transcends

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the limits of human patience and industry. What is most essential is to select, among the multitude of terms, such as may possibly acquire considerable co-efficients by integration.

The following table (extracted from Baily) exhibits in one view the different elements of the lunar orbit. The epoch is the commencement of the present century.

Mean inclination to the plane of the ecliptic	5°	8′	47″·9
Longitude of ascending node	11	53	17 ·7
Motion of node in 365 mean solar days	19	19	42 ·316
Longitude of perigee	266	10	7 ·5
Mean motion of perigee in 365 mean solar days	40	39	45 ·36
Mean [illegible]	118	17	8 ·3
Greatest equation of the centre	6	17	12 ·7
Eccentricity	0·0548442		
Mean distance from the earth in diameters of the terrestrial equator	29·982175		

SECT. III.—*Of the different Species of Lunar Months.*

In treating of the sun, we took notice of three different species of revolutions or years, namely, the mean solar year, or the interval of time which the sun employs in performing a complete revolution with regard to the equinoxes; the sidereal year, or the time in which he returns to the same fixed star; and the anomalistic year, or the time in which he returns to the same point of his ellipse. In like manner, if we understand by the term *month* the time which the moon employs to make an entire revolution relatively to any given point, moveable or fixed, we shall have as many different species of months as there are different motions with which that of the moon can be compared. For example, if we estimate her revolution relatively to the sun, the month will be the time which elapses between two consecutive conjunctions or oppositions. This is called the *synodic month*, *lunar month*, or *lunation*. If we consider her revolution as completed when she has gone through 360° of longitude counted from the moveable equinox, we shall have the *tropical* or *periodic month*. The interval between two successive conjunctions with the same fixed star is the *sidereal month*. A revolution with regard to the apsides of her orbit, that is to say, the time in which she returns to her perigee or apogee, gives the *anomalistic month*: and, finally, the revolution with regard to the nodes is the *nodical* or *draconitic month*.

Of these different periods the most important to mankind is the synodic month. It is also that which, by reason of the striking manner in which it is marked out by the phases of the moon, would first offer itself to the attention of the observer; and when its period is accurately determined, the other months may be deduced from it without difficulty, when the relative motions of the sun and moon are known with sufficient precision. The eclipses furnish a simple means of determining the synodic revolution with a great degree of accuracy. A few rude observations suffice to show that the period of a lunation is very nearly 29½ days; and with this knowledge we are in a condition to compare two distant eclipses without running any risk of mistaking the number of revolutions that have taken place in the interval. One of the oldest observations recorded by Ptolemy is an eclipse of the moon, which happened 720 years B. C., on the 19th of March, at 6 hours 48 minutes mean time at Paris, according to Lalande. In order to make use of this observation directly for the purpose of determining the synodic revolution, it is necessary to compare it with another of the same kind in which the moon occupied the same point of her ellipse, or the same position relatively to her apsides; for as it is the *true* place of the moon which is observed, and the *mean* motion which we are in quest of, the equation of the centre ought to be the same in both observations. Now, a similar observation is furnished by an eclipse which happened in 1717, on the 9th of September, at 6 hours 2 minutes, the moon's anomaly being very nearly the same as in the Babylonian observation. In the interval between the two observations the moon had therefore completed a whole number of revolutions, with regard to her mean as well as her true motion. The interval between the eclipses is 2437 years and 174 days minus 46 minutes, which expressed in days is 890287·9680555 days. In this interval it is found, from the approximate value of 29½ days, that 30148 synodic revolutions had happened; hence the mean length of the synodic month is $= \frac{890287{\cdot}968055}{30148} = 29$ days 12 hours 44 min. 2·8497 sec.

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To deduce the other revolutions, let N = the number of days in a synodic month, n the number of synodic revolutions in the interval between the two observations, m the mean motion of the sun, and T the time of a tropical revolution. We shall then have the proportion $T : N :: 360° : n \times 360° + m$; whence

$$T = \frac{N \times 360°}{n \times 360° + m} = \frac{N}{n + \frac{m}{360°}} = \frac{\left(\frac{N}{n}\right)}{1 + \frac{m}{n \times 360°}}$$

$$= \frac{N}{n}\left\{1 - \frac{m}{n \times 360°} + \left(\frac{m}{n \times 360°}\right)^2 - \&c.\right\}.$$

Let S = the time of a sidereal revolution. The value of S is immediately found from T; for let p = the precession of the equinoxes in the time T, we shall have $S : T :: 360° : 360° - p$; whence

$$S = \frac{T \times 360°}{360° - p} = \frac{T}{1 - \frac{p}{360°}}.$$

$$= T\left\{1 + \frac{p}{360°} + \left(\frac{p}{360°}\right)^2 + \&c.\right\}.$$

In like manner, if we represent by u the motion of the apside, and by v that of the node, in the time T, the times of the anomalistic and nodical revolutions will be respectively obtained by the substitution of u and $-v$ (the motion of the node being retrograde) in the last formula in place of p. Instead, however, of proceeding in this manner, it is better to assume as the basis of the calculation the mean motion of the moon in longitude, which is accurately known by the observations of 2000 years, and thence to deduce the time of the mean tropical revolution.

The mean motion of the moon in 100 Julian years, or 36525 days, is found to be 1336 circumferences + 307° 52′ 43″·5; or, by reducing the degrees, &c. to the fraction of a circumference, 1336·85521875 circumferences. The periodic month is therefore $\frac{35625}{1336{\cdot}85521875}$ days. In order to reduce the denominator of this fraction to a smaller number of digits, we may divide its terms by 3, multiply them by 32, then divide them by 900, and there will result $\frac{432{\cdot}888\ldots}{15{\cdot}84421}$, the denominator of which contains only 7 digits in place of 12. On performing the division, we shall find the periodic month or tropical revolution = 27·321582388 days = 27 days 7 hours 43 min. 4·7183 sec.

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The mean motion of the moon in 36525 days is.....1336° 307° 52′ 43″·5
that of the sun.....100 0 45 45

hence the relative motion is.....1236° 307° 6′ 58″·5 = 445267·11625 degrees. The time of a synodic revolution is therefore $\frac{360 \times 36525}{445267{\cdot}11625}$ days; or, multiplying numerator and denominator by 800, $= \frac{10519200000}{356213693}$; whence the synodic month is 29·5305885391 days = 29 days 12 hours 44 min. 2·849778 sec.

In order to obtain the sidereal revolution, we subtract the secular motion of the equinoctial points = 5010″ = 1° 23′ 30″ from the moon's tropical revolution; the remainder, which gives the sidereal motion of the moon in 36525 days, is 1336° 306° 29′ 13″·5 = 481266·4870833 degrees. Hence the time of a sidereal revolution is $\frac{360 \times 36525}{481266{\cdot}4870833}$ days. On multiplying the terms of this fraction by 2400, it is reduced to $\frac{31557600000}{1155039569}$, which gives the sidereal month = 27 days 7 hours 43 min. 11·544375 sec.

In like manner, by subtracting the motion of the perigee in 100 years from the secular motion of the moon, we shall find the anomalistic revolution to be 27 days 13 hours 18 min. 34·9488 sec.; and by adding the retrograde secular motion of the node to the secular motion of the moon, the revolution in respect of the nodes is found to be performed in 27 days 5 hours 5 min. 35·60769 sec.

The following table exhibits the different kinds of lunar periods and motions:—

	Days.	Ho.	Min.	Sec.	Days.
Synodic revolution	29	12	44	2·84 =	29·5305887
Tropical	27	7	43	4·71 =	27·3215824
Sidereal	27	7	43	11·54 =	27·3216614
Anomalistic	27	13	18	37·40 =	27·5545995
Nodical	27	5	5	35·60 =	27·2122176
Tropical revolution of node	6798	4	17	43·18 =	6798·1789720
Sidereal	6793	6	59	15·34 =	6793·2911498

☾'s mean tropical daily motion.....13° 10′ 35″·027
☾'s mean sidereal daily motion.....13° 10′ 34″·889
☾'s daily motion in respect of node.....13° 13′ 45″·534

According to Ptolemy, the synodic month is 29 days 12 hours 44 min. 3⅓ sec., which differs from the above only by half a second. The same great astronomer made the tropical month to consist of 27 days 7 hours 43 min. 7¼ sec., which exceeds the true time by 2½ seconds; an error into which he was led by assigning too great a value to the mean motion of the sun.

The ancient astronomers paid great attention to these different revolutions, for the purpose of regulating their lunisolar calendar, and of avoiding the calculation of eclipses, which is attended with difficulties that to them must have proved almost insuperable. Their object was therefore to assign composite periods, after the revolution of which the eclipses would again return in the same order. Now, it is easy to see that a period which will bring back eclipses of the same magnitude and duration, on the same day of the year and at the same longitude, must be an exact multiple of the different lunar months. The return of the moon to the same distance from her node will give an eclipse of the same magnitude; if she returns at the same time to the same point of her orbit, the eclipse will also be of the same duration; and if, in addition to these circumstances, she has also returned to the same longitude, the eclipse will take place on the same day of the year. But the numbers in the above table being incommensurable, it is impossible to find any period, however long, that will embrace all these conditions; the ancients therefore formed periods of different lengths, according as they aimed at satisfying the different conditions with a greater or less degree of precision. For an account of some of the most remarkable of the ancient lunisolar periods, see CALENDAR.

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On account of the acceleration of the mean motion of the moon, the ratios of the different species of months are constantly undergoing alterations, and therefore the different cycles, supposing them exact at the time of their formation, cannot continue so for an indefinite length of time. This circumstance is, however, little to be regretted; for, in the present state of astronomical science, they are not of any great use, inasmuch as we are in possession of surer methods of predicting eclipses, the calculation of which, from the ephemerides, is now a matter of comparative facility. They are, however, interesting in an historical point of view, and their formation was a principal object of the labours of the early astronomers. (On this subject, see Lalande, *Astronomie*, tome ii. p. 185; Delambre, *Astronomie Théorique et Pratique*, tome ii. p. 319; Schubert, *Traité d'Astronomie Théorique*, tome ii.; Woodhouse's *Astronomy*, p. 665.)

SECT. IV.—*Of the Rotation and Libration of the Moon.*

On account of the proximity of the moon to the earth, the surface of that body is far better known to us than that of any other of the solar system, and in proportion to the increase of optical power which is brought to bear upon it, delineations of the mountains and volcanic craters that occupy the greater portion of it become more minute and accurate. As seen through a good telescope, the dark patches visible with the naked eye assume the appearance of mountainous inequalities, prodigiously increased in number, and with every possible variety of outline. These present no changes of form like those of the sun, but permanently exhibit the same uniform appearances, and retain their relative situations with regard to each other, and also, with some slight variations, to the apparent centre of the moon. The moon, therefore, at all times presents very nearly the same face to the earth. But if this were rigorously the case, it would follow that the moon revolves about an axis, perpendicular to the plane of her orbit, in the same time in which she completes a sidereal revolution about the earth, and that the angular velocities of the two motions are exactly equal. It is, however, proved by observation, that there are some variations in the apparent position of the spots on the lunar disk. Those which are situated very near the border of the disk alternately disappear and become visible, making stated periodical oscillations. But as they suffer no sensible changes in their relative positions, and always re-appear under the same form and magnitude when they return to the same position, it is inferred that they are permanently fixed to the surface of the moon; and their oscillations consequently seem to indicate a sort of vibratory motion of the lunar globe, which is known by the appellation of its *libration*. This motion has, however, no real existence. The phenomenon is the complicated result of several optical illusions, and does not depend in any degree on the rotation of the moon, which, relatively to us, is perfectly equable; or at least, if it be subject to irregularities, they are too minute to be appreciated.

In order to form a precise idea of the phenomenon of the libration, we must consider that the disk of the moon, seen from the centre of the earth, is terminated by the circumference of a great circle of the moon, the plane of which is perpendicular to a line drawn from the earth's centre to that of the moon. The lunar hemisphere is projected on the plane of this circle turned towards the earth; and if the moon did not revolve round her axis, the projection would incessantly present different appearances to us, inas-

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much as the radius vector drawn from the centre of the earth by which the plane of projection is determined, would intersect the surface of the moon in a different point, at every new position in her orbit. But in consequence of her rotation, the radius vector is always directed to nearly the same point of the lunar surface, and would be always directed exactly to the same point if the angular velocity of rotation corresponded exactly with the angular velocity in the orbit. But the rotation of the moon is sensibly uniform; while the motion of revolution, being affected by the periodic inequalities, is sometimes slower and sometimes more rapid. The apparent rotation occasioned by the revolution of the moon round the earth is consequently in such cases not exactly counterbalanced by the real rotation, which remains constantly the same. Hence the different points of the lunar globe must appear to turn about her centre, sometimes in one direction, and sometimes in the contrary, and the same appearances be produced as would result from a small oscillation of the moon, in the plane of her orbit, about the radius vector drawn from her centre to the earth. The spots near the eastern or western edge of her disk disappear according as her motion in her orbit is more or less rapid than her mean motion. This is called the *Libration in Longitude.*

Further; the axis of rotation of the moon is not exactly perpendicular to the plane of her orbit. If we suppose the position of this axis fixed, during a revolution of the moon it inclines more or less to the radius vector, so that the angle formed by these two lines is acute during one part of her revolution, and obtuse during another part of it; hence the two poles of rotation and those parts of her surface which are near these poles are alternately visible from the earth. This is the *Libration in Latitude.*

Besides all this, the observer is not placed at the centre of the earth, but at its surface. It is the radius drawn from his eye to the centre of the moon which determines the middle point of her visible hemisphere. But, in consequence of the lunar parallax, it is obvious that this radius must cut the surface of the moon in points sensibly different according to the height of that luminary above the horizon. An observer at the surface of the earth perceives points on the upper part of the moon's disk, at the time of her rising, which could not be seen from the centre. In proportion as the moon acquires a greater elevation, these points approach the border of the disk, and finally disappear, while new ones become visible on the eastern part of the disk, which increase in number as the moon descends towards the horizon; so that in the course of a day she appears to oscillate about her radius vector in the direction of the earth's rotation. This phenomenon constitutes what is called the *Diurnal Libration,* and is evidently the effect of the lunar parallax.

The libration in latitude and the diurnal libration were discovered by Galileo soon after the invention of the telescope. It was Hevelius who discovered the libration in longitude, and explained it by the hypothesis of the equable rotatory motion of the moon combined with her unequal velocity in her orbit.

To the inhabitants of the moon, if such there be, the earth will appear as a species of moon, much larger than the moon appears to us, but visible only to that hemisphere which is turned towards the earth. At those places which are situated near the border of her visible disk, the earth will sometimes rise a few degrees above the horizon; and an inhabitant of the moon placed near the middle of the hemisphere presented to the earth will always see the earth near his zenith, making oscillations of only a few degrees in consequence of the libration. But an inhabitant of the other hemisphere will never see the earth at all; so that while one hemisphere of the moon is constantly enlightened, during her long night, by the light reflected from the earth, the other remains in constant darkness. In regard, therefore, to the distribution of light, one of the lunar hemispheres enjoys very great advantages over the other.

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The elements of the rotation of the moon, that is to say, the position of her equator, the place of its nodes, and its inclination to the plane of the ecliptic, are found by the same methods which have been explained for determining the corresponding elements relatively to the sun. The geocentric positions of the spots are observed in the same manner; and in converting them into selenocentric latitudes and longitudes, the same formulæ may be employed, with a slight modification rendered necessary by the inclination of the lunar orbit to the ecliptic. One circumstance, not less remarkable than the coincidence which obtains between the times of rotation and sidereal revolution, is, that the nodes of the lunar equator coincide with those of the moon's orbit, if not exactly, at least so nearly, that the differences are so small as to fall within the probable errors of observation and calculation. All the observations since the time of Hevelius agree in showing that the longitude of the descending node of the equator is very nearly equal to the mean longitude of the ascending node of the orbit; whence it follows that the nodes of the equator have a retrograde motion equal to that of the nodes of the orbit. With regard to the inclination of the lunar equator to the ecliptic, Mayer states it to be 1° 29′, and Lalande 1° 43′. According to the latest computations made from the observations of Bouvard, the mean inclination of the lunar equator to the ecliptic is 1° 28′ 42″. Mr Baily makes it 1° 30′ 10″·8. Since the descending node of the equator coincides with the ascending node of the orbit, it is evident that its plane must be situated between the planes of the ecliptic and orbit, making an angle of about 1° 30′ with the first, and of 3° 39′ with the second.

Suppose three planes to pass through the centre of the moon, one of which represents her equator, the second the mean plane of her orbit, and the third parallel to the ecliptic. It is evident, from what precedes, that these three planes have a common section; that the first falls between the other two, making with them respectively the angles 3° 39′ and 1° 30′. In the space of 6793 days, the time of a revolution of the nodes of the lunar orbit, the poles of the first two planes describe about the pole of the ecliptic, in a direction contrary to the order of the signs, two small circles parallel to the ecliptic, and of which the semidiameters are respectively the arcs 1° 30′ and 5° 9′. Hence the difference between the longitudes of these two poles is constantly 180°, and the three poles are situated on the same great circle, that of the ecliptic being between the two others.

These results, which rank among the most curious discoveries of modern astronomy, were first obtained by Dominic Cassini: they were shown by Lagrange to be necessary consequences of the attraction which the earth exercises on the lunar spheroid.

The positions of the spots on the moon's surface are determined by their distance from the lunar equator, and from a conventional meridian, that is, by their selenocentric latitudes and longitudes, after the manner in which the position of places is determined on the surface of the earth. The first meridian is assumed to be that which passes through the pole of the visible hemisphere when the true place of the moon in her orbit is equal to her mean place; hence the first meridian is always very near the middle of the face which the moon turns towards the earth, never deviating from it farther than by a quantity

equal to the equation of the moon, or her libration in longitude. The rotatory motion being equal to that of revolution, the selenocentric longitude of the first meridian, at any epoch, is found by adding 180° to the mean longitude of the moon; and this gives also the distance of the first meridian from the ascending node of the lunar equator. The position of the equator and first meridian being determined, the co-ordinates of a spot are computed without difficulty; and in this manner catalogues of the spots have been formed, and arranged according to their latitudes and longitudes.

Sect. V.—*Of the Nature and Constitution of the Lunar Substance.*

It has already been observed, that a slight attention to the different phases of the moon is sufficient to prove that she is an opaque spherical body, shining only by virtue of the light which she receives from the sun. The line bounding the visible part of her surface has exactly the form which would be produced by an illuminated hemisphere brought into different positions with respect to the eye; and the circular contour of the obscured portion of the sun during a solar eclipse could only be caused by the interposition of a spherical body. Besides, the parts of her hemisphere turned towards the earth, which the sun's rays do not reach, are in some circumstances sufficiently discernible, and she has then the same circular appearance which she exhibits when at the full.

But if the light which comes to us from the moon is only that which she receives from the sun and reflects back to the earth, how does it happen, it may be asked, that the portion of her disk not directly exposed to the solar rays is distinctly visible for some days after the new moon? This phenomenon was ascribed by the ancients to the native light of the moon, to which, on account of its pale ashy hue, they gave the name of *lumen incinerosum*. The explanation which is now generally given was first suggested by a celebrated painter, Leonard da Vinci. It consists in supposing that a portion of the light which is reflected from the illuminated hemisphere of the earth to the moon undergoes a second reflection at the lunar surface, and is transmitted back to the earth. The ancients were confirmed in their opinion respecting the native light of the moon, by observing that she is not altogether invisible in her eclipses. Plutarch, indeed, ingeniously ascribes her appearance under these circumstances to the light of the stars reflected from the moon; a cause, however, totally inadequate to produce the effect. This phenomenon is now generally ascribed to the scattered beams of the sun bent into the earth's shadow by the refraction of its atmosphere.

The opinion that the moon's light is chiefly, if not wholly, caused by the reflection of the sun's rays at the lunar surface, has prevailed in all ages; and indeed no other explanation seems to have been thought of till it was suggested by Licetus, professor of philosophy at Bologna, as being more probable that the moon possesses a phosphorescent quality, and that the sun's influence is only wanted to occasion the propulsion of the light which lies absorbed in her substance. This idea has been adopted by Professor Leslie, whose arguments in its support are at least extremely plausible and ingenious. So far as the appearances, and the explanation of the phases, are concerned, it is evidently matter of indifference whether we suppose that the solar rays are reflected from the surface of the moon, or that they exert an action in virtue of which the moon emits rays of her own. In either case it is that part of her surface only which is exposed to the impact of the solar rays that sends forth light to the earth.

The principal argument in favour of the phosphorescent nature of the moon is founded on the quantity of light which proceeds from her surface. It is evident that the moon does not act as a polished speculum, and reflect the whole of the incident rays; for in that case, as is known from the laws of *Catoptrics*, she would merely reflect an image of the sun, equally bright, varying in size according to her different positions relatively to the sun and the earth, and increasing till she arrives at her opposition, when her diameter would appear equal to about the 458th part of its real dimensions. Her phases could never be distinguished, and she would only appear to approach to or recede from the earth, in proportion as her diameter increased or diminished. It follows, therefore, that the moon's surface must be irregular, or what is termed a *mat surface*, that is, of such a nature, that from every point of it the rays of light are reflected in all directions indifferently. According to the experiments of Bouguer, a white surface of this sort, for instance paper, or plaster of Paris, reflects only about the 150th part of the rays which fall upon it in a perpendicular direction; and the proportion is less as the angle of incidence becomes more oblique. Making allowance for the irregular surface and obscure spots of the moon, Mr Leslie computes that the solar light which she remits to the earth must be attenuated at least 105 million times; but Bouguer's experiments show that the moon's light is between the 250,000th and 300,000th part of the direct light of the sun, or about 350 times greater than the computed amount of reflected light. If every part of the moon's surface reflected the light in the most perfect manner, it may be shown that only the 210,000th part of the rays which she receives from the sun would be thrown off in the direction of the earth; a quantity not much exceeding that which, according to Bouguer's estimate, we actually receive from her. Mr Leslie states that he found the intensity of the moon's light to approach the 150,000th part of the direct light of the sun; a result which, if admitted, must be entirely decisive of the question; for as the utmost possible quantity of reflected light cannot exceed the 210,000th part, it follows that the excess must be owing to the spontaneous light of the moon. Hence this ingenious philosopher concludes that the body of the moon is a phosphorescent substance, like the *Bolognian Stone*, which possesses the property of shining for some time when carried into a dark room, after having been exposed to the light of the sun. A fact first observed by the celebrated Arago seems to increase the probability of this opinion. All rays reflected from a surface not metallic acquire a peculiar modification, or become *polarized*; but as the rays of the moon are not so modified, it is inferred that they have not undergone a reflection at her surface.

The secondary light of the moon, of which we have already made mention, affords arguments in favour of her native light precisely similar to the above. If the earth reflected, like a mirror, the whole of the incident rays, the illumination produced by the reflection would amount to about a 16,000th part of that which is caused by the sun; but as the sea reflects only about a 55th part of those rays, and the land a still smaller proportion, we may suppose that the reflected light of the earth does not exceed a millionth part of the direct light of the sun. It is extremely doubtful whether a light so greatly attenuated would suffice to render the moon visible. The lucid bow, or silvery thread of light, which, proceeding from the extremities of the lunar crescent, seems to embrace her unenlightened orb, is easily explicable on this hypothesis;

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whereas it can hardly be satisfactorily accounted for by ascribing it to the secondary illumination from the earth. "I should rather refer it," says Mr Leslie, "to the spontaneous light which the moon may continue to emit for some time after the phosphorescent substance has been excited by the action of the solar beams. The lunar disk is visible although completely covered by the shadow of the earth: nor can this fact be explained by the inflection of the sun's rays in passing through our atmosphere; for why does the rim appear so brilliant? Any such inflection could only produce a diffuse light, obscurely tinging the boundaries of the lunar orb; and, in this case, the earth, presenting its dark side to the moon, would have no power to heighten the effect by reflection. But even when this reflection is greatest about the time of conjunction, its influence seems extremely feeble. The lucid bounding arc is occasioned by the narrow *lunula*, which, having recently felt the solar impression, still continues to shine; and from its extreme obliquity, glows with concentrated effect." (*Inquiry into the Nature and Propagation of Heat.*)

Fig. 48. Although these arguments go far to support the ancient opinion of the native light of the moon, they are not entirely conclusive; and indeed cannot be easily reconciled with some of the phenomena. If the moon shines in virtue of her native light, rays will be emitted in all directions from every point of her surface; whence, since a visual angle of a given magnitude includes a much larger portion of a spherical surface near the extremities of its apparent disk than towards the centre, and as the number of rays is proportional to the surface from which they proceed, it follows that the intensity of the moon's light ought to be greater near the border than at the centre of her disk. The reason why this is not the case with regard to the sun is, that a greater proportion of the rays are absorbed in passing through a greater extent of the solar atmosphere; but the moon, having no atmosphere, ought to be sensibly most brilliant near the circumference of her orb. The contrary is, however, the case; her light is greatest at the centre, and less intense towards the circumference, exactly as it ought to be on the supposition of its being occasioned by the reflection of the solar rays. With regard to the ingenious argument of Arago, it cannot be held to be conclusive till we become more certainly acquainted with the nature of the lunar substance. The only property which we can safely ascribe to it as yet is *density*: whether in its physical properties it resembles the substances with which we are acquainted, is a question hardly within the bounds of legitimate investigation.

The spots of the moon, affording grounds for conjectures relative to her physical constitution and the nature of her surface, have been observed with great interest since the discovery of the telescope; and as they are of some service in the observation of eclipses, astronomers have been at much pains to determine their selenographic positions. On account of their number, it has been found necessary to distinguish them by particular names. Riccioli designated the most conspicuous of them by the names of astronomers, and other eminent men. Hevelius gave them the names belonging to countries, islands, seas, and regions on the earth, without reference to situation or figure. The nomenclature of Riccioli has, however, been deservedly preferred by Schroeter and others who have particularly observed the phenomena of the lunar surface, and is now universally followed. Mayer gave a catalogue of 89 of the most remarkable of the spots, with their selenographic latitudes and longitudes referred to a first meridian, namely, that which passes through the centre of the moon's apparent disk, perpendicular to the lunar equator, accompanied by an accurate map of her surface. Delineations of the lunar disk have also been given by Hevelius in his *Selenographia*; by Cassini, Russel, Schroeter, Lohrmann, and others. The engraving (fig. 47) which accompanies this article gives a pretty accurate view of the appearance of the moon in her mean libration.

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Plate LXXX. Fig. 47.

The following table contains the selenographic positions of some of the principal spots. The sign + indicates a northern, and — a southern latitude.

No.	Riccioli's Names.	Long.	Lat.
1	Zoroaster	West 72°	+ 58°
2	Mercurius	67	+ 40
3	Petavius	64	— 24
4	Langrenus	62	— 8
5	Endymion	60	+ 53
6	Cleomedes	55	+ 26
7	Atlas	48	+ 47
8	Hercules	42	+ 48
9	Censorinus	32	0
10	Fracastorius	32	— 22
11	Possidonius	32	+ 31
12	Theophilus	27	— 12
13	Cyrillus	25	— 13
14	St Catharina	24	— 18
15	Menelaus	15	+ 16
16	Aristoteles	West 15	+ 50
17	Ptolomæus	East 2	— 10
18	Arzachel	3	— 20
19	Archimedes	5	+ 28
20	Tycho	10	— 43
21	Plato	10	+ 52
22	Pitatus	12	— 29
23	Eratosthenes	12	+ 14
24	Clavius	16	— 60
25	Copernicus	19	+ 9
26	Bullialdus	21	— 21
27	Blancanus	25	— 65
28	Heraclides	38	+ 41
29	Keplerus	38	+ 7
30	Gassendus	39	— 19
31	Aristarchus	48	+ 24
32	Hevelius	67	— 1
33	Schickardus	68	— 49
34	Grimaldus	East 68	— 5

Great inequalities on the surface of the moon.

That there are prodigious inequalities on the surface of the moon, is proved by looking at her through a telescope at any other time than when she is full; for then there is no regular line bounding the dark and illuminated parts, but the confines of these parts appear as it were toothed and cut with innumerable notches and breaks; and even in the dark part, near the borders of the enlightened surface, there are seen some small spaces enlightened by the sun's beams. Upon the fourth day after new moon there may be perceived some shining points, like rocks or small islands, within the dark body of the moon; but not far from the confines of light and darkness there are observed other little spaces which join to the enlightened surface, but run out into the dark side, which by degrees change their figure, till at last they come wholly within the illuminated face, and have no dark parts round them at all. Afterwards many more shining spaces are observed to arise by degrees, and to appear within the dark side of the moon, which, before they drew near to the illumined portion of the disk, were invisible, being totally immersed in the shadow. The contrary is observed in the decreasing phases, where the lucid spaces which

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joined the illuminated surface recede gradually from it, and remain for some time visible after they are quite separated from the confines of light and darkness. Now it is impossible that this should be the case, unless these shining points were higher than the rest of the surface, so that the rays of the sun may illumine their summits before they reach their bases. Portions of considerable extent are also perceived on the lunar surface, which are never brilliant like the other parts, but remain constantly obscure. These are supposed to be deep valleys or cavities: they were formerly supposed to be seas, but, for reasons about to be given, this idea has been abandoned.

These phenomena render it certain that the surface of the moon is covered with mountains of a great height, with rocks or masses of unknown matter, but possessing the property of reflecting the sun's light. The height of the lunar mountains may be determined in the following manner.

Fig. 48.

Let ABO (fig. 48) be the illuminated hemisphere of the moon, SO the tangential solar ray, and consequently O one of the points of the circle which separates the enlightened from the obscure hemisphere. All the part OD will be in darkness; but if this part contain a mountain aM so elevated that its summit M reaches the solar ray SO, the point M will be enlightened. Now, if the line OM can be determined by observation, it will be easy to deduce the arc Oa, and thence the height of the mountain aM, in terms of the moon's radius. Let E be the place of an observer on the earth; draw the lines EM, EO, EC (C being the centre of the lunar orb), and Om perpendicular to EM. The distance of the moon from the earth being known, we have the distance **EO**: the angle OEm is measured by the micrometer; therefore Om, which is the projected distance of OM, is a given quantity. Now $\mathrm{OM} = \frac{\mathrm{O}m}{\cos.\ \mathrm{MO}m}$; and since OE$m$ is a very small angle, EOm may be considered a right angle, consequently $\mathrm{MO}m = \mathrm{MOE} - 90°$; therefore $\mathrm{OM} = \frac{\mathrm{O}m}{\cos.\ (\mathrm{MOE} - 90°)} = \frac{\mathrm{O}m}{\sin.\ \mathrm{MOE}} = \frac{\mathrm{O}m}{\sin.\ \mathrm{EOS}}$. that is, the distance between the summit of the mountain and the illuminated part of the moon's disk is equal to the projected distance measured by the micrometer, divided by the sine of the moon's elongation from the sun. Suppose this distance $\mathrm{OM} = n \times \mathrm{CO}$; we shall then have $\mathrm{CM} = \mathrm{CO}\sqrt{1 + n^2}$, and the height of the mountain $a\mathrm{M} = \mathrm{CO}(\sqrt{1 + n^2} - 1) = \frac{n^2}{2}\ \mathrm{CO}$ (neglecting in the development of the radical the powers of n which are higher than the square). According to the observations of Hevelius, the greatest value of n is $\frac{1}{15}$, which gives the height of the mountain equal to $\frac{1}{338}$ of the semidiameter of the moon. Schroeter, who estimated the heights of the lunar mountains by measuring the projections of their shadows at the time the sun was near their horizon, makes it in some cases $\frac{1}{214}$. The highest mountains on the earth do not reach an elevation greater than $\frac{1}{1000}$ of the terrestrial radius; the lunar mountains, therefore, in proportion to the diameters of the earth and moon, are nearly five times higher than those of our globe. Their absolute height is above five English miles. It is easy to see that these determinations are susceptible of very little accuracy.

Not only is the moon's surface rendered irregular by high and precipitous mountains, but numerous cavities appear in every part of her surface, some of which, according to Schroeter, are upwards of four English miles in depth, and forty in circumference at the orifice. An insulated mountain is frequently observed to rise in the centre of these enormous pits or caverns; and they are surrounded by high annular ridges, the masses of which would exactly fill the inclosed cavities. From this circumstance, it is probable that the elevations and hollows which abound on the surface of the moon have been produced by volcanic eruptions. Herschel imagined that he even observed volcanoes in activity. At the time of the new moon he perceived on different parts of her obscure disk three luminous points, resembling pieces of burning charcoal, covered with a thin coat of white ashes, one of which, by a comparison with the third satellite of Jupiter, appeared to be upwards of three miles in diameter. Their brilliancy continued during several days, undergoing variations altogether independent of the increase of the moon's apparent magnitude, and at the end of that time they appeared to become extinct.

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The existence of a lunar atmosphere has been a fertile subject of controversy among astronomers. It has been urged that, as the brightness of the moon is sensibly equal at all times when she is not obscured by clouds in the terrestrial atmosphere, she cannot be surrounded by an atmosphere similar to that of our earth, so variable in its density, and so liable to be obscured by clouds and vapours. The assumption of an equable brightness in the appearance of the moon has not, however, been allowed to pass uncontroverted. Hevelius relates that he has several times found in skies perfectly clear, when even stars of the sixth and seventh magnitude were visible, that, at the same altitude of the moon, at the same elongation from the earth, and with the same telescope, the moon and her maculæ do not appear equally lucid and clear at all times, but are much brighter and more distinct at some times than at others. Several other observers have noticed that the moon is not always equally conspicuous during total eclipses; a fact which is held to be indicative of accidental variations in the state of the lunar atmosphere.

Lunar atmosphere.

Another objection against the existence of a lunar atmosphere is derived from the circumstance that, if it existed, its influence would be perceptible in the occultations of the planets, or fixed stars, by the moon. When the moon approaches so near to a star that part of her atmosphere (supposing she has one) is interposed between the star and the eye of the observer, the star, it is contended, ought to suffer a change in its colour in consequence of the absorption of some of its light in traversing the denser parts of the moon's atmosphere. But when we consider that the region of the vapours and clouds in the terrestrial atmosphere does not exceed the height of four miles, or the 1980th part of the earth's diameter, and that consequently the obscure part of the lunar atmosphere, supposing it to be similarly constituted, would not subtend an angle of one second (the mean apparent diameter of the moon being 1889 seconds), and that this space is passed over by the moon in less than two seconds of time, it will scarcely be expected that observation will be able to decide whether the supposed obscuration takes place or not. Some observers have, however, remarked instances of stars, when about to be occulted, presenting an evident diminution of light. (See a Paper by Mr Ramage of Aberdeen, in the 2d vol. of the *Memoirs of the Astronomical Society*.)

The existence of a lunar atmosphere cannot increase or diminish the apparent diameter of the moon, because its effect on the rays of light when they enter it will be exactly counteracted at the time of their emergence. It might seem, therefore, that in order to determine whether the light of a star or planet is inflected when it passes very near the

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border of the lunar disk, it would be sufficient to compare the observed duration of the occultations of the stars, or eclipses of the sun, with the time, calculated from the theory of the moon's motion, which she consumes in passing through a space equal to her apparent diameter. But if, as is generally supposed, a certain irradiation is produced around luminous objects, by which their image is dilated, the apparent diameter of the moon will thereby be augmented when she is projected on the dark sky. On the contrary, when the disk of the moon is projected on that of the sun in annular eclipses, the irradiation, by dilating the luminous ring which seems to surround the moon, will cause her apparent diameter to appear smaller than it actually is. On this account it becomes very difficult to ascertain by direct measurement the amount of the inflection of light at the border of the lunar disk, or even to be certain of its existence. An indirect method of arriving at the desired object was, however, imagined by Dionis du Sejour, who regarded the irradiation and inflection as two unknown quantities to be determined simultaneously from the observations of the phases of eclipses, upon which their effects are different. The observations best adapted for this purpose are those of the magnitude of the luminous crescent, and its successive increase in annular eclipses. Du Sejour calculated with great care the annular eclipse of the sun which took place in the year 1764, and was visible over all Europe; and which, by reason of the extent and variety of its phases, presented a great many points of comparison. He particularly employed the observations made in different places of the instants of the formation and rupture of the ring. He likewise confirmed these observations by measurements made by Mr Short, at London, of the distance between the horns of the crescent at divers instants. It resulted, from the comparison of an immense number of observations, that the measurements could not be reconciled without supposing an irradiation of 3″ on the semidiameter of the sun, and an inflection of nearly the same amount round the disk of the moon, produced by her atmosphere. According to this result, the horizontal refraction at the surface of the moon amounts to 1″·5. The mean horizontal refraction observed at the surface of the earth is 0°·585, and consequently about 1400 times greater than that at the moon. Hence, supposing the moon's atmosphere of the same nature as that of the earth, its density must be 1400 times less, and consequently rarer than the most perfect vacuum which can be produced by the best pneumatic machines.

The existence of a lunar atmosphere, though of small extent, is indicated with considerable probability by the observations of Schroeter, who perceived that some ranges of lunar mountains, when in the dark hemisphere, are illuminated more feebly in proportion as they recede from the boundary of light and darkness; an effect which would be produced by the partial absorption of the rays of light which pass near the moon's surface. He also remarked the same circumstance with regard to the cusps, and perceived other indications of an atmosphere in some changes of tint, which induced him to think that a twilight might be discernible towards the cusps. With a view to prove the accuracy of this conjecture, he examined the moon with great care under the most favourable circumstances, and at length descried a faint glimmering which he took to be crepuscular light, extending from the cusps into the dark body of the moon. Its greatest breadth was 2″; and it extended 1′ 20″ from the cusps, along the circumference of the lunar disk. From these data he computed that the height of the lunar atmosphere, to the limit where it ceases to inflect the rays of light or diminish the brightness of a star, does not exceed 5742 English feet. A ring of this breadth, at the distance of the moon, will subtend an angle of only 0″·94; hence the almost imperceptible influence of the lunar atmosphere.

Some observations, related by Mr Ramage of Aberdeen, in a memoir already alluded to, of occultations of Jupiter and his satellites, with an excellent reflecting instrument, also tend to confirm the existence of a small lunar atmosphere. On the approach of the satellites no diminution of their light was perceptible. On coming into contact with the moon's limb they did not disappear instantly, like fixed stars, but formed an indentation or notch in the limb, as if imbedded in it, but at the same time *separated from it by a fine line of light.* The indentation continued visible till about half their diameters were immersed, when it disappeared. (*Memoirs of the Astronomical Society of London*, vol. ii. p. 87.)

The dark spots on the moon's surface were formerly supposed to be water; but as elevations and cavities are distinctly perceptible in them, that hypothesis is evidently erroneous. Besides, the extreme tenuity of her atmosphere is inconsistent with the existence of water at her surface. It is only by the weight of the terrestrial atmosphere that the liquids at the surface of the earth are prevented from being dissipated in vapours. If the present atmosphere were removed, every liquid would continue to be dissipated in this manner till a new atmosphere was formed, to which each would contribute in proportion to its elastic force; and the evaporation would only cease when the tension of the vapour of each liquid was equal to its elastic force in a vacuum at the same temperature. But if the vapours were removed as they arose, by any absorbing cause, the evaporation would continue till the liquids entirely disappeared. Now we may suppose this to have been the case with respect to the moon, and that at one time she may have had an atmosphere, which the attractive force of the earth, aided by some accidental circumstance, may have swept away and united with our own. (Biot, *Astr. Phys.* tome ii. p. 413.)

Under these circumstances it is evident, that no animal, similarly constituted to those which inhabit the earth, could respire at the surface of the moon.[1] Every thing there appears solid, desolate, and unfit for the production and support of organized substances; and the excessive cold which certainly prevails must be sufficient to destroy every source of animal or vegetable life. May it not then be supposed that the moon is a planet which has not yet reached a state of maturity—a maturity to be prepared by successive volcanic eruptions; or that, having fulfilled its destiny, it is now in a state of decay?

On the subject of this section, see Hevelius, *Selenographia;* Schroeter, *Selenotopographische Fragmente;* Hooke's *Micrographia*, 1665; Lemonnier, *Selenographie;* Mayer, *Cosmographische Nachrichten*, 1748; Boscovich, *De Lunæ Atmosphæra*, 1753; Dunn, *Phil. Trans.*, 1762; Herschel, *Phil. Trans.*, 1780 and 1787, p. 229; Ferguson's *Astronomy*, by Brewster; Biot, *Astronomie*, tome ii. p. 413; Schubert, *Traité d'Astronomie Théorique*, tome ii. p. 364.

[1] It has always been a favourite opinion with mankind, that the celestial bodies, resembling the earth in some respects, are also, like it, peopled with rational beings. The author of the verses attributed to Orpheus ascribes to the moon many mountains, and cities, and palaces:

ἡ πολλ' ουρε' εχει, πολλα αστεα, πολλα μελαθρα.

Sect. VI.—*Of Eclipses and Occultations.*

In describing these interesting phenomena, we will first consider the eclipses of the moon, which, for any given place on the earth, are much more frequent than those of the sun, and, by reason of certain circumstances about to be explained, can also be computed with much greater facility.

1.—*Eclipses of the Moon.*

The earth being an opaque, round body, much smaller than the sun, must project behind it in space a conical shadow, limited by straight lines drawn from the extremities of the sun's disk to touch the surface of the earth. When the moon enters this shadow, and a portion of her disk is still enlightened by the sun, the enlightened part will necessarily have the form of a luminous crescent, the concavity of which is turned to the conical shadow of the earth; and this appearance will likewise be exhibited when the moon begins to emerge from the shadow. As she approaches towards the shadow, her light is not suddenly eclipsed, but passes insensibly through all the successive gradations of obscurity, till the darkness attains its greatest intensity. The reason of this will be easily comprehended by considering that when an opaque body is placed between an object and the sun, so as to conceal only a part of his disk, the object is then less enlightened than when none of the solar rays are intercepted; and this in proportion as more or less of the sun is concealed. Between full illumination and total obscurity there are consequently intermediate tints and gradations of light, which are denominated the *Penumbra*, in contradistinction to the *Umbra* which covers those places to which the sun's rays are completely intercepted. Let S and E (fig. 49) be the centres of the sun and earth, and ABB′A′ any plane whatever passing through the axis SE, in which, let AB, A′B′ be tangents to the sun and earth on opposite sides of the axis SE; these tangents will meet the prolongation of the axis in a point C. Let also AB′, A′B touch the sun and earth on opposite sides of SE, and let C′ be their intersection. If we now suppose the plane to turn round the axis SC, a conical shadow or umbra, of which the apex is C, will be formed behind BB′; and if the moon is situated within any part of the cone BCB′, no light whatever can fall on her. As soon as the moon emerges from this cone, a part at least of the sun's rays will fall upon her, and she will be in the penumbra. If situated, for example, at M, and MN be drawn to touch the earth and meet the solar disk in N, then the part of that disk between A and N will be visible at M. The extent of the penumbra is therefore determined by the angle DBC. When M is situated in the straight line BD, the whole of the sun's disk is visible; when M is in BC the sun entirely vanishes, and his visible portion diminishes from the instant M passes BD till it reaches BC. The intensity of the penumbra, therefore, goes on increasing from the first of these limits to the second, where it is confounded with the total darkness. This explains the progressive obscuration of the moon's disk in her eclipses.

If we now attempt to determine the circumstances under which an eclipse of the moon can take place, it is obviously necessary to inquire, in the first place, into the length of the conical shadow BCB′; for an eclipse can only happen on the supposition of its extending beyond the orbit of the moon. For this purpose let EF (fig. 50) be drawn parallel to AB, and meeting SA in F. We have then sin.

Plate LXXXIII. Fig. 50.

$$\text{ECB} = \text{sin. SEF} = \frac{\text{SF}}{\text{SE}} = \frac{\text{SA} - \text{EB}}{\text{SE}} = \text{sin. R} - \text{sin. } p,$$

R being the apparent semidiameter of the sun, and p his horizontal parallax. By reason of the smallness of these angles the arcs may be substituted for the sines; hence the angle ECB $= \text{R} - p$. But $\text{CE} = \frac{\text{EB}}{\text{sin. ECB}}$, therefore making EB, the radius of the earth, $= a$, $\text{CE} = \frac{a}{\text{sin.}(\text{R} - p)}$.

From this expression it is evident that the value of CE depends on the horizontal parallax, and therefore varies with the sun's distance from the earth. On calculating, by means of the values of R, a, and p, given in the preceding sections, the values of CE at the perigean, mean, and apogean distances, the following results will be obtained:—

	Lengths of CE.
Sun in perigee	212·896 terrestrial radii.
at mean distance	216·531
in apogee	220·238

Now the greatest distance of the moon from the earth is less than 64 terrestrial radii (sect. ii.), consequently the shadow of the earth is projected into space between three and four times farther than the distance of the moon. Hence it appears, that if the moon moved in the ecliptic she would traverse the earth's shadow and be eclipsed every revolution. On account of the inclination of her orbit to that plane, the eclipses can only happen when she is in or near her nodes. The greatest distances from the nodes at which they can take place are called the *Lunar Ecliptic Limits*.

In order to determine these limits, it is necessary first of all to know the apparent diameter of a section of the earth's shadow, at the place where it is traversed by the orbit of the moon. Let $l\text{M}l'$ (fig. 50) be a part of the moon's orbit, intersecting the lines AC and A′C in m and m'; then mm' is the geocentric diameter of the shadow, the half of which is measured by the angle mEC. Now the angle mEC is the difference between the angles EmA and ECA, the first of which, namely, EmA, is the apparent semidiameter of the earth seen from the moon, or, in other words, the moon's horizontal parallax. Let this angle, therefore, be denoted by P. It has already been shown that ECA $= \text{R} - p$; consequently we have mEC $= \text{P} + p - \text{R}$ in all cases; that is to say, *the semidiameter of the shadow is equal to the sum of the horizontal parallaxes of the sun and moon, diminished by the apparent semidiameter of the sun.* On calculating the amount of this expression from the values of P and p given above, the following table will be obtained, exhibiting the magnitude of the apparent diameters of the earth's shadow for different distances of the sun and moon.

		Apparent diameters of earth's shadow.
Sun in perigee,	☽ in apogee	1° 15′ 24″·30
	at mean distance	1 23 2 ·31
	in perigee	1 30 40 ·31
Sun at mean distance,	☽ in apogee	1 15 56 ·86
	at mean distance	1 23 34 ·87
	in perigee	1 31 12 ·87
Sun in apogee,	☽ in apogee	1 16 28 ·29
	at mean distance	1 24 6 ·30
	in perigee	1 31 44 ·30

The greatest apparent diameter of the moon being only 33′ 31″·07, which is about a third part of the diameter of the earth's shadow, it follows that the moon may not only be completely enveloped in the shadow, but, since she passes over a space nearly equal to her own breadth in an hour, that she may continue to be totally eclipsed during a space of about two hours.

The above determination refers only to the umbra or cone of total darkness; but the diameter of the penumbra is obtained in a manner exactly similar. In the same

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diagram the semidiameter of the penumbra is measured by the visual angle lEC; but lEC = ElC′ + EC′l, and EC′l = EC′l′ = C′EA + C′AE; therefore lEC = ElC′ + C′EA + C′AE; or, retaining the same denominations as above, lEC = P + p + R. Hence, *the semidiameter of the penumbra is equal to the horizontal parallaxes of the moon and sun, augmented by the apparent semidiameter of the sun.*

All the different numerical values of the semidiameter of the penumbra corresponding to particular positions of the sun and moon may be computed exactly in the same manner as in the case of the umbra.

The two expressions for the semidiameters of the umbra and penumbra, viz. P + p — R, and P + p + R, give immediately the distance of the moon's centre from the axis of the cone when her disk comes into contact with the shadow. Representing the apparent semidiameter of the moon by r, her disk will just touch the umbra when the distance of her centre from the axis SE is equal to P + p — R + r; and it will touch the penumbra when the distance is P + p + R + r. But on account of the very feeble obscurity of the penumbra towards its extreme border, it is impossible to observe with any degree of precision the time at which the moon enters it. In computing the ecliptic limits, therefore, it is only necessary to have regard to the umbra.

In the table given above, the extreme values of P + p — R, the apparent semidiameter of the earth's shadow, are ½ (1° 15′ 24″·30) = 37′ 42″·15, and ½ (1° 31′ 44″·30) = 45′ 52″·15; and the least and greatest values of r, the apparent semidiameter of the moon, are respectively 14′ 45″ and 16′ 45″ (sect. ii.); therefore the least distance of the moon's centre from the axis of the shadow at the time of her immergence or emergence is 37′ 42″·15 + 14′ 45″ = 52′ 27″·15, and the greatest 45′ 52″·15 + 16′ 45″ = 62′ 37″·15. The first is the limit within which an eclipse must necessarily happen; the last that beyond which it cannot happen.

It is now easy to ascertain the limits of the moon's distance from her node, within which the eclipses take place. Let NC (fig. 51) be a portion of the ecliptic, NM part of the moon's orbit, N its node, C the centre of a section of the earth's shadow, M the centre of the moon; the verge of the lunar disk touching, but not penetrating, the shadow at a. It is evident that, if the moon be at a greater distance than CM from NC, there can be no eclipse. The greatest value of CM, as we have just seen, is 62′ 37″·15, from which the corresponding ecliptic limit NC is easily computed by means of the formula

sin. CM = sin. NC × sin. CNM.

Supposing the angle CNM, that is, the inclination of the moon's orbit to the ecliptic, to be 5°, which is its minimum value, the value of NC is found from the logarithmic tables to be 12° 2′ nearly. Hence an eclipse of the moon can only happen when she is within about 12° 2′ of her node. Under the most favourable circumstances, however, the limits may extend to 13° 21′. A lunar eclipse will certainly take place if the moon's distance from her node, at the time of her mean opposition, is not greater than 7° 4′.

When the moon's disk only comes into contact with the shadow, as in fig. 51, the phenomenon is called an *appulse;* when the disk only enters into the shadow in part, the eclipse is said to be *partial;* it is called *total* if the moon entirely disappears, and *central* when her centre coincides with the axis of the cone, or if at the time of the eclipse the moon is exactly in her node.

In the preceding determinations the shadow has been supposed to be conical, whereas, on account of the compression of the earth at the poles, it is not exactly a cone, but a conoid on an elliptic base; and it varies at every instant by reason of the earth's rotation. To determine rigorously the figure of the cone at every instant, and the diameter of its section where the moon enters and leaves it, would require calculations of great complication and prolixity. Such precision is, however, unnecessary; and indeed it is impossible to attain to absolute accuracy so long as the figure of the earth is not exactly known. It is usual and natural to employ the largest diameter which the shadow can have at the distance of the moon.

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It has also been supposed that the shadow is terminated by tangents to the sun and the earth; that is to say, that all the rays of light which are not obstructed by the globe of the earth pass in straight lines from the sun to the moon. But the earth being surrounded by an atmosphere which near the surface exerts a powerful action on the solar rays, it is to be presumed that those rays which, if unobstructed, would glance by the surface of the earth, are absorbed by the lower strata of the atmosphere. The effect of this will be to enlarge the diameter of the shadow; and the requisite correction may be regarded as an augmentation of the earth's radius, by adding to it a part of the atmosphere; or, which amounts to the same thing, an augmentation of the lunar parallax. Now, it is found by experience that such a correction is necessary; and, according to Mayer, the lunar parallax must be augmented by a 60th part in order to satisfy the observations.

Another effect of the action of the earth's atmosphere on the solar rays is to render the moon dimly visible even when she is totally eclipsed,—a circumstance to which allusion was made in the preceding section. Let the circle f g h i (fig. 52) concentric to the earth include that part of the atmosphere which is sufficiently dense to produce a sensible refraction of the rays of light. All those rays which do not fall within that circle, such as Wfw, Viv, proceed in their direct course without suffering any refraction; but those which enter the atmosphere between f and k, and between i and l, on opposite sides of the earth, are gradually more bent inward as they go through a greater portion of the atmosphere, until the rays Wk and Vl, touching the earth at m and n, are bent so much as to meet at q, a little short of the moon; and therefore the dark shadow of the earth is contained in the space $mopqm$, where none of the sun's rays can enter; all the rest, R, R, being mixed by the scattered rays which are refracted as above, is in some measure enlightened by them; and some of those rays falling on the moon, give her the colour of tarnished copper, or of iron almost red-hot; so that if the earth had no atmosphere, the moon would be as invisible in total eclipses as she is when new. If the moon were so near the earth as to go into its dark shadow, suppose about p or q, she would be invisible during her stay in it, but visible before and after in the fainter shadow R R.

After having pointed out the general phenomena of the lunar eclipses, and the limits within which they take place, it only remains to show in what manner the time of their commencement, end, and duration, and also their magnitude, may be determined by computation.

Let the line NE (fig. 53) represent the ecliptic, NO the orbit of the moon, C the centre of the terrestrial shadow, and M the centre of the moon at the instant of the opposition; then CM will be the circle of latitude on which the opposition takes place. The centre of the shadow C being always in opposition with the sun, moves along the ecliptic from west to east, or from N towards E, with the same velocity as the sun. The moon also, at the same time, moves in her orbit from west to east, or from N towards O. Now the velocities of these two motions are given by the astronomical tables, and the question is to determine the instant of time at which the circles

Plate LXXXIX Fig. 53.

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representing sections of the moon and the earth's shadow meet each other either before or after the opposition.

At the time of an eclipse the apparent distance of the centre of the shadow from the moon is very small, consequently CM, and also the differences of the respective longitudes and latitudes of C and M, may be regarded as straight lines. During the short interval between the commencement and end of an eclipse, the motion of the sun, and consequently that of the centre of the shadow, may likewise be regarded as uniform. By these suppositions, sufficiently accurate for our present purpose, the problem is considerably simplified.

Suppose now that C′ and M′ are two simultaneous positions of the shadow and moon at any instant before or after the opposition. Let M′P be perpendicular, and MQ parallel, to NE. The velocities of the moon and terrestrial shadow being known from the tables, the lines C′P and QM′, which represent the motions of the centre of the moon relatively to that of the shadow in longitude and latitude, are known also; whence C′P and PM′ are given, and consequently C′M′ the distance of the centres. Let us assume

λ = CM or ☽'s latitude when in opposition,
s = ☉'s motion in longitude,
m = ☽'s horary motion in longitude,
n = ☽'s motion in latitude,
t = time from M to M′,
c = C′M′ the distance of the centres.

Now, since we suppose that CP and QM′ are the ☽'s motion in longitude and latitude respectively in the time t, it is evident that $CP = mt$, and $QM' = nt$. But CC′ is the sun's motion, or the motion of the terrestrial shadow in longitude during the same time; therefore $CC' = st$. We have then $C'P = mt - st$, and $PM' = \lambda + nt$; consequently

$$c^2 = (mt - st)^2 + (\lambda + nt)^2.$$

In this quadratic equation, if t is regarded as the unknown quantity, the only arbitrary quantity contained in it will be c, the distance of the centres, the others being all determined from the tables. On assigning, therefore, any arbitrary value to c, the resolution of the equation will give the corresponding value of t, and consequently the circumstances or different *phases* of the eclipse which we may wish to determine.

On arranging the terms of the above equation so as to obtain the resolution relatively to t, we have

$$[(m-s)^2 + n^2]\, t^2 + 2\lambda\, nt = c^2 - \lambda^2,$$

which may be still simplified by introducing an auxiliary angle θ, such that $\tan.\ \theta = \frac{n}{m-s}$; for by this substitution there will result

$$n^2 t^2 + 2\lambda n \sin.^2\theta \,.\, t = (c^2 - \lambda^2)\sin.^2\theta,$$

which gives the two following values of t:

$$t = \frac{1}{n}\left(-\lambda \sin.^2\theta \pm \sin.\theta \sqrt{c^2 - \lambda^2 \cos.^2\theta}\right).$$

The first of these denotes the time at which the moon enters, and the second that at which she quits, the umbra or penumbra.

The time at which the different phases of the eclipse happen, are calculated directly from this equation. If, for example, we wish to determine the time at which the moon's disk begins to enter the shadow, we make $c = P + p - R + r$ (neglecting the small augmentation of the shadow occasioned by the refraction of the atmosphere). In the case of the penumbra we must take $c = P + p + R + r$; and it is evident that, if in either case λ is of such a magnitude that c is less than $\lambda \cos.\theta$, the value of t will be impossible; in other words, no eclipse can take place.

If we suppose $P + p - R + r = \lambda \cos.\theta$, the two values of t will be equal, and the duration of the phase will only be for an instant, as in the case of the appulse, in which the moon's limb just touches the shadow without entering it. In general, the portion of the diameter of the eclipsed part is $P + p - R + r - \lambda \cos.\theta$; and consequently the diameter of the part not eclipsed is equal to the diameter of the moon, or $2r$, minus this quantity, that is, equal to $\lambda \cos.\theta - P - p + R + r$. When this expression is equal to nothing the eclipse is just a total one; when negative, the upper boundary of the moon's limb will be under the upper boundary of the section of the shadow, and the total eclipse will continue for some time.

The instant at which the middle of the eclipse happens will evidently be that at which the two values of t are equal, or when the radical disappears, that is, when $c = \lambda \cos.\theta$. In this case $t = -\frac{1}{n}\lambda \sin.^2\theta$, and the instant is called that of the *greatest phase*. It is usual to express the quantity of the eclipse in digits, or twelfths of the lunar diameter; so that the eclipsed part is represented by $\frac{12}{2r}(P + p - R + r - \lambda \cos.\theta)$. Thus, taking the moon's apparent diameter at 33′ 18″, and supposing the eclipsed part to be 24′ 52″, this part expressed in digits will be $\frac{24'\ 52''}{33'\ 18''} \times 12 = 8{\cdot}96$ digits.

The obscurity of the penumbra renders observations of the commencement and termination of the lunar eclipses extremely uncertain. To obviate in some degree this inconvenience, care is taken to observe as accurately as possible the instants at which the shadow arrives at or passes different known spots on the moon's disk; so that the same eclipse offers in fact a great number of different observations, the mean of which may be regarded as more certain than any individual one. But after all the precautions that can be taken, the eclipses of the moon are far from affording results equally precise and certain as those of the sun. They were formerly of much greater importance than they are in the present state of astronomy; for the ancients had no other means of determining the geographical longitudes of places on the earth. In fact, as the eclipse is occasioned by the moon's being deprived of her light, the different phases of the eclipse happen at exactly the same physical instant of time to all observers to whom the moon is visible. The difference of the time reckoned by two observers at the instant of the phenomenon will therefore give the difference of the horary angles, or of their meridians; but supposing each to have made a mistake of 4 minutes of time in an opposite sense (and the ancients could scarcely guarantee a greater degree of accuracy), the resulting error in the difference of longitude would amount to 2°. The geographical tables of Ptolemy contain errors of still greater magnitude.

2.—*Eclipses of the Sun.*

The eclipses of the sun are caused by the interposition of the moon between the sun and the earth, and their general phenomena may be explained in the same manner as those of the moon. When the conical shadow which the moon projects behind her in space reaches the earth, those points of the earth's surface on which it falls are completely deprived of the light of the sun, and involved in total darkness. Those parts of the earth which are covered by the penumbra are only partially deprived of the sun's light, because the moon does not conceal the whole, but only a part of the solar disk.

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In order to appreciate the different circumstances of a solar eclipse, the procedure to be adopted is in many respects the same as that which has been explained in regard to the eclipses of the moon. The length of the moon's shadow, the first object of inquiry, is found exactly in the same manner as that of the earth; and it is only necessary to substitute in the formulæ already given the values of the apparent diameter and parallax of the sun which they would have at the surface of the moon. Now, these values are easily found, for the diameter of the sun as seen from the moon is equal to his diameter as seen from the earth, increased in the ratio of the distances of the moon and earth from the sun. In the same manner the parallax of the sun relatively to the moon is equal to his parallax relatively to the earth, augmented in the ratio of the distances, and diminished in the ratio of the diameters, of the moon and earth. Thus, let D represent the distance of the earth from the sun, d the moon's distance from the sun, m the moon's true semidiameter, and a the semidiameter of the earth; the sun's apparent semidiameter as seen from the moon will be $R \cdot \frac{D}{d}$ (R being his apparent semidiameter as seen from the earth), and his horizontal parallax will be $p \cdot \frac{D}{d} \cdot \frac{m}{a}$. The formula then which expresses the length of the terrestrial shadow CE (fig. 50), namely, $\frac{a}{\text{sin. } (R - p)}$, adapted to the case of the moon, becomes $\frac{m}{\text{sin.} \left\{ \left(R - p \cdot \frac{m}{a} \right) \frac{D}{d} \right\}}$, and expresses the distance between the centre of the moon and the apex of her shadow. By means of this formula the following results, which refer to the extreme cases in which the length of the shadow is a maximum and minimum comparatively with the moon's distance from the earth, may be computed.

		Length of shadow.	Moon's distance.
Sun in apogee,	Moon in perigee,	59·730	55·902
Sun in perigee,	Moon in apogee,	57·760	63·862

In the first case the shadow of the moon will reach beyond the centre of the earth; in the second it will not reach even to the surface. It follows, therefore, that even if the orbit of the moon coincided with the ecliptic, she would not produce a total obscurity every time she comes between the sun and the earth. At her greatest distances, where the shadow does not reach the earth, the effect of her interposition would be to conceal only a part of the sun's disk.

By introducing into the other formulæ modifications similar to the above, we shall find the apparent diameter of the shadow and the solar ecliptic limits. The apparent semidiameter of the earth's shadow has been shown to be equal to $P + p - R$; consequently the semidiameter of the lunar shadow at the distance of the earth, as seen by an observer placed on the moon, is equal to the parallax of the earth, plus the parallax of the sun relatively to the moon, minus the apparent semidiameter of the sun seen from the moon. The parallax of the earth means simply the apparent semidiameter of the moon seen from the earth; and if we neglect the parallax of the sun, which cannot influence the result to the extent of half a second, we shall have the following theorem: *The semidiameter of the lunar shadow is equal to the excess of the apparent semidiameter of the moon above the apparent semidiameter of the sun.* Hence, denoting the moon's apparent semidiameter by r, the semidiameter of the lunar shadow will be expressed by $r - R \cdot \frac{D}{d}$; or, taking into account the sun's parallax, $r + p \cdot \frac{m}{a} \cdot \frac{D}{d} - R \cdot \frac{D}{d}$. The ratio of the distances $\frac{D}{d}$, in this and the preceding formula, may be expressed in terms of the parallaxes; for since $p = \frac{a}{D}$, and $P = \frac{a}{D - d}$, therefore $\frac{D}{d} = \frac{P}{P - p}$. Since also $\frac{m}{a} = \frac{r}{P}$, according to the nature of parallax, we have likewise $r + p \cdot \frac{m}{a} \cdot \frac{D}{d} = \frac{r P}{P - p}$; therefore, by substituting these values, the expression for the semidiameter of the lunar shadow becomes

$$(r - R) \cdot \frac{P}{P - p}.$$

If to the apparent semidiameter of the shadow at the point where it is touched by the earth, we add the apparent semidiameter of the earth as seen from the moon, that is to say, the moon's horizontal parallax (P), the distance between the centres of the moon's shadow and of the earth will be

$$P + (r - R) \frac{P}{P - p},$$

from which expression the solar ecliptic limits may be readily computed. The result of the computation is, that a solar eclipse may take place if the moon's distance from her node, at the time of her mean conjunction with the sun, does not exceed 19° 44′. If her distance from the node is less than 13° 33′, the sun will certainly be eclipsed in some part of the world.

The solar eclipses present a great variety of appearances, depending on the relative positions of the sun, the moon, and the spectator. If the apparent diameter of the moon happens to surpass that of the sun, the eclipse will be *total*; but if the moon's diameter be the smaller, the observer will see a luminous ring, formed by that part of the sun's disk which exceeds that of the moon, and the eclipse will in that case be *annular*. If the centre of the moon is not in the same straight line which joins the observer and the centre of the sun, the eclipse can only be *partial*, as the moon can only conceal a *part* of the sun's disk. When the moon merely touches without penetrating the solar disk, the phenomenon is called an *appulse*; and the eclipse is *central* if the observer is placed at the centre of the shadow, on the straight line joining the centres of the sun and moon.

When the change happens within 17 degrees of the node, and the moon is at her mean distance from the earth, the point of her shadow just touches the earth, and she eclipses the sun totally to that small spot whereon her shadow falls; but the darkness is not of a moment's continuance.

The moon's apparent diameter, when largest, exceeds the sun's, when least, only two minutes of a degree; so that in the greatest eclipse of the sun that can happen at any time and place, the total darkness continues no longer than whilst the moon passes over two minutes in her orbit, that is, about 3 minutes and 56 seconds of an hour.

Extent of the moon's shadow and penumbra.

The moon's shadow covers only a spot on the earth's surface about 180 English miles broad, when her diameter appears largest, and the sun's least; and the total darkness can extend no farther than the limits of the dark shadow. Yet the partial shadow or penumbra may then cover a circular space 4900 miles in diameter, within all which the sun is more or less eclipsed, as the places are less or more distant from the centre of the penumbra. When the moon changes exactly in the node, the penumbra is circular on the earth at the middle of the general eclipse, because at

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that time it falls perpendicularly on the earth's surface; but at every other moment it falls obliquely, and will therefore be elliptical; and the more so as the time is longer before or after the middle of the general eclipse; and then much greater portions of the earth's surface are involved in the penumbra.

To make several of the above and other phenomena plainer, let S (fig. 52) be the sun, E the earth, M the moon, and AMP the moon's orbit. Draw the straight line W *e* from the western side of the sun at W, touching the western side of the moon at *c*, and the earth at *e*: draw also the straight line V *d* from the eastern side of the sun at V, touching the eastern side of the moon at *d*, and the earth at *e*: the dark space *c e d* included between these lines is the moon's shadow, ending in a point at *e*, on the surface of the earth, because in this figure the moon is supposed to be at her mean distance from the earth. Had the moon been in her perigee, the shadow would have covered a space on the surface of the earth of about 180 miles in diameter, to all places within which space the eclipse would have been total. Had she been in her apogee, the shadow would have terminated in a point above *e*, and to an observer at *e* the sun would have been eclipsed annularly. Draw the straight lines W X *dh* and V X *cg*, touching the contrary sides of the sun and moon, and ending on the earth at *a* and *b*; draw also the straight line SXM from the centre of the sun's disk, through the moon's centre to the earth, and suppose the two former lines W X *dh* and V X *cg* to revolve on the line SXM as an axis, and the points *a* and *b* will describe the limits of the penumbra TT on the earth's surface, including the large space *a b a*, within which the sun appears more or less eclipsed, according as the places are more or less distant from the verge of the penumbra *a b*.

Draw the right line *y* 12 across the sun's disk, perpendicular to SXM the axis of the penumbra; then divide the line *y* 12 into twelve equal parts, as in the figure, for the twelve digits or equal parts of the sun's diameter; and at equal distances from the centre of the penumbra at *e* (on the earth's surface YY) to its edge *a b*, draw twelve concentric circles.

To an observer on the earth at *b*, the eastern limb of the moon at *d* seems to touch the western limb of the sun at W when the moon is at M, and the sun's eclipse begins at *b*; but at the same moment of absolute time, to an observer at *a*, the western edge of the moon at *c* leaves the eastern edge of the sun at V, and the eclipse ends. At the very same instant, to all those who live on the circle next to *ab*, the moon cuts off or darkens a twelfth part of the sun, and eclipses him one digit; to those who live on the next interior circle, the moon cuts off two twelfth parts of the sun; to those on the following circle, three parts; and so on to the centre at *e*, where the sun is centrally eclipsed. The different appearances of the eclipse, as seen by spectators in these different situations, with regard to the centre of the shadow, are represented in fig. 54, under which figure there is a scale of hours and minutes, to show at a mean state how long it is from the beginning to the end of a central eclipse of the sun on the parallel of London, and how many digits are eclipsed at any particular time from the beginning at A to the middle at B or the end at C. Thus, in 16 minutes from the beginning, the sun is two digits eclipsed; in an hour and five minutes, eight digits; and in an hour and 37 minutes, 12 digits.

Having determined the diameter of the moon's shadow at the earth, and the limits within which eclipses of the sun can take place, the next object is to determine the time of their commencement and termination. If the position of the observer were on the moon instead of the surface of the earth, our solar eclipses would appear to him as eclipses of the earth, and they would commence at the instant when the earth's disk began to penetrate the lunar shadow. A spectator so situated might therefore compute all the circumstances of a terrestrial eclipse in exactly the same manner in which we compute those of the moon; the same formulæ would suffice, with the slight modifications which have already been made. But relatively to an observer placed on the earth the case is altogether different. To him the eclipse does not begin when the moon's shadow comes into contact with the earth's disk, but when it begins to obscure his station. This, therefore, is one circumstance which renders the computation of solar more complicated and difficult than that of lunar eclipses; for it is necessary not only to determine generally what portion of the terrestrial disk is covered by the shadow, but also its position relatively to the equator and to a given meridian, and likewise the path described by the centre and contour of the umbra and penumbra on the surface of the earth. There is another circumstance which still further augments the difficulty of the computation, namely, the position of the observer, on account of which it is necessary to introduce the particular conditions which depend on the parallax. In the case of a lunar eclipse, it is only necessary that the moon's disk enter the earth's shadow in order that the eclipse may be visible to any part of the terrestrial hemisphere opposite to the moon; but a solar eclipse may happen in some parts of the earth without being visible at others—a circumstance which is occasioned entirely by parallax.

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When we abstract from the effects of parallax, or suppose the observer to be placed at the centre of the earth, the problem of determining the different circumstances of a solar eclipse is exactly the same as that relative to an eclipse of the moon. But when the spectator is supposed to be placed at the surface, the latitudes and longitudes corresponding to his situation are different from the geocentric latitudes and longitudes; and in order to adapt the formula from which the time is given to these new circumstances, it is necessary, as a preliminary step, to compute the corrections which must be applied in consequence of the effects of parallax in longitude and latitude. The chief circumstance, therefore, in which the calculation of solar eclipses differs from that of lunar, consists in its being necessary to compute the effect of parallax in the direction of the angular distances which form the data of the problem, in order to apply the requisite correction to the values of those distances furnished by the tables. The development of these computations belongs to Practical Astronomy.

The sun's ecliptic limits exceeding 17° 21′, while those of the moon are only 11° 26′, it follows that the eclipses of the sun must be much more frequent than those of the moon. Yet the lunar eclipses being visible to every part of the terrestrial hemisphere opposite to the sun, and those of the sun visible only to the small portion of the hemisphere on which the moon's shadow falls, it happens that for any particular place on the earth the lunar eclipses are much more frequently visible.

Number of eclipses in a year.

In any year the number of eclipses of both luminaries cannot be less than two, nor more than seven: the most usual number is four, and it is very rare to have more than six; for the sun passes through both the nodes but once a year, unless he passes through one of them in the beginning of the year; and if he does, he will pass through the same node again a little before the year is finished; because, as these points move 19½ degrees backwards every year, the sun will come to either of them 173 days after the other;

and when either node is within 17 degrees of the sun at the time of new moon, the sun will be eclipsed. At the subsequent opposition, the moon will be eclipsed in the other node, and come round to the next conjunction again ere the former node be 17 degrees past the sun, and will therefore eclipse him a second time. When three eclipses take place about either node, the like number generally happens about the opposite, as the sun comes to it in 173 days afterwards; and six lunations contain but four days more. Thus, there may be two eclipses of the sun and one of the moon about each of her nodes. But when the moon changes in one of the nodes, she cannot be near enough the other node at the next full to be eclipsed; and in six lunar months afterwards she will change nearer the other node: in these cases there can be but two eclipses in a year, and they are both of the sun.

The eclipses of the sun being of great importance for the determination of geographical longitudes, it is of consequence to be in possession of some easy method of assigning the time at which they may be expected to occur, in order to avoid the necessity of long and tedious calculations. This may be done in a very simple manner, by considering that if a time can be assigned after which the sun and moon occupy exactly or nearly the same positions with regard to the nodes of the lunar orbit, their motions after that interval will recommence under the same circumstances, and the eclipses be reproduced in the same order. Now, it has been shown (chap. iii. sect. 2) that the nodes of the lunar orbit retrograde at the rate of 19°·3286 in a year, consequently the time in which the sun returns to the moon's node is that which he requires to describe an arc of 360° — 19°·3286, or, as is found by a simple proportion, 346·619851 days. On comparing this with 29·5305887 days, the time of a lunation, it will be observed that these numbers are nearly in the ratio of 223 to 19, so that after 223 synodic revolutions the moon has returned 19 times to the same position relatively to the sun. But 223 synodic revolutions are completed in 18 mean solar years and 10 or 11 days, consequently after that interval all the eclipses, whether of the sun or the moon, return again in nearly the same order; which gives a very simple means of predicting them, since only 18 years of observation are required. This period was known to the astronomers of the remotest ages, and is generally supposed to be that which the Chaldeans distinguished by the name of *Saros*. (See PART I. of this article.)

But the ratio of 223 to 19 is not exact, and it is besides subject to variation from the secular inequalities of the sun and moon, by reason of which the rates of their mean motions are sensibly changed. Discordancies will hence arise; and in the course of time the order of eclipses observed in one of these periods will require correction. But the variations are slow and gradual; the lunisolar periods may, therefore, continue to be employed when approximative results only are required. When rigorous accuracy is wanted, recourse must be had to computation from the astronomical tables.

Occultations.

Occultations of planets and stars by the moon are phenomena of which the calculation depends on exactly the same principles, and is even made by the help of the same formulæ, as the eclipses of the sun. Let E (fig. 55) denote the centre of the earth, M that of the moon, and S a star or planet concealed by the moon; the straight line SM will represent the axis of the lunar shadow, that is to say, the portion of space which the rays proceeding from the star cannot reach in consequence of their being intercepted by the moon; and the angle EMO (EO being perpendicular to SM) will be the apparent distance of the centre of the shadow from the centre of the earth. The expression for this angle in a function of the time is obtained in exactly the same manner as in solar eclipses; and by equating it with the different values of the angle which correspond to the different phases of the occultation, and regarding the time as the unknown quantity, the epochs will be obtained at which the phases take place. There is only one circumstance which renders a slight modification of the formulæ necessary. In computing the angle SEM, or the apparent distance of the centres of the star and moon seen from the centre of the earth, that distance may be regarded in solar eclipses as the hypothenuse of a right-angled triangle, the sides of which are respectively the latitude of the moon, and the difference between the longitudes of the moon and sun. But in occultations of the planets or stars, the star may be out of the ecliptic, and consequently its latitude not zero; so that the sides of the right-angled triangle, of which the apparent distance of the centres is the hypothenuse, are the difference of latitude of the star and moon, and the difference of longitude reduced to the moon's place, that is to say, multiplied by the cosine of the moon's latitude. It is evident that any of the planets may suffer an occultation by the moon; but with regard to the fixed stars, it is only those which are situated at a distance from the ecliptic not greater than the moon's extreme latitude, that can ever be hid by the interposition of the lunar disk.

The following is a list of all the solar eclipses that will be visible in this country during the present century. The time of the commencement of the eclipse, and the number of digits eclipsed, are computed for the middle of England. (See Baily's *Tables*, &c. p. 52.)

LIST OF SOLAR ECLIPSES.

Year.	Day and Hour.				Digits Eclipsed.	
1858	March	15d.	11h.	A. M.	11°	30′
1860	July	18	2	P. M.	9	12
1861	December	31	2	P. M.	5	0
1863	May	17	6	P. M.	3	46
1865	October	19	4	P. M.	7	36
1866	October	8	5	P. M.	5	3
1867	March	6	8	A. M.	8	42
1868	February	23	3	P. M.	contact	
1870	December	22	11	A. M.	9	36
1873	May	26	8	A. M.	3	43
1874	October	10	9	A. M.	6	18
1875	September	29		noon	0	33
1879	July	19	7	A. M.	4	0
1880	December	30	2	P. M.	4	24
1882	May	17	6	A. M.	2	18
1887	August	19	3	A. M.	11	58
1890	June	17	8	A. M.	4	39
1891	June	6	5	P. M.	3	0
1895	March	26	9	A. M.	1	0
1896	August	9		sunrise	contact	
1899	June	8	5	A. M.	3	13
1900	May	28	3	P. M.	8	0

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CHAP. IV.

OF THE PLANETS.

SECT. I.—*General Phenomena of the Planetary Motions.*

Having now described the motions and explained the phenomena of the sun and moon, our attention will be next occupied by the planets, those no less interesting bodies, whose remarkable peculiarities of apparent motion have attracted the curiosity, and formed a principal object of the labours, of astronomers in all ages. The sun and moon move among the stars always in the same direction, and with velocities nearly uniform; but the planets, though their apparent motions are most frequently from west to east, sometimes appear to have no proper motions, or to remain stationary among the fixed stars; at other times they appear to move in a contrary direction, or to retrograde; and hence the earth cannot be the centre of the planetary orbits. The determination of that centre, and the order of distance in which the orbits of the different planets are placed around it, is comparatively an easy task since the telescope and micrometer have made us acquainted with the phases and variations of the apparent diameters of the planets; but the ancients, who were guided by the apparent motions alone, found greater difficulty in extricating the elements of their theories from observations, and in framing hypotheses by which the phenomena could be represented with tolerable accuracy. The different hypotheses which have been proposed for this purpose are called, with sufficient impropriety, *Systems of the World.*

In order to obtain a general notion of the path traced by a planet in the heavens, it is necessary to attend closely to the various phenomena which it exhibits. As an example, we may take Venus, the most brilliant and remarkable of all the planets.

A slight attention to the position of Venus, continued a few days, suffices to show that she changes her place with considerable rapidity among the fixed stars. If we observe her in the evening, we shall soon find that her greatest distance from the sun never exceeds an arc of about 47°; that after attaining this distance she begins again to approach the sun, the time which she continues above the horizon after sunset gradually diminishing, till at last she sets simultaneously with the sun, and is lost in the effulgence of his rays. From the circumstance of her appearing in the evening, and not remaining visible more than about three hours after the sun has descended below the horizon, Venus has obtained the name of Ἑσπερος, Hesperus, or the evening star; sometimes also she is called the shepherd's star.

A few days after the evening star has disappeared, a brilliant star is observed in the morning preceding the sun in the east, which was not seen while Venus followed him in the west. At first it rises only a few minutes before the sun, but every succeeding morning somewhat earlier, till its distance from him is between 45 and 47 degrees. It then begins gradually to fall back; its elongation or distance from the sun becomes less and less, till it approaches so near to him as to be again lost in his rays. This has been called Φωσφορος, Lucifer, or the morning star.

Hesperus and Lucifer were long regarded as different stars. It could not fail, however, to be remarked, that during the time the first continues to shine in the evening, the other is invisible in the morning, and as soon as the bright harbinger of day makes its appearance, the evening star ceases to be visible. It was, besides, observed that the one star disappears within a very short distance from the sun, and that the other, when first seen after its periodical disappearance, is equally near to him on the opposite side. The distance which each recedes from the sun was likewise remarked to be the same; and the times during which they are alternately visible were found to be equal. These phenomena led some bolder genius to affirm that Hesperus and Lucifer are the same star, which is alternately visible in the morning and evening, according as it precedes or falls behind the sun. Obvious as this conclusion is, it was not arrived at till after many ages of reflection and experience.

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Since Venus never appears at a greater distance from the sun than about 47°, it is evident that the earth is neither the centre of her orbit, nor included within it; for in either case she would sometimes, like the moon, be seen in opposition to the sun. From the appearances which have as yet been described, it can only be inferred that Venus is a satellite of the sun, and that her orbit is carried along with him in his annual revolution in the ecliptic; but the phenomena which she presents when seen through the telescope afford the means of deducing more definite conclusions.

When Venus, after having been for some time visible in the evening, begins to approach the sun, she appears through the telescope as a fine luminous crescent, the horns of which are turned towards the east, and which becomes narrower as her distance from the sun diminishes. After she has passed the sun, and begins to appear in the morning, the horns of the crescent are turned towards the west, and its breadth gradually enlarges in proportion as the planet recedes from the sun, till she has gained her greatest elongation, when her disk becomes a semicircle. After this she begins to approach the sun with an accelerated motion, and her disk becomes gibbous, the illuminated or visible part being greater than a semicircle; and when she overtakes the sun, her disk has attained the dimensions of a full orb. Having passed the sun, the orb begins again to contract, and passes through the same gradation of changes on the eastern side of the sun, till the planet comes again into conjunction, when it vanishes entirely. All these phases, which nearly resemble those of the moon, are illustrated by fig. 56. When Venus is in the superior conjunction at A, or in the same straight line with the sun, she presents the full orb, because the hemisphere enlightened by the sun is turned directly towards the earth at E. Arrived at B, the illuminated hemisphere is not turned exactly towards the earth, and consequently one side of her orb must appear elliptical, the major axis being to the minor as radius to the cosine of the inclination of the planes of illumination and vision, as was shown in explaining the phases of the moon. (Chap. iii. sect. 1.) At C, where the straight lines drawn from the planet to the earth and sun form a right angle, the minor axis of the ellipse vanishes, and we have the half-illuminated orb. At D only a small portion of the enlightened hemisphere is visible from E; and when the planet arrives at F, the inferior conjunction, her dark side is wholly turned towards the earth, and she is invisible.

Plate LXXXII. Fig. 56.

Mercury exhibits phenomena exactly analogous to those of Venus. Like Venus, he oscillates on opposite sides of the sun; but his oscillations are much quicker, and performed in a much smaller arc. His greatest elongation or distance from the sun does not exceed 28° 20′; so that he never appears above the horizon longer than an hour and 50 minutes after sunset or before sunrise. He emits a very vivid white light; but, by reason of his proximity to the sun, he is seldom visible to the naked eye. His phases resemble those of Venus, and he is frequently seen as a dark spot passing over the sun's disk.

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From these phenomena several important conclusions may be drawn. In the first place, Mercury and Venus are opaque bodies, which are only visible in consequence of the sun's rays reflected from their surfaces. In the second place, their orbits are described about the sun, and do not embrace the earth, because both planets pass between the sun and the earth, and their digression from the sun never exceeds a certain limit. For this reason they are called *Inferior Planets*. In the third place, since the digressions of Venus are much more considerable than those of Mercury, it is obvious that her orbit includes that of Mercury. This last fact is established by other phenomena. Their angular velocities may be compared by means of the times which they respectively employ in returning to their conjunctions; and in this way it is found that the angular velocity of Mercury is nearly three times greater than that of Venus—a circumstance of itself sufficiently indicative of his greater proximity to the sun. But the occultation of one of these planets by the other furnishes a decisive evidence of the disposition of their orbits. On the 17th of May 1737 Mercury was observed to be occulted by Venus near their inferior conjunction; whence it follows that Venus is nearer the earth, and consequently at a greater distance from the sun. This fact was known to the Egyptians, and the name of the *Egyptian System* given to that theory according to which Mercury and Venus were regarded as satellites of the sun; but as the ancient astronomers were unacquainted with one of its strongest proofs, namely, the transits over the sun, and could only form inferences from the digressions, it was not generally adopted by them.

The revolution of Venus and Mercury about the sun may also be inferred from the variations of their apparent diameters, although, on account of the unequal distances of the sun from the earth, these variations are subject to considerable irregularities. When Venus approaches nearest to the earth, her apparent diameter subtends an angle of about 61″, while it does not amount to 10″ when she is at her greatest distance. The apparent diameter of Mercury varies from 12″ to 5″, indicating corresponding variations of distance. These variations of his apparent diameter are not sensible to the naked eye, on account of the irradiation which surrounds the disks of the planets, and which renders it impossible to form any correct judgment respecting the magnitudes of small luminous objects seen from so great a distance.

The phenomena of the other planets differ in some respects from those of Mercury and Venus. Instead of remaining constantly within a certain distance from the sun, their angles of elongation assume all possible values, and they are frequently seen in opposition, and consequently more distant from him than the earth is. Their orbits, therefore, embrace the earth; and as they are never observed in their conjunctions to pass, like the inferior planets, over the sun's disk, even when the direction of their motion traverses the sun, it follows that the sun is also included within their orbits. This fact is rendered certain by the appearance of their disks at the time when they are in conjunction. If they were then placed between the sun and the earth, their disks would appear cornicular, like those of Mercury and Venus; but they uniformly present a full orb at the time of their conjunction, and consequently the same hemisphere is presented to the earth and the sun, at least if, as is certain, they derive their light from him. They must therefore be situated beyond the sun. From the circumstance that their orbits include both the earth and the sun, they are called *Superior Planets*. In order to determine whether the sun or the earth is the centre of their motions, it will be convenient to have recourse to observations of their apparent diameters, which, if their orbits are circular, and have the earth in their centre, will always be of the same magnitude. But the apparent diameter of Mars gradually increases from his conjunction to his opposition; and therefore, since the distance of the planet is directly proportional to the magnitude of its apparent diameter, Mars is nearer to the earth at his opposition than at his conjunction. The variations of the apparent diameter of this planet are very considerable, the limits being 18″·28 and 3″·6; so that Mars is five times farther from the earth at his greatest distance than at his least. His orbit, therefore, cannot be a circle described about the earth. We might indeed suppose it to be an ellipse, or other elongated curve; but the enormous eccentricity which it would be necessary to assign to it renders this supposition extremely improbable. The analogy of Venus and Mercury will rather lead us to infer that the sun is the centre of his motion; and of this we have a geometrical proof in the circumstance that the difference of his greatest and least distances is equal to the diameter of the earth's orbit. Jupiter, Saturn, and Uranus, present exactly similar phenomena. We therefore conclude in the same manner that they are superior planets, circulating about the sun.

The order of distance in which the superior planets are disposed about the sun and the earth may be inferred either from the rate of their motion when they are in opposition with the sun (it being natural to suppose that their velocities will diminish in proportion to their distances or the magnitude of the orbit which they describe), or it may be determined from the variation of their apparent diameters. Now, the apparent diameters at the conjunctions and oppositions are nearly in the following ratio: those of Mars as 1 to 5, of Jupiter as 10 to 15, of Saturn as 1 to 1·23; hence the diameter of the terrestrial orbit is to the diameters of the orbits of Mars, Jupiter, and Saturn, as the difference of the preceding numbers is to their sum, or as unity to the numbers $1\frac{1}{2}$, 5, and $9\frac{1}{2}$. In this manner we find that Jupiter is at a much greater distance from the earth than Mars, and Saturn than Jupiter.

It has already been remarked that the apparent motions of the planets are not always in the same direction. Through the most considerable part of their orbits they move from west to east, according to the order of the signs; and their motion is most rapid when they are at the greatest distance from the earth. It gradually relaxes until the planet has reached its greatest eastern digression if it is an inferior planet, or its eastern quadrature if a superior one; after which its proper motion is slower than the sun's motion in the ecliptic. In the course of a short time the planet seems stationary among the stars for some days, its right ascension undergoing scarcely any variation. In the course of a few days more, however, it begins again sensibly to change its place, and now moves in an opposite direction, or retrogrades. This retrograde motion continues to be accelerated as the planet approaches its inferior conjunction, or its opposition, at which point it attains its maximum. After this it begins to be retarded; the planet becomes a second time stationary, and then assumes its direct motion, to pass through another series of similar changes. The arc and time of retrogradation are different for each of the planets, being greatest in the case of those which are nearest the earth, and least for those which are at the greatest distance.

These phenomena, which are called the *Stations* and *Retrogradations* of the planets, were observed with great attention by the ancients and the astronomers of the middle ages, to whom their explanation gave much embarrassment on account of their being incompatible with

the supposition that the earth is the centre of the celestial motions. In fact, if the earth is supposed immovable, the path described by the planets is a curve so extremely complicated and irregular, that Aristotle, and even Riccioli, who lived in an age when the celestial motions were much better known, were reduced to the necessity of supposing a genius or angel to reside in each of the planets, directing its motions as the mind of man directs the motions of his body. Suppose the earth to be at rest in E (fig. 57), the orbit of a superior planet will resemble the curve *abcdef*, &c. When the planet arrives at *b*, before it comes into opposition with the sun at A it becomes stationary. From *b* to *c* it retrogrades, and is again stationary at *c*. Its motion then becomes direct, and its distance from the earth continues to increase while it runs through the arc *defgh*, and till it arrives at *h*, and is in conjunction with the sun at B. It is then at its greatest distance, and in passing through the arc *klm* continues to approach the earth till it arrives at *m*, in opposition with the sun at C. Here it exhibits the same phenomena as at the former opposition, becoming stationary, retrograding, &c.; and at every succeeding opposition describes a sort of node or loop, similar to *lmn*. Its path is thus made up of an infinity of nodes, and presents a sufficiently striking resemblance to an epicycloid. Fig. 58, which has been copied from Cassini into most of the elementary treatises of astronomy, represents the apparent motions of Saturn, Jupiter, and Mars, in respect of the earth.

Plate LXXXI. Fig. 57.

Such are the general phenomena presented by the motions of the planets. We must next endeavour to determine the nature of the curve described by each of them, and the law according to which it is described, in order to arrive at the solution of the principal problem of astronomy, viz. to express the position of the heavenly bodies in terms of the time reckoned from a given instant.

System of epicycles.

The first successful attempt to frame a system by means of which the motions of the planets might be numerically calculated, was made by Apollonius of Perga. Apollonius supposed that a planet, instead of describing a circle about the earth, moves in the circumference of a second circle, the centre of which is carried round the circumference of the first. Let us suppose two unequal circles, situated in the same plane, the greater of which ACB (fig. 59), which is called the *deferent*, carries on its circumference the centre of the smaller PRP′S, which is called the epicycle; and let us also suppose that each of these circles turns uniformly about its centre, according to the order of the signs, that is, from west to east. The earth is situated at E the centre of the deferent, and the planet whose motions we consider is placed on the circumference of the epicycle. The phenomena resulting from this disposition will be different according to the ratio of the velocities of the two circles. In the first place, suppose the velocities to be equal, and that at the first instant the planet is placed at P, the extremity of the straight line which joins the centres of the deferent and epicycle: the planet is then at its apogee, and it is evident that its apparent velocity is the greatest possible, being the sum of the velocities in the two circles. It is evident also that the apparent velocity of the planet will diminish as it approaches the lower extremity P′ of its epicycle, or its perigee, and that in this point it will vanish altogether, because the perigee is carried backwards in the direction RP′S by the motion of the epicycle with a velocity equal to that by which it is carried forward by the motion of the deferent. From this point the apparent motion will receive a gradual augmentation of velocity, till the planet arrives again at its apogee, where it will recommence a course perfectly similar to the preceding. In this case, therefore, the apparent motion of the planet, though alternately accelerated and retarded, will always be direct.

Plate LXXXII. Fig. 59.

Let us next suppose that the velocity of the epicycle is greater than that of the deferent, which is the hypothesis adopted by Apollonius and Ptolemy. From P to R the motion of the planet is direct. At the point R its path coincides with the tangent RE, and it would be stationary if the epicycle were immovable; but as the epicycle advances according to the order of the signs, the planet will continue to move directly till it arrives at the point π, where its retrograde motion in the epicycle, in the direction π P′, is equal to the direct motion in the deferent. At the perigee P′ the planet will retrograde, because the directions of the two motions are diametrically opposite, and the retrograde motion in the epicycle is greater than the direct motion in the deferent. At π' it becomes a second time stationary, after which it resumes its direct motion, precisely according to the actual phenomena.

Ptolemaic system.

Lastly, if we suppose the velocity of the deferent to be greater than that of the epicycle, there will be neither station nor retrogradation, and the planet will always advance in the same direction, but contrary to that of the motion of the deferent. This, in the Copernican system, would be the motion of the moon with reference to a spectator placed on the sun, and regarding the orbit of the earth about the sun as the deferent, and that of the moon about the earth as the epicycle; for then the velocity of the earth about the sun would be about thirty times greater than that of the moon about the earth.

This method of representing the geocentric motions of the planets was adopted and fully developed by Ptolemy, who assigned the ratios of the radii of the epicycles and deferents of each of the planets, and disposed the orbits in the manner most conformable to the apparent motions. It may be remarked that the absolute lengths of the radii are immaterial; it is only their relative lengths to which it is necessary to have regard. As observations were multiplied, and new inequalities in the motions of the planets detected, the system of simple epicycles was in most instances found insufficient to explain the phenomena. Double and triple systems were therefore introduced, in which the first epicycle was regarded as a second deferent carrying its own epicycle, the second epicycle as a third deferent, and so on, till every irregularity of motion was explained. It is easy to conceive all this mechanism, and even to reduce it to general formulæ; but although it affords considerable facility for calculation, it is much too complicated to have place in nature. It is now well known that the orbits of the planets are not epicycloids, but ellipses: nevertheless, at a time when the circle and straight line alone were admitted in the solution of geometrical problems, it was extremely natural to inquire whether any construction could be found, without employing other curves, to represent the planetary motions; and the system of epicycles which resulted from this inquiry will remain a perpetual monument of the ingenuity of its authors, Apollonius and Ptolemy.

In arranging the planetary system, Ptolemy placed the earth at the centre of the universe, and nearest to it the moon, whose synodic revolution is the shortest of all, being performed in 29½ days. Next to the moon he placed Mercury, who returns to his conjunctions in 116 days. After Mercury followed Venus, whose periodic time is 584 days. Beyond Venus he placed the sun, then Mars, next Jupiter, and lastly Saturn, beyond which is the sphere of the fixed stars. (See fig. 60.) Plato and some other philosophers had placed the orbit of the sun immediately after that of the moon, and Mercury and Venus beyond the sun, on account that these planets

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were never seen on the solar disk. Ptolemy, however, remarked that this reason was inconclusive, because the planets might easily be supposed to pass between the sun and the earth, without appearing exactly on the sun's disk, in the same manner as the new moons do not always cause a solar eclipse. In the system of Ptolemy, it is, however, a matter of absolute indifference whether the orbits of these planets are placed above or below that of the sun, inasmuch as the phenomena are exactly the same in both dispositions. This fact doubtless furnishes a strong objection to his system, and might have led him, we are apt to suppose, to adopt the system of the ancient Egyptians with regard to Mercury and Venus, and place the sun at the common centre of their orbits. But it must be recollected that Ptolemy had no means of measuring the diameters of the planets, or of forming any accurate notions of their distances; he was unacquainted with the phases of Venus, which demonstrate the revolution of that planet about the sun; and, in short, knew of no phenomenon which could not be reconciled with his system. His object was solely to represent the apparent motions by a geometrical construction, and by such means as geometry at that time could legitimately employ; and this object he fully accomplished. He never regarded his system in any other light than as a mere hypothesis, by means of which the celestial phenomena could be reduced to calculation.

But while thus much must be conceded in favour of the system of Ptolemy, it must be confessed that scarcely any thing could well be imagined more complicated and cumbersome; more at variance with the simplicity which pervades the economy of nature, or, in a physical point of view, more absurd. Yet so prone is the human mind to cling to the ideas which have been first presented to it, and with so much difficulty are errors which have once obtained a firm footing eradicated, that, till the beginning of the 16th century, it was implicitly followed by astronomers of all countries. The glory of bursting the fetters of prejudice and authority, and of building the true system of the world on the ruins of a fabric which had been erected with so much address and labour, was reserved for Copernicus. This great man was led, by a profound meditation on the different hypotheses which had been imagined to account for the apparent motions of the heavenly bodies, to adopt the ideas of some of the ancients, and remove the earth from the centre of the world, ascribing to it a double motion of rotation about its own axis and of revolution about the sun. From some scattered hints contained in the writings of the ancient philosophers, Copernicus composed the system which retains his name; a system of the truth of which the complete development of the planetary theory has furnished the most convincing and satisfactory proofs. According to this system the sun is the common centre of the orbits of all the planets, which revolve around him in the following order:—Mercury, Venus, the Earth, Mars, Jupiter, and Saturn. Far beyond the orbit of Saturn he supposed the fixed stars to be placed, which formed the boundaries of the visible creation.

System of Copernicus.

Although the great simplicity and beauty of the Copernican system soon recommended it to the adoption of the most philosophical of the astronomers of that period, yet for a long time it met with considerable opposition. The most eminent of its opponents was the celebrated Tycho Brahe, who could never bring himself to adopt the supposition of the motion of the earth. The principal objections which he urged against it were the immense distance at which it is necessary to suppose the fixed stars to be placed, in order to account for the smallness, or rather the entire absence, of the annual parallax; the improbability that a heavy mass like the earth should have so rapid a motion; and some passages of Scripture which seem to suppose the motion of the sun and the immobility of the earth. Tycho, therefore, proposed another system, in which he endeavoured to retain the most essential advantages of the Copernican theory, and at the same time preserve the earth's stability. In the system of Tycho the earth is supposed to be the centre of the solar and lunar orbits, and the sun to be the centre of all the planetary orbits, the orbits of the two inferior planets being smaller, and those of the superior larger, than the orbit of the sun; a distinction which is necessary for the explanation of the conjunctions and oppositions. This disposition of the orbits will be understood by referring to fig. 61. The system of Tycho is far less philosophical than that of Copernicus, and he has therefore exposed himself to the charge of having made a retrograde movement in science; but it must be confessed that it affords a satisfactory explanation of all the phenomena, and that the objections which can be urged against it are not of an astronomical, but of a physical or mechanical nature. In fact, if the planets are supposed to revolve about the sun, it is absolutely indifferent, so far as regards the phenomena, whether the annual motion is ascribed to the sun or the earth; but it is a physical absurdity to suppose that the sun, with its whole train of attendant planets, revolves about the earth, which, in comparison of them, is a mere atom.

Tychonic system.

Theoretical Astronomy.

Taking the truth of the Copernican theory for granted, let us consider what effect the motion of the earth has upon the apparent motions of the other planets. Were the earth to stand still in any part of its orbit, the places of conjunction both in the superior and inferior semicircle, as also of the greatest elongation, and consequently the places of direct and retrograde motion, and of the stations of an inferior planet, would always be in the same part of the heavens; whereas, on account of the earth's motion, the places where these appearances happen are continually advancing forward in the ecliptic, according to the order of the signs. In fig. 62 let ABCD be the orbit of the earth; *efgh* that of Mercury; ☉ the sun; GFKI an arc of the ecliptic extended to the fixed stars. When the earth is at A, the sun's geocentric place is at F; and Mercury, in order to be in conjunction, must be in the line AF; that is, in his orbit he must be at *f* or *h*. Suppose him to be at *f* in his inferior semicircle: if the earth stood still at A, his next conjunction would be when he is in his superior semicircle at *h*; the places of his greatest elongation also would be at *e* and *g*, and in the ecliptic at E and G. But supposing the earth to go on in its orbit from A to B; the sun's geocentric place is now at K; and Mercury, in order to be in conjunction, ought to be in the line BK at *m*. As by the motion of the earth the places of Mercury's conjunctions are thus continually carried round in the ecliptic according to the order of the signs, so the places of his greatest elongations must also be carried forward in the same direction. Thus, when the earth is at A, the places of his greatest elongation from the sun are in the ecliptic E and G; the motion of the earth from A to B advances them forward from G to L and from E to I. But the geocentric motion of Mercury will best be seen in fig. 63. Here we have part of the extended ecliptic marked ♈, ♉, ♊, &c., in the centre of which S represents the sun, and round him are the orbits of Mercury and the Earth. The orbit of Mercury is divided into 11 equal parts, such as he goes through once in eight days; and the divisions are marked by numeral figures, 1, 2, 3, &c. Part of the orbit of the earth is like-

Effects of the earth's motion on the appearances of the planets.

Plate VII. Fig. 63.

Theoretical Astronomy.

wise divided into 22 equal arcs, each arc being as much as the earth goes through in eight days. The points of division are marked with the letters *a, b, c, d, e, f,* &c. and show as many several stations from whence Mercury may be viewed from the earth. Suppose then the planet to be at 1 and the earth at *a*; draw a line from *a* to 1, and it shows Mercury's geocentric place at A. In eight days he will have advanced to 2, and the earth to *b*; draw a line from 2 to *b*, and it shows his geocentric place at B. In other eight days he will have proceeded to 3, and the earth to *c*; a line drawn from 3 to *c* will show his geocentric place at C. In this manner, going through the figure, and drawing lines from the earth at *d, e, f, g,* &c. through 4, 5, 6, 7, &c. we shall find his geocentric places successively at the points D, E, F, G, &c. where we may observe, that from A to B, and from B to C, the motion is direct; from C to D, and from D to E, retrograde. In this figure 22 stations are marked in the earth's orbit from whence the planet may be viewed, corresponding to which there ought to be as many in the orbit of Mercury; but as the periodic time of that planet does not include so many intervals of eight days, his place is marked at the end of every eight days for two of his periodical revolutions; and to denote this, two numeral figures are placed at each division.

The geocentric motion of Venus may be explained in a similar manner; only, as the motion of Venus is much slower than that of Mercury, her conjunctions, oppositions, elongations, and stations, all return much less frequently than those of Mercury.

To explain the stationary appearances of the planets, it must be remembered, that the diameter of the earth's orbit, and even that of Saturn, are but mere points in comparison of the distance of the fixed stars; and therefore any two lines, though absolutely parallel, drawn at the distance of the diameter of Saturn's orbit from each other, would, if continued to the fixed stars, appear to us to terminate in the same point. Let, then, the two circles

Plate LXXXII

fig. 64 represent the orbits of Venus and of the Earth; let the lines AE, BF, CG, DH, be parallel to SP, we may nevertheless affirm, that if continued to the distance of the fixed stars, they would all terminate in the same point with the line SP. Suppose, then, Venus at E while the earth is at A, the visual ray by which she is seen is the line AE. Suppose again, that while Venus goes from E to F, the earth goes from A to B, the visual ray by which Venus is now seen is BF parallel to AE; and therefore Venus will be all that time stationary, appearing in that point of the heaven where SP, if extended, would terminate: this station is at her changing from direct to retrograde. Again, suppose, when the earth is at C, Venus is at G, and the visual line CG; if, while the earth goes from C to D, Venus goes from G to H, so that she is seen in the line DH parallel to CG, she will be all that time stationary, appearing in the point of the celestial sphere determined by the prolongation of SP. This station is at her changing from retrograde to direct; and both are in her inferior semicircle.

As the superior planets move in larger orbits than the earth, they can only be in conjunction with the sun when they are on the side opposite to the earth; as, on the other hand, they are in opposition to him when the earth is between the sun and them. They are in quadrature when their geocentric places are 90° distant from that of the sun. In order to understand their apparent motions, we shall suppose them to stand still in some part of their orbit while the earth makes a complete revolution; in which case any superior planet would have the following appearances:—1 While the earth is in its most distant semicircle, the motion of the planet will be direct. 2. While the earth is in its nearest semicircle, the planet will be retrograde. 3. While the earth is near those places of its orbit where a line drawn from the planet would be a tangent, it would appear to be stationary. Thus, in fig. 65, let *abcd* represent the orbit of the earth, S the Sun, EFG an arc of the orbit of Jupiter, ABC an arc of the ecliptic projected on the sphere of the fixed stars. Suppose Jupiter to continue at F, while the earth goes round in its orbit according to the order of the letters *abcd*. While the earth is in the semicircle most distant from Jupiter, going from *a* to *b* and from *b* to *c*, his motion in the heavens would appear direct, or from A to B and from B to C; but while the earth is in its nearest semicircle *cde*, the motion of Jupiter would appear retrograde from C to B and from B to A; for *a, b, c, d,* may be considered as so many different stations from whence an inhabitant of the earth would view Jupiter at different seasons of the year; and a straight line drawn from each of these stations through F, the place of Jupiter, and continued to the ecliptic, would show his apparent place there to be successively at A, B, C, B, A. While the earth is near the points of contact *a* and *c*, Jupiter would appear stationary, because the visual ray drawn through both planets does not sensibly differ from the tangent F*a* or F*c*. When the earth is at *b*, a line drawn from *b* through S and F to the ecliptic shows Jupiter to be in conjunction with the sun at B. When the earth is at *d*, a line drawn from *d* through S, continued to the ecliptic, would terminate in a point opposite to B; which shows Jupiter then to be in opposition to the sun; and thus it appears that his motion is direct when he is in conjunction, but retrograde when he is in opposition with the sun.

Theoretical Astronomy.

Plate LXXXIII.

The direct motion of a superior planet is more rapid the nearer it is to a conjunction, and slower as it approaches to a quadrature with the sun. Thus, in fig. 66, let ⊙ be the sun, the little circle round it the orbit of the earth, of which *abcdefg* is the most distant semicircle, OPQ an arc of the orbit of Jupiter, and ABCDEFG an arc of the ecliptic in the sphere of the fixed stars. If we suppose Jupiter to stand still at P, by the earth's motion from *a* to *g* he would appear to move directly from A to G, describing the unequal arcs AB, BC, CD, DE, EF, FG, in equal times. When the earth is at *d*, Jupiter is in conjunction with the sun at D, and there his direct motion is swiftest. When the earth is in that part of its orbit where a line drawn from Jupiter would touch it, as in the points *e* or *g*, Jupiter is nearly in quadrature with the sun; and the nearer the earth is to any of these points, the slower is the geocentric motion of Jupiter; for the arcs CD and DE are greater than BC or EF, and the arcs BC and EF are greater than AB or FG.

Plate LXXXII.

The retrograde motion of a superior planet is more rapid the nearer it is to an opposition, and slower as it approaches to a quadrature with the sun. Thus, let ⊙, fig. 67, be the sun, the little circle round it the orbit of the earth, whereof *ghiklmn* is the nearest semicircle, OPQ an arc of the orbit of Jupiter, NKG an arc of the ecliptic. If we suppose Jupiter to stand still at P, by the earth's motion from *g* to *n* he would appear to move from G to N, describing the unequal arcs GH, HI, IK, KL, LM, MN, in equal times. When the earth is at *k*, Jupiter appears at K in opposition with the sun, and there his retrograde motion is swiftest. When the earth is either at *g* or *n* (the points of contact of the tangents P*g* and P*n*), Jupiter is nearly in quadrature with the sun: and the nearer he is to either of these points the slower is his retrogradation; for the arcs IK and KL are greater than HI or LM, and the arcs HI and LM are greater than GH

Plate LXXXIII.

or MN. Since the direct motion is swiftest when the earth is at *d* (fig. 66), and continues diminishing till it changes to retrograde, it must be insensible near the time of change; and, in like manner, the retrograde motion being swiftest when the earth is in *k* (fig. 67), and diminishing gradually till it changes to direct, must also at the time of that change be insensible; for any motion gradually decreasing till it changes into a contrary one gradually increasing, must at the time of the change be altogether insensible.

Plate LXXXII. Plate LXXXIII.

The same changes in the apparent motions of this planet will also take place if we suppose him to advance slowly in his orbit; only they will happen successively when the earth is in different parts of its orbit, and consequently at different times of the year. Thus (fig. 65), let us suppose that while the earth goes round its orbit, Jupiter goes from F to G; the points of the earth's orbit from which Jupiter will now appear to be stationary will be *x* and *y*; and consequently his stations must be at a time of the year different from the former. Moreover, the conjunction of Jupiter with the sun will now be when the earth is at *f*, and his opposition when it is at *e*; for which reason these also will happen at times of the year different from those of the preceding opposition and conjunction. The motion of Saturn is so slow, that it occasions but little alteration either in the times or places of his conjunction or opposition; and the same will take place in a more eminent degree in Uranus; but the motion of Mars is so much swifter even than that of Jupiter, that both the times and places of his conjunctions and oppositions are thereby very much altered.

Fig. 68 exemplifies the geocentric motion of Jupiter in a very intelligible manner. In this figure ⊙ represents the sun; the circle 1, 2, 3, 4, the orbit of the earth, divided into twelve equal arcs for the twelve months of the year; PQ an arc of the orbit of Jupiter, equal to that which he describes in a year, and divided in like manner into twelve equal parts, each representing the arc he describes in a month. Now suppose the earth to be at 1 when Jupiter is at *a*, a line drawn through 1 and *a* shows Jupiter's place in the celestial ecliptic to be at A. In a month's time the earth will have moved from 1 to 2, Jupiter from *a* to *b*; and a line drawn from 2 to *b* will show his geocentric place to be in B. In another month the earth will be in 3, and Jupiter at *c*, and consequently his geocentric place will be at C; and in like manner his place may be found for the other months at D, E, F, &c. It is likewise easy to observe that his geocentric motion is direct in the arcs AB, BC, CD, DE; retrograde in EF, FG, GH, HI; and direct again in IK, KL, LM, MN. The inequality of his geocentric motion is likewise apparent from the figure.

Supposing the orbits of the planets to be circular, the points of station, and the extent and duration of the retrogradations, may be geometrically determined with great facility; but if we attempt to take into consideration all the inequalities of the orbits, the problem becomes one of extreme complication and difficulty. This, however, is the less to be regretted, on account that it is more a problem of curiosity than of any real importance, and the mean values which result from the supposition of circular orbits are more than sufficiently accurate for all the uses which are now made of these phenomena.

Let S, fig. 69, be the sun, E and V two planets (which we may suppose to be the Earth and Venus) revolving in their respective orbits in the times T and *t*: the problem is, to determine those points at which one of them, as seen from the other, will become stationary, and the extent of the arc through which it will appear to retrograde. Suppose the spectator to be placed at E, and V to be the point at which Venus is stationary. Also let the semidiameters of their orbits SE and SV be R and *r* respectively, the angle of digression SEV = φ, and the angle SVE = ψ. During a short time, at the station, the lines EV and *ev* (Ee and *Vv* being very small arcs) may be considered as parallel; therefore $\varphi = Suv = Sev + ESe = \varphi + \delta\varphi + ESe$, whence $\delta\varphi = -ESe$. In like manner $\psi = Sxe = Sve - VSv = \psi + \delta\psi - VSv$; whence $\delta\psi = VSv$. But as the orbits are described uniformly, $T : t :: VSv : ESe$, and consequently $T : t :: \delta\psi : \delta\varphi$. Now, the triangle SEV gives the equation $\sin.\psi = \frac{R}{r}\sin.\varphi$, from which, by differentiating, we get $\delta\psi \cos.\psi = \frac{R}{r}\delta\varphi \cos.\varphi$, and consequently $\delta\psi : \delta\varphi :: R\cos.\varphi : r\cos.\psi$. Comparing this with the above proportion, we have $T : t :: R\cos.\varphi : r\cos.\psi$, whence $r\cos.\psi = \frac{t}{T}R\cos.\varphi$. Taking the squares, and adding $r^2\sin.^2\psi = R^2\sin.^2\varphi$, there results

$$r^2T^2 = R^2(t^2\cos.^2\varphi + T^2\sin.^2\varphi),$$

whence we derive

$$\sin.\varphi = \frac{1}{R}\left(\frac{r^2T^2 - R^2t^2}{T^2 - t^2}\right)^{\frac{1}{2}};$$

or, if we suppose $\frac{r}{R} = r'$, and $\frac{t}{T} = t'$,

$$\sin.\varphi = \left\{\frac{(r'+t')(r'-t')}{(1+t')(1-t')}\right\}^{\frac{1}{2}}.$$

From this formula, all the circumstances connected with the stations and retrogradations are easily computed, when the diameter of the orbit and the periodic time of the planet are known. Thus, relatively to Venus, the quantity *r'*, that is, the ratio of the diameter of her orbit to that of the earth, is, as will be shown in next section, equal to 0·723, and $t' = \frac{224\cdot7}{365\cdot25} = 0\cdot6152$, whence $\sin.\varphi = \sqrt{\frac{1\cdot338\times\cdot108}{1\cdot615\times\cdot385}} = 0\cdot48208$; and $\varphi = 28°\ 49'$. The angle ψ is obtained from the equation $\sin.\psi = \frac{\sin.\varphi}{r'}$, which gives $\psi = 138°\ 11'$. The angle VSE at the sun, or the heliocentric distance of Venus and the Earth, which we shall designate by χ, is $180° - (\varphi + \psi) = 13°$. From this angle we likewise obtain the time from the station to the conjunction; for since the mean daily motion of Venus is 1° 36′ 7″·8, and that of the earth 59′ 8″·3, the relative daily motion is 36′ 59″·5, therefore the time from conjunction will be $\frac{13°}{36'\ 59''\cdot5}$, or about 21 days, and consequently the retrograde motion of Venus will continue about 42 days.

If in the equation $\sin.\varphi = \frac{1}{R}\left(\frac{r^2T^2 - R^2t^2}{T^2 - t^2}\right)$ we suppose $rT = Rt$, the angle φ vanishes; consequently there will be no regression, and the station will only be momentary at the inferior conjunction. In this case $r : R :: t : T$, or the distances of the planets are proportional to their periodic times. If Rt were greater than rT, φ would become imaginary, and the motion of the planet would always be direct. The stations and retrogradations are therefore consequences of that law of the system according to which the distances are to one another in a greater ratio than the periodic times.

The following table, given by Delambre (*Astronomie*, tome iii. p. 9), exhibits the elements of the stations and retrogradations of the planets, calculated from formulæ equivalent to the above.

	Mercury.	Venus.	Mars.	Ceres.	Jupiter.	Saturn.	Uranus.
φ	18° 12′	28° 51′	136° 12′	126° 7′	115° 35′	108° 47′	103° 15′
♆	126 14	138 9	27 1	18 6	9 59	5 42	2 55
☿	35 34	13 0	16 47	35 47	54 26	65 31	73 52
Mean Arc	13° 24′	15° 22′	14° 41′	10° 30′	9° 55′	6° 47′	3° 45′
Limits	9°...16°	14°...17°	10°...20°		9°·8...10°	6°·7...6°·9	3°½...4°
Duration	22ᵈ·9	42ᵈ·16	72ᵈ·76	97ᵈ·45	120ᵈ·7	137ᵈ·6	151ᵈ·7
Limits	21½...23½	41...43½	61...81½		117...122½	135...139	150...153

SECT. II.—*Of the Orbits of the Planets.*

In determining the elements of the orbits of the sun and moon, the labour of the astronomer is facilitated by the circumstance that the earth, at which his observations are made, either is, or may be regarded as, the centre of motion. But in the case of the planets, the sun, and not the earth, is situated in the centre of their orbits, and consequently the elements of those orbits must be determined from the measurement of certain linear and angular distances from the sun: it is therefore necessary, as a preliminary step, to convert the geocentric into heliocentric observations, that is, to deduce the true place of a planet as seen from the sun, from its apparent place as seen from the earth. On this account the determination of the planetary orbits is attended with somewhat greater difficulties than those which present themselves in the cases of the sun and moon.

1. *Nodes and Inclinations of the Planetary Orbits.*— Conformably with the plan which has been followed in the two preceding chapters, we will first consider those elements which determine the position of the plane of the orbit of a planet; and then those which regard the orbit itself, that is to say, the elements and position of the ellipse which the planet describes. When these are known, and the astronomer is also acquainted with the mean motion, or the time of the periodic revolution of the planet, and the instant at which it occupied any given point of its orbit, he is in a condition to assign the epoch at which it will again occupy the same or any other given point; and this comprehends the complete solution of the problem which he proposes to himself. It is proper, however, to remark here, that although this method of considering the elements separately is extremely convenient, perhaps indispensable, for the purpose of illustration, it is neither that which the practical astronomer follows, nor that by which the various truths which compose the actual system of theoretical astronomy were discovered. No discovery in astronomy has perhaps ever been made by a direct process. The elements first obtained from the observations are imperfect and inexact, and it is only by successive and frequently laborious approximations that they are advanced to accuracy. Hypotheses are first framed to account for or classify the phenomena; the results of these arbitrary suppositions are computed and compared with new observations; and the differences which are found to exist between the computed and observed quantities serve to verify or correct the assumption, or suggest other approximations still nearer the truth. In astronomy, as Woodhouse remarks, scarcely one element is presented simple and unmixed with others. Its value, when first disengaged, must partake of the uncertainty to which the other elements are subject, and can be supposed to be settled to a tolerable degree of exactness only after multiplied observations and many revisions. There are no simple theorems for determining at once the parallax of the sun, or the heliocentric latitude of a planet.

To give a general idea of the method of reducing geocentric to heliocentric longitudes and latitudes, let S (fig. 70) be the sun, E the earth, P the place of a planet in its orbit NP, NA the ecliptic, and N the ascending node, or that point of the ecliptic through which the planet passes when it comes to the north of that plane. Let S♈, E♈, be drawn from S and E to the first point of Aries; these lines being parallel, and representing the direction of one of the axes of co-ordinates to which the places of the planet are referred. Let also PL be drawn perpendicular to the ecliptic, and the other lines as in the figure. It is easy to see that as NPC, NLA are regarded as the intersections of the planes of the orbits of the earth and the planet with the celestial sphere, the centre of which is occupied by the sun, they are portions of great circles; and consequently every question relative to the position of the planet may be resolved by the formulæ of spherical trigonometry. In fact, PL being a circle of latitude, the arc ♈NL is the *Heliocentric Longitude* of the planet, ♈N the longitude of the ascending node, and the spherical angle PNL the inclination of the orbit. In order that the longitude of the planet in its orbit may not differ greatly from its longitude referred to the ecliptic, the former is not reckoned from the node N, but from another point equally distant from the node with the vernal point ♈; so that the longitude of the planet is obtained by adding NP to the longitude of the node. The magnitude of the planet thus reckoned is usually called the longitude in the orbit. The latitude also depends immediately on the distance NP of the planet from the ascending node; hence NP is called the *Argument of the Latitude;* and the difference between the longitudes in the orbit and ecliptic, that is, NP—NL, is called the *Reduction to the Ecliptic.* The angle PEL, or the planet's apparent distance from the ecliptic to an observer at E, is the *Geocentric Latitude;* PSL, its distance from the ecliptic when viewed from the sun, is its *Heliocentric Latitude.* It is evident from the mere inspection of the diagram, that ♈EL and ♈SL are the geocentric and heliocentric longitudes respectively. The angles of the triangle ESL, from which the reductions are computed, being of very frequent use in practical astronomy, have received certain technical denominations with which it is convenient to be acquainted. The angle LES, which is the difference between ♈EL and ♈ES, the geocentric longitudes of the planet and the sun, is called the angle of *Elongation;* ESL, the angle at the sun, is called the angle of *Commutation;* and SLE, which is the difference between the heliocentric and geocentric longitudes, is called the *Annual Parallax,* or the *Prosthaphæresis of the Orbit.* In the case of an inferior planet, the annual parallax SLE may have any value between zero and 360°; but if the planet be a superior one, the greatest value of the annual parallax has place when the straight line drawn from the planet to the

earth is a tangent to the earth's orbit. In any other situation of the planet the sine of the annual parallax will be to the sine of the elongation as SE to SL.

In order to determine the position of the orbit of a planet relatively to the ecliptic, it is necessary to discover in the first place the position of the nodes. The longitude of the node is the heliocentric longitude of the planet at the instant when it is in the ecliptic, and its geocentric and heliocentric latitudes are consequently both equal to zero. If then, at the same instant, the planet should happen to be in opposition with the sun, or (if an inferior one) in its inferior conjunction, its geocentric longitude, which is equal to the longitude of the sun + 180°, would be the heliocentric longitude of the node. But it can happen very rarely that the latitude of a planet is zero at the time of its opposition or conjunction, especially with regard to those of which the periodic times are considerable. Mercury and Venus, indeed, by passing oftener through their nodes within a given time, afford more chances of the occurrence of the phenomenon; and it does occur occasionally under very favourable circumstances when those planets pass over the disk of the sun, for at such times the latitude must be very small, that is, the planet must be very near its node. But this simple method of determining the heliocentric longitude of the node, although it may frequently be had recourse to in the case of Mercury, can seldom be practised with regard to Venus, and is of no use whatever in the cases of the other planets, because, on account of the greater length of their times of revolution, the oppositions and passages through the node take place simultaneously only after very long intervals.

Leaving, therefore, out of consideration the circumstance of opposition, let us inquire what other means are in our possession for determining the longitude of the node. It would be by an extraordinary chance that a planet should happen to be observed at the precise instant of its passage through its node; but if observed when very near it, the diurnal variations of latitude afford data for determining that instant by interpolation. Suppose, then, the planet to be in its node at N: the angle ΥEN is obtained from observation, being the geocentric longitude of the node; and ΥES, the longitude of the sun, is known from the solar tables. Hence, in the triangle ENS the angle SEN = ΥEN − ΥES is known, as is also the side SE, which is the sun's distance from the earth. If, therefore, the angle at the planet, that is ENS, can be found, every part of the triangle will be determined, and we shall then have the heliocentric longitude ΥSN (equal to 180° − ESN + ΥES), and also the radius vector SN, or the distance of the planet from the sun. Now, the sides of a triangle being proportional to the sines of their opposite angles, $\frac{SN}{SE} = \frac{\text{sin. SEN}}{\text{sin. ENS}} = \frac{\text{sin.}(\Upsilon EN - \Upsilon ES)}{\text{sin.}(\Upsilon SN - \Upsilon EN)}$; but from this equation nothing can be deduced, inasmuch as it contains two unknown quantities, SN and ΥSN. Suppose, however, that the planet is observed a second time in its passage through the same node, and that the earth is then in another part of its orbit at *e*: this second observation will furnish another equation, viz. $\frac{SN}{Se} = \frac{\text{sin. } SeN}{\text{sin. } eNS} = \frac{\text{sin.}(\Upsilon eN - \Upsilon eS)}{\text{sin.}(\Upsilon SN - \Upsilon eN)}$, exactly similar to the former, and in which *Se* is equal to SE. If, then, we suppose the place of the node has not sensibly changed in the interval between the two observations, this last equation will furnish a second relation between the two unknown quantities SN and ΥSN, by combining which with the former, the values of both those quantities may be determined. By repeating the same observation, it will be seen whether the place of the node is fixed, or is subject to any other variation than that which arises from the precession of the equinoxes. Its variation, if it does vary, can only be determined by observations made at distant epochs.

When the longitude of the node has been determined in this manner, it will be easy to deduce the inclination of the orbit. For this purpose the planet may be observed at the time when the sun's longitude is equal to that of the node, and the earth is consequently situated in the line of the nodes. By this observation the elongation of the planet, which is then PEN (fig. 71), is given, as also its geocentric latitude PEL. Now, by reason of the right-angled triangles PEL and PSL, we have PL = EL tan. PEL = SL tan. PSL, consequently tan. PSL $= \frac{EL}{SL}$ tan. PEL; but EL : SL : : sin. LSN : sin. LES, therefore tan. PSL $= \frac{\text{sin. LSN}}{\text{sin. LES}}$ tan. PEL. Now, by Napier's rules for circular parts, the right-angled spherical triangle PNL gives also sin. NL = cot. PNL tan. PL; whence tan. PL = sin. NL tan. PNL; or, since tan. PL = tan. PSL, and sin. NL = sin. LSN, therefore tan. PSL = sin. LSN tan. PNL. By equating these two values of tan. PSL, we have

Plate LXXXIII.

$$\text{sin. LSN tan. PNL} = \frac{\text{sin. LSN}}{\text{sin. LES}} \text{ tan. PEL};$$

therefore, ultimately,

$$\text{tan. PNL} = \frac{\text{tan. PEL}}{\text{sin. LES}};$$

that is, the inclination of the orbit is given in terms of the geocentric latitude and the longitude of the node.

The instant at which the sun is in the node of a planet's orbit cannot be easily seized; but the sun's mean motion being known, if his longitude is observed when it is nearly equal to that of the node, the time at which he passes through it may be determined with all the necessary accuracy by a simple proportion. It requires also to be remarked that the above method of determining the inclination takes it for granted that the position of the node is exactly known; but even should some uncertainty remain regarding this element, the resulting inclination would scarcely be affected in any sensible degree by a slight error, especially if at the time of the observation the planet is not very distant from its quadratures. In fact, if we make PNL = I, PEL = λ, and LES = φ, the above equation becomes $\text{tan. I} = \frac{\text{tan. } \lambda}{\text{sin. } \varphi}$, which being differentiated with respect to I and φ, gives d tan. I $= -\frac{d\varphi \cos.\varphi \text{ tan.}\lambda}{\text{sin.}^2\varphi}$. But d tan. I $= \frac{dI}{\text{cos.}^2 I}$, and from the equation itself we derive $\text{cos.}^2 I = \frac{\text{sin.}^2\varphi}{\text{sin.}^2\varphi + \text{tan.}^2\lambda}$; therefore, by substituting

$$dI = -\frac{d\varphi \cos.\varphi \text{ tan.}\lambda}{\text{sin.}^2\varphi + \text{tan.}^2\lambda}$$

From this it is evident that the error of inclination resulting from an erroneous position of the node will be smaller in proportion as φ is greater, and will disappear altogether when φ (that is, LES or the geocentric distance of the planet from its node) is 90°, that is to say, at the quadratures.

The process now explained for determining the position of the nodes gives at the same time the length of

the radius vector SN; and, in consequence of certain relations which will be pointed out in the present section, all the other elements of the orbit may be deduced from simple observations of the passages of a planet through its nodes. But when approximate values of these elements are known, the heliocentric longitudes and latitudes may be found from geocentric observations of various kinds. If, therefore, the planet is observed several times before and after its passage through the node, the diurnal variations of longitude and latitude (which we at present suppose to be known very nearly) will give by interpolation the instant at which the latitude was nothing, and the heliocentric longitude, computed for that instant, will give the place of the node. By means of this more accurate determination the other elements may be corrected; and on repeating the same process with the corrected values, the longitude of the node will be obtained with still greater precision. These indirect methods of correcting the elements by one another were first employed by Kepler, and are of extensive application in every department of astronomy. They lead to more exact values of the elements of the planetary orbits than could be obtained from any direct method whatever.

As the passage of a planet through either of its nodes takes place only once during each periodic revolution, a remote planet, like Uranus, which moves very slowly, can very seldom be observed in those positions. Astronomers have therefore sedulously employed themselves in devising other methods by which all the elements of a planet's orbit may be discovered when a very small portion of it has been made known by observation. But these methods are the results of profound mathematical theory, based on the principle of Universal Gravitation, and could not therefore be properly explained in this place. Their application belongs to Practical Astronomy.

When the longitudes of the nodes of the planetary orbits are deduced by the methods explained above from ancient and modern observations, it is found that the nodes are not altogether fixed, but that, in respect of the fixed stars, they retrograde, or move from east to west; but their motion is so slow, that, although it is in reality, like every motion of the system, alternately accelerated and retarded, it may be regarded as uniform during a very long period of time. The inclinations of the orbits also undergo small variations, scarcely sensible to observation. The retrograde motion of the nodes of the planets, exactly analogous to that of the nodes of the moon, is a necessary consequence of the mutual gravitation of all the planetary bodies. The same is the case with the variations of inclination, of which the period and limits can only be calculated from the same theory to which we owe the knowledge of their existence. It is only indeed by the aid of the theories of Physical Astronomy that the greater part of these small secular variations can be disengaged from the periodic inequalities.

The following table exhibits the inclinations of the orbits of the planets, the positions of their nodes, and the variations of those elements. For the old planets the epoch is the commencement of the present century, that is to say, midnight preceding the 1st of January 1801. For Vesta, Juno, Ceres, and Pallas, the epoch is 1820. The annual increment of the longitude of the node is referred of course to the equinoctial point of Aries: to find its motion in respect of the fixed stars, it is only necessary to subtract the precession of the equinoxes, or 50″·1, from the numbers given in the table.

Names.	Inclination.	Secular Variation of Inclination.	Longitude of Ascending Node.	Annual Variation of Longitude of Node.
Mercury.....	7° 0′ 9″·1	+ 18″·1828	45° 57′ 30″·9	+ 42″·3
Venus.....	3 23 28 ·5	— 4 ·5522	74 54 12 ·9	+ 32 ·5
Mars.....	1 51 6 ·2	— 0 ·1523	48 0 3 ·5	+ 26 ·8
Vesta.....	7 8 9 ·0		103 13 18 ·2	+ 15 ·6
Juno.....	13 4 9 ·7		171 7 40 ·4	
Ceres.....	10 37 26 ·2		80 41 24 ·0	+ 1 ·5
Pallas.....	34 34 55 ·0		172 39 26 ·8	
Jupiter.....	1 18 51 3	— 22 ·6087	98 26 18 ·9	+ 34 ·3
Saturn.....	2 29 35 ·7	— 15 ·5131	111 56 37 ·4	+ 30 ·7
Uranus.....	0 46 28 ·4	+ 3 ·1331	72 59 35 ·3	+ 14 ·2

2. *Of the Figures of the Orbits.*—After the position of the plane of a planet's orbit in space has been determined, it remains to trace its path on that plane, or to determine the figure and elements of the orbit itself. This, it is evident, may be accomplished, if we are in possession of the means of assigning, at any instant, the planet's distance from a fixed point in the plane of its orbit, and likewise the angle formed by the radius vector with a straight line given by position on the same plane. With these data a series of points may be laid down, representing the positions successively occupied by the planet; and the curve formed by joining them together will represent the orbit. Now, when the place of the nodes and the inclination are known, the radius vector and elongation may be computed by the rules of spherical trigonometry from a single observation of the planet's geocentric latitude and longitude at any epoch whatever; but by making the observations when the planet occupies certain situations of its orbit with respect to the earth, the difficulties attending the computation may be in a great measure eluded. If a planet, for example, is observed at the time of its opposition or conjunction, there will be no occasion for a previous deduction of the heliocentric from the geocentric longitude; because, in either of those cases, the radius vector of the planet, and the straight line EP (fig. 72) drawn from it to the observer, are projected on the plane of the ecliptic in the same straight line ESL; and consequently the planet, whether seen from the earth or the sun, is referred to the same point of the ecliptic, excepting indeed the inferior planets, which in their inferior conjunctions are referred to points diametrically opposite. Let P, therefore, be the place of a planet in opposition; then, in the spherical triangle PNL, right-angled at L, the side NL, being the longitude of the planet minus that of the node, is given by observation (the longitude of the node being supposed to be previously determined); the inclination PNL is also known; therefore, by Napier's rules,

Plate LXXXIV.

$$\text{tan. PN} = \frac{\text{tan. NL}}{\text{cos. PNL}};$$

that is, the elongation of the planet is given in terms of its longitude and the inclination of its orbit. The same

Theoretical Astronomy.

triangle PNL also affords data for determining the radius vector: for tan. PL = tan PNL sin. NL; but PL is the measure of the angle PSL, and consequently PSL, the heliocentric latitude, also becomes known. Now, in the triangle PES the angle PES is given by observation, therefore EPS (= PSL — PES) is also given; but PS : SE :: sin. PES : sin. EPS, whence $PS = SE \frac{\text{sin. PES}}{\text{sin. EPS}}$, or the radius vector is found in terms of the sun's distance from the earth and given angles.

In consequence of the incommensurable relation subsisting between the times of the periodic revolutions of the planets and that of the earth, the successive oppositions and conjunctions never take place at the same points of the orbits; therefore, by making a number of similar observations, as many different angles of elongation and radii vectores will be found, which, unless the orbits are circular, will all have different values. By computing, therefore, the values of these radii vectores in terms of the greater axis of the earth's orbit, and laying them down in their true positions round the sun, we shall obtain an approximation to the curve described by the planet on the plane of its orbit. A few observations of this sort will suffice to show that the orbit is eccentric; and as we have already seen that the solar orbit is an ellipse, analogy will immediately suggest the probability that that of the planet is also an ellipse, having the sun in one of its foci. It is easy to determine whether this be the case or otherwise. Three points given by position on a plane completely determine an ellipse of which a focus is known: having therefore computed an ellipse which satisfies three observations of a planet, its periphery, if the hypothesis of elliptic motion is correct, will comprehend all the places of the same planet computed from any other observations. Now, it is found that this is what takes place with regard to every one of the planets; hence results the first of the three laws discovered by Kepler which form the basis of the whole system of modern astronomy, namely, that the *orbits of the planets are ellipses, of which the sun occupies one of the foci.*

First law of Kepler.

By a comparison of the sectors formed by two contiguous radii vectores and the arcs included between them, with the time consumed by the planet in describing those arcs, Kepler was led to the discovery of the second great law of the planetary motions, namely, that *the areas described by the radius vector of a planet are proportional to the times employed in describing them.* The data from which this important conclusion was deduced were not rigorously exact; but the fact itself has been confirmed by an infinity of observations since the time of Kepler; and Newton, by the application of geometry to dynamics, demonstrated that it is *necessarily* true of all motions regulated by a central force, whatever the nature of that force may be.

Second law of Kepler.

Kepler having, by means of the most laborious computations, established the existence of these two laws with regard to each of the planets separately, next undertook to discover whether any analogy could be found regulating their mean distances from the sun. As there were only six planets known in his time, he commenced his investigation by comparing the intervals between their respective orbits with the five regular geometrical solids. Having failed in this speculation, and in various others suggested by a mind equally fertile and persevering, he at length, by a happy inspiration of genius, thought of comparing the mean distances of the planets with their respective periods of revolution, and soon perceived that the numbers which represent the periodic times of the planets, beginning with Mercury and ending with Saturn, increase in a much greater ratio than those representing their mean distances from the sun. Jupiter, for example, is *five* times more distant from the sun than the earth is; but his period is *twelve* times greater than that of the earth. Kepler then tried the various powers of the distances and periods. Unfortunately an error of computation for some time concealed the discovery from him; but having resumed the subject, he at length found, on the 15th of May 1618 (and few days, as Mr Playfair has remarked, are more memorable in the annals of science), with all the delight which a great and important discovery gives rise to, that *the squares of the numbers which express the times of revolution are to one another as the cubes of those which express the mean distances of the planets from the sun.*

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Third law of Kepler.

These three general laws, which are necessary consequences of the law of force varying directly as the masses and inversely as the squares of the distances, greatly facilitate the investigation of the orbit of a newly discovered planet, and may even be regarded as more accurate than the results obtained from any moderate number of observations, however exact. Thus, instead of having recourse to observation for the determination of the radius vector, which cannot be found by direct observation but with considerable difficulty, it is preferable to deduce it by means of the third law from the planet's periodic time, which can always be determined with great precision, and with much greater facility. They also afford a strong analogical proof of the annual motion of the earth. In fact, if we compute from the third law the periodic time of a body placed at the same distance from the sun as the earth is known to be, the result will give exactly the sidereal year. It is therefore certain that the earth obeys the same laws as the planets; and, when classed among them, the most perfect analogy pervades the whole system.

The periodic time of a planet may be determined by observing the interval which elapses between two consecutive passages through the same node. The retrograde movement of the nodes being, as we have seen, inconsiderable, the planet, in returning to its node, also returns to the same position very nearly with reference to the fixed stars, and therefore has in the interval completed a sidereal revolution. Hence the mean sidereal motion is known, and consequently, from the third law of Kepler, the planet's mean distance from the sun, the double of which is the transverse axis of the orbit. But the observation of the passages through the nodes not only gives the time of a sidereal revolution, but also approximate values of the eccentricity and the position of the line of the apsides; for, unless the orbit is circular, or the line of the apsides coincides with that of the nodes, the time the planet consumes in passing from the ascending to the descending node, or from ☊ to ☋, will be different from that in which it passes from ☋ to ☊; and, by a comparison of this difference with the theory of elliptic motion, it is easy to deduce the greatest difference between the true and mean anomalies, that is, the greatest equation of the centre, and thence the eccentricity. The method is exactly similar to that which has already been described in chap. ii. sect. 2.

But as these methods lead to results of no great accuracy, and as the passages through the nodes in the case of the distant planets occur only after considerable intervals of time, the astronomer requires some more accurate and expeditious means of determining the elements of an orbit; and three geocentric observations of the planet in any part of its orbit whatever are sufficient to determine these elements, when the nodes and inclination, mean motion and mean distance, are known. By the known

positions of the sun and planet relatively to the earth, the position of the planet with respect to the sun can be computed. Let then v, v', v'', represent three heliocentric longitudes of a planet, and π the longitude of the perihelion, all reduced to the plane of the orbit. The true anomalies corresponding to the three observations will consequently be $v-\pi$, $v'-\pi$, $v''-\pi$. Now, if, as in the series given in chapter ii. section 2, for the true anomaly in terms of the mean, we express the mean motion by n, and the time elapsed since the passage through the perihelion by t, the three corresponding mean anomalies will be respectively $n\,t$, $n\,t'$, $n\,t''$; and it will be observed, that although t is unknown, yet as $t'-t$ and $t''-t$ (the intervals between the first and the other two observations) are known, t' and t'' are both given in terms of t.

Omitting the square, and all the higher powers, of the eccentricity e, the series just referred to gives the three following equations,

$$n\,t = v - \pi - 2\,e\sin.(v-\pi)$$
$$n\,t' = v' - \pi - 2\,e\sin.(v'-\pi)$$
$$n\,t'' = v'' - \pi - 2\,e\sin.(v''-\pi)$$

from which we must deduce the three unknown quantities t, e, π, that is to say, the epoch of the planet's passage through the perihelion, the eccentricity, and the longitude of the perihelion. By subtracting the first of these equations from each of the other two, we obtain

$$n(t'-t) = v' - v - 2\,e\,[\sin.(v'-\pi) - \sin.(v-\pi)]$$
$$n(t''-t) = v'' - v - 2\,e\,[\sin.(v''-\pi) - \sin.(v-\pi)];$$

and if we assume

$$n(t'-t) - (v'-v) = a$$
$$n(t''-t) - (v''-v) = b$$

(a and b being thus known quantities), these two equations give us the two following,

$$a = -2\,e\,[\sin.(v'-\pi) - \sin.(v-\pi)]$$
$$b = -2\,e\,[\sin.(v''-\pi) - \sin.(v-\pi)];$$

whence, by division,

$$\frac{a}{b} = \frac{\sin.(v'-\pi) - \sin.(v-\pi)}{\sin.(v''-\pi) - \sin.(v-\pi)}$$

Now, the numerator of this fraction

$$= \sin.(v-\pi)\left\{\frac{\sin.(v'-\pi)}{\sin.(v-\pi)} - 1\right\}$$
$$= \sin.(v-\pi)\left\{\frac{\sin.v'\cos.\pi - \cos.v'\sin.\pi}{\sin.v\,\cos.\pi - \cos.v\sin.\pi} - 1\right\}$$
$$= \sin.(v-\pi)\left\{\frac{\sin.v' - \sin.v - \tan.\pi\,(\cos.v' - \cos.v)}{\sin.v - \cos.v\,\tan.\pi}\right\};$$

and, similarly, the denominator

$$= \sin.(v-\pi)\left\{\frac{\sin.v'' - \sin.v - \tan.\pi\,(\cos.v'' - \cos.v)}{\sin.v - \cos.v\,\tan.\pi}\right\};$$

therefore

$$\frac{a}{b} = \frac{\sin.v' - \sin.v - \tan.\pi\,(\cos.v' - \cos.v)}{\sin.v'' - \sin.v - \tan.\pi\,(\cos.v'' - \cos.v)};$$

whence

$$\tan.\pi = \frac{a(\sin.v'' - \sin.v) - b(\sin.v' - \sin.v)}{a(\cos.v'' - \cos.v) - b(\cos.v' - \cos.v)};$$

an equation which gives π, the longitude of the perihelion reduced to the orbit, the angles v, v', v'', being given by observation.

Having thus found π, and consequently $v-\pi$, $v''-\pi$, it is easy to determine the eccentricity e. From the equation

$$a = -2\,e\,[\sin.(v-\pi) - \sin.(v-\pi)]$$

we obtain

$$2e = -\frac{a}{\sin.(v'-\pi) - \sin.(v-\pi)};$$

a formula which may be rendered better adapted for logarithmic calculation by being put under the form

$$e = -\frac{a}{4\sin.\frac{v'-v}{2}\cdot\cos.\left(\frac{v'+v}{2} - \pi\right)}$$

By means of the values of e and $v-\pi$, which have now been found, we obtain t, the epoch of the passage of the planet through its perihelion, immediately from the equation

$$n\,t = v - \pi - 2\,e\sin.(v-\pi).$$

The only element which now remains undetermined is the radius vector, and this is given by the polar equation of the ellipse, viz.

$$r = \frac{a(1-e^2)}{1 + e\cos.(v-\pi)},$$

in which a represents the semi-axis major, or mean distance found by the third law of Kepler.

In this manner approximate values of the different elements are obtained, but no method can be proposed which will give them, without repeated corrections, so accurately as to accord with the precise observations of the present day; and the great object of the practical astronomer is to advance them gradually nearer and nearer to the truth. From the laws of Kepler applied to a few observations, formulæ are constructed which represent the mean values of the elliptic elements nearly; every successive observation gives a geocentric latitude and longitude; and by comparing these with the corresponding latitude and longitude computed from the formulæ, equations of condition are obtained, by means of which the formulæ are corrected and rendered still more exact. New observations give new equations of condition, to be joined with the former; and after a great number of such equations have been obtained, geometry teaches us how to combine them so that each may have its just influence in the determination of the final result. Thus the tables are gradually approximated to perfection, or to such a state that they differ only insensibly from the mean of a great number of observations.

But the great difficulty of obtaining an exact conformity between observation and the results of computation arises from the circumstance that the different elements of the orbits have no fixed values, but are incessantly though slowly varying, in consequence of the mutual disturbances which the planets occasion to the motions of each other. If the planets had no mutual attraction, and obeyed only the central force of the sun, the problem of determining the different circumstances of their motion would be one of easy solution, and each of them would accurately describe an ellipse on the plane of its orbit, according to the laws of Kepler. In consequence, however, of their mutual attraction, every planet is compelled to deviate more or less from its ellipse; so that when the matter is viewed with mathematical precision, the laws of Kepler belong only to an ideal system, and have no actual existence in nature. It is in the determination of the amount of these effects of perturbation, and the secular variations they give rise to, that the most profound and intricate theories of physical astronomy find their application; for it is from theory alone that we can derive any knowledge of the laws and periods of changes which are completed only after many hundreds or thousands of years. The planets whose motions are most disturbed by their mutual attractions are Jupiter and Saturn; and even with respect to them, observation, although it makes

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known the existence of inequalities, can neither detect their laws nor assign their periods. The only elements which are exempted from secular changes occasioned by the perturbing forces are the greater axes of the orbits, and the mean motions depending on them according to the third law of Kepler. The eccentricities of the orbits vary slowly. With regard to Mercury, Mars, and Jupiter, those elements are at the present time increasing; in the cases of Venus, the Earth, Saturn, and Uranus, they are diminishing. The perihelia are also gradually shifting their places on the planes of the orbits. These motions are direct in the case of all the planets excepting Venus, the perihelion of whose orbit, when referred to the fixed stars, moves in a direction contrary to that of the signs.

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The following table exhibits the mean motions of the planets, and the elements and positions of their ellipses on the planes of their orbits, at the commencement of the year 1801. For the four new planets the epoch is 1820.

Planet.	Mean Sidereal Revolution.	Mean Distance.	Eccentricity.	Secular Variation of Eccentricity.	Longitude of Perihelion.	Ann. Var. of Longitude of Perihelion.	Mean Longitude of Planet.
Mercury	$87^d\cdot969258$	0·387098	0·20551494	+ 0·00000386	74° 21′ 46″·9	+ 55″·9	166° 0′ 48″·6
Venus...	224·700786	0·723331	0·00686074	— 0·00006271	128 43 53·1	+ 47·4	11 33 3·0
Earth....	365·256361	1·000000	0·01678356	— 0·00004163	99 30 5·0	+ 61·8	100 39 10·2
Mars.....	686·979645	1·523692	0·09330700	+ 0·00009017	332 23 56·6	+ 65·9	64 22 55·5
Vesta....	1325·743100	2·367870	0·08913000	+ 0·00000401	249 33 24·4	+ 94·2	278 30 0·4
Juno.....	1592·660800	2·669009	0·25784800		53 33 46·0		200 16 19·1
Ceres....	1681·393100	2·767245	0·07843900	— 0·00000583	147 7 31·5	+ 121·3	123 16 11·9
Pallas....	1686·538800	2·772886	0·24164800		121 7 4·3		108 24 57·9
Jupiter...	4332·584821	5·202776	0·04816210	+ 0·00015935	11 8 34·6	+ 57·1	112 15 23·0
Saturn...	10759·219817	9·583786	0·05615050	— 0·00031240	89 9 29·8	+ 69·5	135 20 6·5
Uranus...	30686·820829	19·182390	0·04667938		167 31 16·1	+ 52·5	177 48 23·0

3. *Of the real Dimensions of the Planetary Orbits, and the Transits of Venus and Mercury over the Sun's Disk.*—In what has hitherto been said respecting the mean distances of the planets from the sun, those distances have been estimated in parts of the semi-axis major of the earth's orbit; a convenient scale, which enables us to form a very precise idea of the relative dimensions of the several orbits, and likewise serves to express their absolute dimensions, provided we can determine the distance between the sun and the earth in terms of any measure with which we are familiar. It is evident, indeed, in consequence of the relation that subsists between the mean distances and mean motions, that it is only necessary to determine the mean distance of any one of the planets from the sun, in order to determine the mean distances of all the others, and assign the dimensions of the whole solar system. Now there are various ways of determining the sun's distance from the earth in terms of the earth's semidiameter. The distance of a planet from the sun may likewise be obtained if we can find the means of measuring its distance from the earth at any epoch; for the geocentric positions of the sun and the planet being known from the theory of their motions, the radius vector of the orbit, or planet's distance from the sun at that epoch, may be found by a simple trigonometrical computation. To determine the distance of a planet from the earth, it might seem only necessary to determine its horizontal parallax; but in general the parallaxes of the planets are quantities by far too small to be directly observed. That of Mars, however, becomes very appreciable in particular circumstances, that is to say, when Mars is in opposition with the sun, and at the same time near the perihelion of his orbit. Thus, in the year 1751, on the 6th of October, that planet, being near his opposition, was observed at the same instant of time by Lacaille at the Cape of Good Hope, and by Wargentin at Stockholm; and the horizontal parallax deduced from the two observations, in the manner explained in chap. i. sect. 2, was found to amount to 24″·6. Now the distance of the planet being equal to unity divided by the sine of the horizontal parallax, the distance of Mars from the earth at the time of the observation was consequently

$$1 \div \frac{24''\cdot6 \times 3\cdot1416}{180^\circ \times 60 \times 60} = \frac{648000}{77\cdot28} = 8381 \text{ terrestrial radii.}$$

But the distance of Mars from the earth at that time, as computed from the theory of his elliptic motion, was 0·435 parts of the radius of the earth's orbit; consequently the whole length of that radius is $\frac{8381}{0\cdot435} = 19226$ semidiameters of the earth. Hence the distance of Mars from the sun = 19226 + 8381 = 27607 semidiameters of the earth. It will be remarked that these numbers are only approximative, our present object being to explain the method, and not to determine the exact quantities.

But besides the inconvenience attending the determination of a planet's distance by this method, which requires observations to be made simultaneously on opposite sides of the earth, the method is in itself liable to great uncertainty. The error of a result is always in a certain proportion to the error of observation, and in the present case a very large quantity is to be determined from a very small one; hence a very slight error of observation will occasion a very erroneous result in the computation of the mean distance. It would be difficult in a single observation of this nature to answer for an error of 2″; but here 2″ is a twelfth part of the whole parallax; consequently an uncertainty amounting to a twelfth part affects the mean distance.

A much more accurate method of determining the sun's distance, and thence the dimensions of the planetary orbits, is afforded, though rarely, by the transits of Venus over the sun's disk. When Venus is at her inferior conjunction, and at the same time very near her node, her body will be projected on the disk of the sun; and through the effect of her proper motion, combined with that of the earth, she will appear as a dark spot passing over the disk, and describing a chord which will be seen under different aspects by spectators placed at different points on the earth, because, by reason of the parallax, they refer the planet to different points on the solar disk. The position of the spectator not only occasions a difference in the apparent path described by the planet, but has also a very sensible influence on the duration of the transit, in consequence of which the parallaxes both of Venus and the sun can be determined with great exactness. In order to illustrate this, let E (fig. 73) represent the earth, V Venus, and S the sun. An observer placed at E, the centre of the earth, would see Venus in the di-

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rection of the visual ray EV: she would consequently appear to him projected on the sun's disk at S, and in her successive positions would appear to describe the line DS. Other observers placed at O′ and O″ on the earth's surface would see the planet at V′ and V″: to the first she would appear to describe the chord D′V′, and to the second D″V″. This is a necessary result of the difference of the parallaxes of Venus and the sun; and as the chords D′V′, D″V″ differ in length according as they are more or less remote from the centre of the disk, the duration of the transit will be longer or shorter according to the situation of the observer and the geocentric latitude of the planet. If by reason of the relative parallax the time of a transit is longer than the true time in one hemisphere, it will be shorter in the opposite; and hence the difference of the times (which may be observed with great accuracy) at places having very different latitudes may serve to determine the relative parallax, or the difference between the parallax of Venus and that of the sun. But the parallaxes are reciprocally proportional to the distances; and the ratio of the distances being known, therefore the ratio of the parallaxes is also known; and having thus the ratio and the difference of the two parallaxes, it is easy to compute the separate amount of each.

This particular application of the transits of Venus to the determination of the sun's distance was first pointed out by Dr Halley, when he announced the transits of 1761 and 1769. Kepler had before announced the occurrence of a transit, but he regarded it only as a curious, and till that time unobserved, phenomenon.

The transit of Venus which occurred in 1769 was anxiously expected by astronomers, and observed in many different parts of the world. The result of the whole of the observations renders it extremely probable that the parallax of the sun is included within the limits of 8″·5 and 8″·7. The mean 8″·6 has been adopted by Delambre and Lalande. From the following table, computed from the different observations, and published by Delambre in the second volume of his *Astronomie*, p. 505, an idea may be formed of its probable accuracy. Delambre, indeed, remarks that the sun's parallax is now sufficiently well known for all the practical purposes of astronomy.

Places of Observation.	Deduced Difference of Parallaxes.	Sun's Parallax.
Otaheite, Wardhus	21″·561	8″·7094
Otaheite, Kola	21 ·166	8 ·5503
Otaheite, Cajaneburg	20 ·762	8 ·3865
Otaheite, Hudson's Bay	21 ·066	8 ·5036
Otaheite, Paris and Petersburg	21 ·730	8 ·7780
California, Wardhus	21 ·330	8 ·6160
California, Kola	20 ·765	8 ·3880
California, Cajaneburg	20 ·208	8 ·1630
California, Hudson's Bay	20 ·284	8 ·1521
California, Paris and Petersburg	21 ·576	8 ·7155
Hudson's Bay, Wardhus	22 ·592	9 ·1260
Hudson's Bay, Kola	20 ·941	8 ·4589
Hudson's Bay, Cajaneburg	20 ·233	8 ·1730
Hudson's Bay, Paris and Petersburg	22 ·897	9 ·2491

Here the mean of the first 5 results is nearly...8″·59
of the next 5.....8 ·41
of the next 4.....8 ·75
of all.....8 ·57

Having once obtained the value of the solar parallax, it is easy to deduce the sun's distance, and consequently the dimensions of all the planetary orbits. For this purpose we have

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sin. 8″·6 : 1 :: radius of earth : sun's distance;

that is, on reducing the radius of a circle to seconds,

$$\text{sun's distance} = \frac{\text{earth's radius}}{8''\cdot6 \times \sin. 1''} = 23984 \text{ terrestrial radii.}$$

Now, if we assume the semidiameter of the earth to be 4000 miles in round numbers, the distance of the sun, or radius of the earth's orbit, will consequently be 23984×4000=95936000 miles approximately.

By means of this value the mean distances of the planets from the sun, which in the table given above were expressed in terms of the mean distance of the earth, may be converted into miles. The following are the results in round numbers.

Planet.	Mean Distance from the Sun in Miles.
Mercury	37,000,000
Venus	68,000,000
Earth	95,000,000
Mars	142,000,000
Ceres	262,000,000
Jupiter	485,000,000
Saturn	890,000,000
Uranus	1,800,000,000

Periodic recurrence of the transits.

The transits of Venus being phenomena of great importance, in consequence of their practical application to the problem of the sun's distance, it becomes interesting to determine the periods at which they successively occur. It is evident that, by reason of the inclination of the orbit, they can only take place when Venus is very near one of her nodes. Two conditions must therefore be satisfied: Venus must be within a short distance of her node, and at the same time in her inferior conjunction. Now, the interval between two successive conjunctions, that is, the period of a synodic revolution, is easily deduced from the sidereal revolutions of the planet and the earth. Thus, generally, let A and B be two planets, T and t the times of their sidereal revolutions respectively, and suppose T to be greater than t. In the time T, A describes a complete circumference, therefore $T : t :: 1 : \frac{t}{T}$ = part of a circumference described by A in the time t. But during the same time t, B describes a whole circumference; therefore $1 - \frac{t}{T}$ is what B gains on A in the time t. But the successive conjunctions will always take place when B has gained a whole circumference; therefore, denoting by S the interval between two successive conjunctions, we have $1 - \frac{t}{T} : 1 :: t : S$, whence $S = \frac{Tt}{T-t}$.

From this simple formula the synodic revolution of any of the planets is found by substituting for T and t the times of the sidereal revolutions of the earth and planet. Suppose, for example, we wish to find the time of a synodic revolution of Mercury. In this case T=365·256 days, and t = 87·969 days; consequently $T - t$ = 277·287, and

$$S = \frac{365\cdot256 \times 87\cdot969}{277\cdot287} = 115\cdot877 \text{ days,}$$

which, therefore, is the time of a synodic revolution of Mercury.

In the case of Venus we have t = 224·700, whence $T - t$ = 365·256 − 224·700 = 140·556, and consequently

$$S = \frac{365\cdot256 \times 224\cdot700}{140\cdot556} = 583\cdot93 \text{ days;}$$

which is the period of her synodic revolution.

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Let us next attend to the other condition which must be satisfied before a transit can take place, namely, that the planet has returned to its node as well as to its inferior conjunction. If we represent by m the number of revolutions of the earth in the required period, and by n the number of synodic revolutions of the planet in the same time, it is evident that we shall have $m\mathrm{T} = \frac{n\mathrm{T}t}{\mathrm{T}-t}$, whence $\frac{m}{n} = \frac{t}{\mathrm{T}-t}$. In the case of Mercury, therefore, $\frac{m}{n} = \frac{87969}{277287}$; that is to say, after 87969 years, in the course of which Mercury will have been 277287 times in conjunction, the earth and Mercury will be again in conjunction, occupying the same points of their orbits as at the commencement of the period, supposing the nodes fixed. But periods of such enormous length are of no practical use: it is necessary to find an approximating ratio expressed by smaller numbers. For this purpose it is convenient to have recourse to the method of continued fractions, from which the following series is obtained:—

$$\frac{87969}{277287} = \frac{1}{3} + \frac{1}{6} + \frac{1}{11} + \frac{1}{1} + \frac{1998}{5691}.$$

Here the first approximating fraction is $\frac{1}{3}$, which denotes that in one year, during which there will happen three synodic periods, Mercury will not be very far from his conjunction, nor from the same point of his orbit in which he was at the commencement of that time. The next approximation is $\frac{1}{3} + \frac{1}{6} = \frac{6}{19}$, showing that after six years, during which there will have been 19 conjunctions, Mercury will be again nearly in conjunction at the same point of his orbit. By continuing the process we obtain the following series of fractions, each approaching nearer to $\frac{87969}{277287}$, namely,

$$\frac{1}{3}, \frac{6}{19}, \frac{7}{22}, \frac{13}{41}, \frac{33}{104}, \frac{46}{145}, \text{ \&c.}$$

of which the numerators express the number of years, and the denominators the corresponding number of synodic revolutions.

Approximative fractions might be found in the same manner to express the ratio of the number of revolutions of Mercury to those of the earth, or of $\frac{t}{\mathrm{T}}$; but it is unnecessary to have recourse again to division, inasmuch as they are easily obtained from the above. For example, since the fraction $\frac{1}{3}$ denotes that Mercury has *gained* three revolutions on the earth in one year, it is evident that he must have completed $3+1=4$ revolutions. In the same way, in six years Mercury gains 19 on the earth, or completes $19+6=25$. Hence, in the series required the numerators of the fractions will continue the same as in the series above, while the denominators will be the sums of the terms of the corresponding fractions. The new series will therefore be

$$\frac{1}{4}, \frac{6}{25}, \frac{7}{29}, \frac{13}{54}, \frac{33}{137}, \frac{46}{191}, \text{ \&c.}$$

the numerators being the number of years, and the denominators the corresponding periods of Mercury.

Applying to the case of Venus and the earth the formula $\frac{m}{n} = \frac{t}{\mathrm{T}-t}$, we shall have $t = 224{\cdot}7008$, $\mathrm{T}-t = 365{\cdot}2563 - 224{\cdot}7008 = 140{\cdot}5555$; therefore $\frac{m}{n} = \frac{2247008}{1405555}$.

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The series of fractions approximating to this ratio, obtained in the manner indicated above, is

$$\frac{1}{1}, \frac{2}{1}, \frac{3}{2}, \frac{8}{5}, \frac{227}{142}, \frac{235}{147}, \frac{243}{152}, \text{ \&c.}$$

the numerators of which, as before, express the years, and the denominators the synodic periods. Taking the fourth fraction of the series, it appears that after eight years, in which there are five synodic periods, Venus will again occupy nearly the same position with respect to the earth and the nodes of her orbit. This will take place more nearly after 227 years, and more nearly still after 235; consequently, 235 years after a transit has taken place, the occurrence of another may be expected with great probability. The alteration, however, which takes place in the position of the line of the nodes, which in the preceding computations we have regarded as fixed, renders the numbers a little uncertain.

Since Venus returns to her conjunction at nearly the same point of her orbit after eight years, it may happen, and sometimes indeed actually does happen, that a transit will take place in about eight years after the occurrence of a former one. But in that time the latitude of Venus, in consequence of the inclination of her orbit, undergoes a variation amounting to 20′ or 24′; in sixteen years the change of latitude increases to 40′ or 48′, which is considerably greater than the diameter of the sun. It cannot happen, therefore, that three transits will take place within sixteen years. From the above series of fractions we might infer that another could not take place before 227 years; but that series was obtained on the supposition that the transits only happen when Venus returns to the *same* node; and it is evident that they may equally occur when the planet is near the other node, and consequently after an interval of half the length of the former, or 113 years. If, at the occurrence of the first transit, Venus has passed her node, the next will happen eight years sooner; or, if she has not reached the node, eight years later. Hence, after two transits have occurred within eight years, another cannot be expected before 105, 113, or 121 years, that is, 113 ± 8 years. But these periods sometimes fail: that of 235 brings about the phenomenon with greater certainty, and 243 (which is the double of 121) is the surest of all. The periods of 235 and 251 are that of 243 diminished or augmented by 8. The whole calculation, therefore, reduces itself to periods of 121 and ± 8 years. The last transits took place in 1761 and 1769; the next will not happen till the years 1874 and 1882; and thus the infrequency of these phenomena adds to the interest they derive from their real importance.

Delambre has given a list of all the transits of Venus for a period of 2000 years, from which the following is extracted. (*Astronomie*, tome ii. p. 473.)

Year.	Month.	Mean Time (at Paris) of Conjunction.	Node.
1631	Dec. 6.	17h 28m 40s	☊
1639	Dec. 4.	6 9 40	☊
1761	June 5.	17 44 34	☋
1769	June 3.	10 7 54	☋
1874	Dec. 8.	16 17 44	☊
1882	Dec. 6.	4 25 44	☊
2004	June 7.	21 0 44	☊

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SECT. III.—*Of the Physical Constitution of the Planets, their Magnitude, Rotation, and other remarkable objects.*

Mercury.

Mercury is a small body, but emits a very bright white light, though, by reason of his always keeping near the sun, he is seldom to be seen; and when he does make his appearance, his return to the sun is so rapid, that he can only be discerned for a short space of time. Delambre was able to observe him only twice with the naked eye.

Mercury is about 3140 English miles in diameter, and his mean distance from the sun about 37 millions of miles. On account of his smallness and brilliancy it is extremely difficult to find any spot on his disk so distinctly marked as to afford the means of determining his rotation. Besides, by reason of his proximity to the sun, an observation of a spot, if made in the evening, can scarcely be well begun before the planet sets; or, if in the morning, before the increasing twilight renders the spot invisible. Hence it is only possible to observe daily a very small arc of a small circle; and if the spot re-appears on the succeeding day, it is doubtful whether the arc which it has passed over exhibits the whole motion, or if one or more circumferences ought to be added. By an attentive observation of the variations of the phases of Mercury, Schroeter has, however, remarked that he revolves about his axis in the space of 24 hours 5 minutes 30 seconds. M. Harding discovered in 1801 an obscure streak on the southern hemisphere of the planet, the observations of which, together with those of a spot discovered by Schroeter, gave the same period of rotation. The results of Schroeter's researches on Mercury may be summed up as follows: 1*st*, The apparent diameter of Mercury at his mean distance is 6″·02; 2*d*, His form is spherical, exhibiting no sensible compression; 3*d*, His equator is very considerably inclined to his orbit, and the differences of his days and seasons must consequently be very great; 4*th*, There are mountains on his surface which cast very long shadows, and of which the height bears a greater proportion to the diameter of the planet than those of the Earth, the Moon, or even of Venus. The height of Chimboraço is $\frac{1}{1017}$ of the radius of the earth; one of the mountains in the moon has been estimated at $\frac{1}{214}$ of her radius; the highest in Venus at $\frac{1}{144}$; and one in Mercury at $\frac{1}{120}$. The highest mountains are in the southern hemisphere, which is also the case in respect of the Earth and Venus. There are no observations to prove decisively whether Mercury is surrounded by an atmosphere.

Venus.

Venus, the most beautiful object in the heavens, is about 7700 English miles in diameter, and placed at the distance of 68 millions of miles from the sun. Although the oscillations of this planet are considerably greater than those of Mercury, and she is seldom invisible, yet on account of the uniform brilliancy of her disk, it is extremely difficult to ascertain the period of her rotation. Dominic Cassini, after having long fruitlessly attempted to discover any object on her surface so well defined as to enable him to follow its motions, at length, in 1667, perceived a bright part, distant from the southern horn a little more than a fourth part of the diameter of the disk, and near the eastern edge. By continuing his observations on this spot, Cassini concluded the rotation of Venus to be performed in about 23 hours; but he does not seem to have considered this conclusion as deserving of much confidence. In the year 1726 Bianchini, an Italian astronomer, made a number of similar observations for the same purpose, from which he inferred that the rotation of the planet is performed in 24 days 8 hours. The younger Cassini has shown, however, that the observations of Bianchini, as well as those of his father, could be explained by a rotation of 23 hours and 21 or 22 minutes, whereas the rotation of 24 days 8 hours cannot be reconciled with the appearances observed by the elder Cassini. The determination of Cassini was regarded by astronomers as the more probable of the two, particularly as Bianchini was not able to make his observations in a connected manner, on account that a neighbouring building intercepted his view of the planet, [illegible] aim to transport his telescope to a different situation. The question of the rotation of Venus was finally settled by Schroeter, who found it to be performed in 23 hours 21 minutes 19 seconds. Each of the three observers found the inclination of the axis of rotation to the axis of the ecliptic to be about 75°. Some doubt, however, still exists with respect to the value of this element.

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Schroeter's observations on this planet were principally directed to a mountain situated near the southern horn. The line which joins the extremities of the horns is always a diameter; and the horns of the crescent of a perfect sphere ought to be sharp and pointed. Schroeter remarked that this was not always the case with regard to the horns of Mercury and Venus. The northern horn of the latter always preserved the pointed form, but the southern occasionally appeared rounded or obtuse,—a circumstance which indicated that the shadow of a mountain covered the part B*o* (fig. 74), so that the line joining the extremities of the horns appeared to be A*o*, and not AB (the diameter of the circular disk); but at *d*, beyond *o*B, he remarked a luminous point, which he supposed to be the summit of another mountain, illuminated by the sun after he had ceased to be visible to the rest of that hemisphere. Now, in order that the horn of the crescent may appear obtuse in consequence of the shadow of a mountain falling upon it, and another mountain *d* present a luminous point, the two mountains must be at the same time both at the edge of the disk and on the line separating the dark from the enlightened part of the planet. But this position cannot be of long continuance; for the rotation will cause *d* to rise into the enlightened part, or sink into the dark hemisphere, and in either case the mountain will cease to be visible. If, however, the rotation is completed in 23 hours 21 min., the mountain *d* will appear 39 min. sooner than it did on the previous day; for in the course of a day the boundary of light and darkness will hardly have shifted its position on the surface of the planet through the effects of the orbital motion. Hence it is possible to obtain several consecutive observations, from which an approximate value of the period may be found; and this being once obtained, it may be rendered still more exact by observations separated from each other by a longer interval. Thus Schroeter found that an interval of 20 days 11 hours 15 min. between two apparitions of the mountain being divided by 23 hours 21 min., gave 21·04 revolutions. That intervals of 121 days 14 hours 25 min., 142 days 1 hour 40 min., 155 days 18 hours 11 min., divided each by 23 hours 21 min., gave 125·01, 146·02, 160·09 revolutions respectively. All these comparisons prove that the revolution of 23 hours 21 min. is somewhat too short. They ought to have given 21, 125, 146, and 160 revolutions exactly, supposing the observations to have been perfectly accurate. On dividing the intervals by 21, 125, 146, and 160 respectively, the quotients will be each the time of a revolution very nearly; and by taking a mean among the whole, the most pro-

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table result at least will be obtained. In this manner Schroeter found the period of rotation already stated, namely, 23 hours 21 min. 19 sec.

Since the time of rotation of Mercury and Venus is nearly equal to that of the earth, the compression of these planets at the poles, which results from the centrifugal force, ought also to be nearly in the same proportion. But at the distance of the earth the compression must be imperceptible even in the case of Venus; for, supposing it to amount to $\frac{1}{300}$, the difference between the radius of her poles and that of her equator would only amount to a tenth of a second as seen from the earth.

Atmosphere of Venus.

During the transits of Venus over the sun's disk in 1761 and 1769 a sort of penumbral light was observed round the planet by several astronomers, which was occasioned, without doubt, by the refractive powers of her atmosphere. Wargentin remarked that the limb of Venus which had gone off the sun showed itself with a faint light during almost the whole time of emersion. Bergman, who observed the transit of 1761 at Upsal, says that at the ingress the part which had not come upon the sun was visible, though dark, and surrounded by a crescent of faint light, as in fig. 75; but this appearance was much more remarkable at the egress: for as soon as any part of the planet had disengaged itself from the sun's disk, that part was visible with a like crescent, but brighter (fig. 76). As more of the planet's disk disengaged itself from that of the sun, the part of the crescent farthest from the sun grew fainter, and vanished, until at last only the horns could be seen, as in fig. 77. The total immersion and emersion were not instantaneous; but as two drops of water, when about to separate, form a ligament between them, so there was a dark shade stretched out between Venus and the sun, as in fig. 78; and when this ligament broke, the planet seemed to have got about an eighth part of her diameter from the limb of the sun (fig. 79). The numerous accounts of the two transits which have been published abound with analogous observations, indicating the existence of an atmosphere of considerable height and density. Schroeter calculated that its horizontal refraction must amount to 30′ 34″, differing little from that of the terrestrial atmosphere. A twilight which he perceived on the cusps afforded him the data from which he deduced this conclusion.

Cassini and Montaigne imagined that they had observed a satellite accompanying Venus; but this appears to have been an optical illusion arising from the strong light of the planet reflected back from the convex surface of the eye upon the eye-glass of the telescope, and thence reflected a second time back to the eye. This hypothesis at least will explain the appearances which they have described; and although astronomers have sought for this pretended satellite with great care, they have neither observed it on the sun during the transits of Venus in 1761 and 1769, nor in any other part of her orbit.

Mars.

After Venus, Mars is the planet whose orbit is nearest to the earth. His diameter is about one half, and his volume only about one sixth part of that of our globe. He is of a dusky reddish colour, by reason of which he is easily recognised in the heavens. His mean distance from the sun is about 142 millions of miles.

The rotation of Mars was suspected before the year 1643 by Fontana, a Neapolitan astronomer; but it was reserved for Cassini to demonstrate its existence and assign its period. Cassini began to observe the spots on the surface of Mars at Bologna in 1666; and after having continued his observations for a month, he found they returned to the same situation in 24 hours and 40 min. The planet was observed by some astronomers at Rome with longer telescopes; but they assigned to it a rotation of 13 hours only. This, however, was afterwards shown by Cassini to have arisen from their not distinguishing between the opposite sides of the planet, which, it seems, have spots pretty much alike. He made further observations on the spots of this planet in 1670; which confirmed his former conclusion respecting the time of rotation. The spots were again observed in subsequent oppositions, particularly for several days in 1704 by Maraldi, who took notice that they were not always well defined, and that they not only changed their shape frequently in the interval between two oppositions, but even in the space of a month. Some of them, however, continued of the same form long enough to allow the time of the planet's rotation to be determined. Among these there appeared that year an oblong spot, resembling one of the belts of Jupiter when broken. It did not reach quite round the body of the planet; but had, not far from the middle of it, a small protuberance towards the north, so well defined that Maraldi was thereby enabled to fix the period of its revolution at 24 hours 39 min., only one minute less than what Cassini had determined it to be.

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The near approach of Mars to the earth in 1719 afforded an excellent opportunity of observing him, as he was then within $2\frac{1}{2}°$ of his perihelion, and at the same time in opposition to the sun. His apparent magnitude and brightness were thus so much increased, that he was by the vulgar taken for a new star. His appearance at that time, as seen by Maraldi through a telescope of 34 feet long, is represented in fig. 80. There was then a long belt that reached half-way round, to the end of which another shorter belt was joined, forming an obtuse angle with the former, as in fig. 81. This angular point was observed on the 19th and 20th of August, a little to the east of the middle of the disk; and 37 days after, on the 25th and 26th of September, it returned to the same situation. This interval, divided by 36, the number of revolutions contained in it, gives 24 hours 40 minutes for the period of one revolution; a result which was verified by another spot of a triangular shape, one angle whereof was towards the north pole, and the base towards the south, and which on the 5th and 6th of August appeared as in fig. 82. After 72 revolutions it returned to the same situation on the 16th and 17th of October. Some of the belts of this planet are said to be parallel to his equator; but that seen by Maraldi was very much inclined to it.

Bright spots about the poles of Mars.

Besides these dark spots on the surface of Mars, astronomers had noticed that a segment of his globe about the south pole exceeded the rest of his disk so much in brightness, that it appeared to project as if it were the segment of a larger globe. Maraldi informs us that this bright spot had been taken notice of for 60 years, and was more permanent than the other spots on the planet. One part of it is brighter than the rest, and the least bright part is subject to great changes, and has sometimes disappeared.

A similar though less remarkable brightness about the north pole of Mars was also sometimes observed, the existence of which has been confirmed by Sir W. Herschel, who examined the planet with telescopes of much greater power than any former astronomer ever was in possession of. A very full account of Herschel's observations on this planet is given in the 74th volume of the *Philosophical Transactions*. Some of the remarkable appearances there described are represented in fig. 83–88. The magnifying powers he used were sometimes as high

Herschel's account of these spots.

as 932; and with this the south polar spot was found to be 41″′ in diameter. Fig. 96 shows the connection of the other figures marked 89, 90, 91, 92, 93, 94, 95, which complete the whole equatorial succession of spots on the disk of the planet. "The centre of the circle," Herschel observes, "marked 90, is placed on the circumference of the inner circle, by making its distance from the circle, marked 92, answer to the interval of time between the two observations, properly calculated and reduced to sidereal measure. The same is done with regard to the circles marked 91, 92, &c.; and it will be found by placing any one of these connected circles in such a manner as to have its contents in a similar situation with the figures in the single representation, which are marked with the same number, that there is a sufficient resemblance between them; though some allowance must be made for the distortions occasioned by this kind of projection."

From these observations Herschel concluded that the diurnal rotation of Mars is accomplished in 24 hours 39 minutes 21⅔ seconds; that his equator is inclined to his orbit in an angle of 28° 42′, and his axis of rotation to the axis of the ecliptic in an angle of 30° 18′. Hence the time of rotation and the seasons of this planet are little different from those of the earth.

The bright appearance so remarkable about the poles of Mars is ascribed by Herschel to the reflection of light from mountains of ice and snow accumulated in those regions. "The analogy between Mars and the earth," says he, "is perhaps by far the greatest in the whole solar system. Their diurnal motion is nearly the same, the obliquity of their respective ecliptics not very different; of all the superior planets, the distance of Mars from the sun is by far the nearest alike to that of the earth; nor will the length of the Martial year appear very different from what we enjoy, when compared to the surprising duration of the years of Jupiter, Saturn, and the Georgium Sidus. If we then find that the globe we inhabit has its polar region frozen and covered with mountains of ice and snow, that only partly melt when alternately exposed to the sun, I may well be permitted to surmise, that the same causes may probably have the same effect on the globe of Mars; that the bright polar spots are owing to the vivid reflection of light from frozen regions; and that the reduction of those spots is to be ascribed to their being exposed to the sun."

Since the discovery of the flattened form of the earth, it was to be presumed that the rotation of the other planets would produce a similar effect on their figures, and this supposition has been fully confirmed by observation. The time of the rotation of Mars is nearly equal to that of the earth, but his diameter being only about half that of the earth, the velocity of a point on his equator is consequently only half as great as that of a point on the earth's equator: hence we might expect that the deviation of his figure from a perfect sphere would be much less considerable. The contrary, however, appears to be the case; and his compression seems to be much greater than that of the earth. According to Herschel, the ratio of his equatorial and polar axes is 103 to 98. Schroeter estimates the same ratio to be that of 81 to 80. This remarkable compression at the poles of Mars arises in all probability from considerable variations of density in the different parts of his globe.

Atmosphere of Mars.

It has been commonly related by astronomers, that the atmosphere of this planet is possessed of such strong refractive powers as to render invisible the small fixed stars near which it passes. Dr Smith relates an observation of Cassini, in which a star in the water of Aquarius, at the distance of six minutes from the disk of Mars, became so faint before its occultation, that it could not be seen by the naked eye, nor even with a three feet telescope. This would indicate an atmosphere of a very extraordinary size and density; but the following observations of Herschel seem to show that it is of much smaller dimensions. "1783, Oct. 26th. There are two small stars preceding Mars, of different sizes; with 460 they appear both dusky red, and are pretty unequal; with 218 they appear considerably unequal. The distance from Mars of the nearest, which is also the largest, with 227, measured 3′ 26″ 20″′. Some time after, the same evening, the distance was 3′ 8″ 55″′, Mars being retrograde. Both of them were seen very distinctly. They were viewed with a new 20 feet reflector, and appeared very bright. October 27th: the small star is not quite so bright in proportion to the large one as it was last night, being a good deal nearer to Mars, which is now on the side of the small star; but when the planet was drawn aside, or out of view, it appeared as plainly as usual. The distance of the small star was 2′ 5″ 25″′. The largest of the two stars," adds he, "on which the above observations were made, cannot exceed the 12th, and the smallest the 13th or 14th magnitude; and I have no reason to suppose that they were any otherwise affected by the approach of Mars, than what the brightness of its superior light may account for. From other phenomena it appears, however, that this planet is not without a considerable atmosphere; for, besides the permanent spots on its surface, I have often noticed occasional changes of partial bright belts, and also once a darkish one in a pretty high latitude; and these alterations we can hardly ascribe to any other cause than the variable disposition of clouds and vapours floating in the atmosphere of the planet."

Ceres, Pallas, Juno, and Vesta.

The commencement of the present century was rendered remarkable in the annals of astronomy by the discovery of four new planets circulating between Mars and Jupiter. Kepler, from some analogy which he found to subsist among the distances of the planets from the sun, had long before suspected the existence of one at this distance; and his conjecture was rendered more probable by the discovery of Uranus, with regard to which the analogy of the other planets is observed. So strongly, indeed, were astronomers impressed with the idea that a planet would be found between Mars and Jupiter, that, in the hope of discovering it, Baron Zach formed an association of 24 observers, who divided the sky into as many zones, and undertook each to explore one carefully. A fortunate accident anticipated a discovery which might have required years of toil. An error in the catalogue of Wollaston, who had laid down a star in a position in which it is not to be found, engaged Piazzi, the superintendent of the observatory at Palermo, to observe for several successive days all the small stars in the neighbourhood of the place indicated. On the first day of the present century, the 1st of January 1801, he observed a small star in Taurus, which, on the day following, appeared to have changed its place. On the 3d he repeated his observation, and was then satisfied that it had a diurnal motion of about 4′ in right ascension, and 3′½ in declination towards the north pole. He continued to observe it till the 23d, when he communicated his discovery to MM. Bode and Oriani, giving them the positions of the star on the 1st and 23d, and only adding, that between the 11th and 13th its motion had changed from retrograde to direct. Before the communication reached them, however, the planet was lost in the sun's rays; and, owing to its ex-

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treme smallness. the difficulty of finding it after its emergence was so great, that it was not again seen till the 31st of the following December, when it was detected by Zach. In this was recognised the planet which Kepler had suspected to circulate between Mars and Jupiter. Piazzi, in honour of Sicily, gave it the name of the tutelary goddess of that country, *Ceres;* and her emblem, the sickle, ☽, has been adopted as its appropriate symbol.

Ceres is of a reddish colour, and appears to be about the size of a star of the eighth magnitude. The eccentricity of her orbit is somewhat greater than that of Mercury; and its inclination to the ecliptic greater than that of any of the old planets. The distance of Ceres from the sun is about 3·2 times that of the earth, or nearly 270 millions of miles. Schroeter found her apparent diameter to be 2″, corresponding to about 1624 miles; but Herschel reduced this measurement to 0″·5, which would indicate a diameter of about 160 miles. The nebulosity which surrounds the planet renders it almost impossible to distinguish the true disk; and hence arises the great discrepancy between the above estimates of its magnitude. From a great number of observations, Schroeter inferred that Ceres has a dense atmosphere, rising to the height of no less than 675 English miles above the planet, and subject to numerous changes. On this account he conceives that there is little chance of discovering the period of its rotation.

Discovery of Pallas.

The difficulty of finding Ceres induced Dr Olbers of Bremen to examine with particular care the configurations of all the small stars situated near her geocentric path. On the 28th of March 1802 he observed a star of the seventh magnitude, which formed an equilateral triangle with the stars 20 and 191 of Virgo in Bode's catalogue. He was certain that he had never seen a star in that place before, and at first imagined it might be one of those which are subject to periodical changes of brilliancy; but after examining it for two hours, he remarked that its right ascension was diminishing, while its northern declination continued to augment nearly in the same manner as had been the case with Ceres when that planet was first seen by him in almost the same position. On the following day he found its right ascension had diminished 10′, while its northern declination had increased 20′. From observations continued during a month, M. Gauss calculated an elliptic orbit, the eccentricity of which amounted to ·24764, much greater than that of any of the other planets. He also found its inclination to be 34° 39′, exceeding the aggregate inclinations of all the other planetary orbits; and its mean distance 2·770552, almost the same as that of Ceres. On account of these three circumstances, the new planet, otherwise of little importance, became the most singular in the whole system. One planet had been suspected to exist between Mars and Jupiter, and two were now discovered. The great inclination of the last rendered it necessary to enlarge the boundaries of the zodiac; but the extent of the zodiac is entirely arbitrary, and had been limited by the extreme latitudes of Venus. There is no reason, as Delambre remarks, why it may not be extended even to the poles. Dr Olbers gave the new planet the name of Pallas, choosing for its symbol the lance, ⚴, the attribute of Minerva.

The most surprising circumstance connected with the discovery of Pallas was the existence of two planets at nearly the same distance from the sun, and apparently having a common node. On account of this singularity Dr Olbers was led to conjecture that Ceres and Pallas are only fragments of a larger planet, which had formerly circulated at the same distance, and been shattered by some internal convulsion. Lagrange made this hypothesis the subject of an ingenious memoir, in which he determined the explosive force necessary to detach a fragment from a planet with a velocity that would cause it to describe the orbit of a comet. He found that a fragment detached from the earth in this manner, with a velocity equal to 121 times that of a cannon-ball, would become a direct comet; and if with a velocity equal to 156 times that of a cannon-ball, its motion would be retrograde. For other planets the velocity must be $\frac{121 \text{ or } 156}{\sqrt{\text{mean distance}}}$, and consequently less as the mean distance of the planet from the sun is greater. A smaller velocity would be required to cause the detached fragment to move in an elliptic orbit; and with regard to the four small planets we are now considering, an explosive force less than twenty times that of a cannon-ball would have sufficed to detach them from a primitive planet, and cause them to describe ellipses similar to their actual orbits. This hypothesis served also to explain the great eccentricities and inclinations by which these planets are distinguished from the others belonging to the system; for it is evident that the explosive force must have projected the different fragments in all directions, and with different velocities. It followed also, that other fragments of the original planet might probably exist, revolving in orbits which, however they might differ in respect of inclination and eccentricity, would still intersect each other in the same points, or have common nodes, in which the several fragments would necessarily be found at each revolution. Dr Olbers therefore proposed to examine carefully every month the two opposite parts of the heavens in which the orbits of Ceres and Pallas intersect each other, with a view to the discovery of other planets, which might be sought for in those parts with greater chance of success than in a wider zone embracing the whole limits of their orbits. Subsequent discoveries scarcely support his conjecture, though it has still a great degree of probability.

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According to Herschel, the diameter of Pallas is only about 80 English miles, or about one half of that which he assigned to Ceres, while Schroeter estimates it at 2099 miles. Schroeter also found the atmosphere of Pallas to be about two thirds of the height of that of Ceres, or about 450 miles. The light of the planet undergoes considerable variations, the cause of which is uncertain.

Discovery of Juno.

While M. Harding, of the observatory of Lilienthal, near Bremen, was engaged in forming complete charts of the small telescopic stars near the orbits of Ceres and Pallas, with which these planets were likely to be confounded, he determined, on the 2d of September 1804, the position of a small star, by comparing it with the two stars marked 93 and 98 of Pisces in Bode's catalogue. These two stars are situated very near the equator, and at a small distance from one of the nodes of Ceres and Pallas, and exactly in that sort of *defilé* where, according to Dr Olbers, an observer would be certain of detecting in their passage the other fragments of the original planet of which Ceres and Pallas are parts. On the 4th the star was no longer in the same position, but had moved a little to the south-west. On the 5th and 6th M. Harding, by means of a circular micrometer, determined the rate of its motion to be 12′ 42″ in declination to the south, and 7′ 30″ in right ascension, retrograde, the interval between the observations being 24 hours 14 min. 12 sec. From this it was evident that the body belonged to the planetary system. It had then the appearance of a star between the eighth and ninth magnitudes. It was without any nebulosity, and of a whitish colour. A few days

afterwards the elements of its orbit were computed by Gauss. This planet has received the name of Juno, and for its symbol ♆, the starry sceptre of the queen of Olympus.

Juno is distinguished from the other planets by the great eccentricity of her orbit, which is so considerable, that she describes that half of it which is bisected by the perihelion in about half the time which she employs to describe the other half. This planet is somewhat smaller than Ceres and Pallas, and, though free from nebulosity, must have, according to Schroeter's observations, an atmosphere of greater density than that of any of the old planets.

Discovery of Vesta.

The success of M. Harding encouraged Dr Olbers to renew the plan of research which he had pointed out on the discovery of Pallas; and on the 29th of March 1807 he perceived, in the constellation of Virgo, a star of the fifth or sixth magnitude, which he suspected from the first observation to be a new planet. A few subsequent observations rendered this conjecture certain. Dr Olbers left to Gauss the care of giving a name to the new planet, and of determining the elements of its orbit. Gauss named it Vesta, and chose for its symbol ⚶, an altar surmounted with a censer holding the sacred fire. Vesta is the smallest of all the celestial bodies known to us. Her volume is only about a fifteen thousandth part of that of the earth, and her surface is about equal to that of the kingdom of Spain. She is distinguished by the vivacity of her light, and the luminous atmosphere with which she is surrounded.

Jupiter.

Jupiter is by far the largest planet in the system. His diameter is about 11 times, and his volume 1281 times, greater than that of the earth. His distance from the sun is $5\frac{1}{5}$ times the radius of the ecliptic, or nearly 125,000 terrestrial semidiameters, and consequently above 490 millions of miles. His apparent diameter, which, at his mean distance, is 36″·7, and varies between 45″·8 and 30″, would subtend an angle of 3′ 17″ if seen at the same distance as the sun. From Jupiter the sun will appear under an angle of 6′ at most; the sun's disk will appear to be 27 times smaller than when seen from the earth, consequently the light and heat which Jupiter receives from the sun will be only the 27th part of what is received by our globe. His density is ·99239, that of the sun being considered as unity, or is about one fourth of the density of the earth; and a body which weighs one pound at the equator of the earth, would weigh 2·444 pounds if removed to the equator of Jupiter.

Belts of Jupiter.

Plate LXXXV.

Jupiter has the same general appearance with Mars, only the belts on his surface are much larger and more permanent. Their usual appearance, as described by Dr Long, is represented fig. 97–100; but they are not to be seen but by an excellent telescope. They are said to have been first discovered by Fontana and two other Italians, but Cassini was the first who gave a good account of them. Their number is very variable, as sometimes only one, but seldom more than three, may be perceived. Messier at one time saw so great a number that the whole disk seemed to be covered by them. They are generally parallel to one another, but not always so; and their breadth is likewise variable, one belt having been observed to grow narrow, while another in its neighbourhood has increased in breadth, as if the one had flowed into the other: and in this case a part of an oblique belt lay between them, as if to form a communication for this purpose. The time of their continuance is very uncertain: sometimes they remain unchanged for three months, at other times new belts have been formed in an hour or two. In some of these belts large black spots have appeared, which moved swiftly over the disk from east to west, and returned in a short time to the same place; whence the rotation of this planet about its axis has been determined. On the 9th of May 1664, Dr Hooke, with a twelve feet telescope, observed a small spot in the broadest of the three obscure belts of Jupiter; and observing it from time to time, found that in two hours it had moved from east to west about half the visible diameter of the planet. In 1665 Cassini observed a spot near the largest belt of Jupiter, which is most frequently seen. It appeared round, and moved with the greatest velocity when in the middle, but appeared narrower, and moved slower, the nearer it was to the circumference; showing that the spot adhered to the body of Jupiter, and was carried round upon it. This principal, or ancient spot as it is called, is the largest and the most permanent of any hitherto known; it appeared and vanished no fewer than eight times between the years 1665 and 1708: from the year last mentioned it was invisible till 1713. The longest time of its continuing to be visible was three years, and the longest time of its disappearing was from 1708 to 1713. It seems to have some connection with the principal southern belt; for the spot has never been seen when that disappeared, though the belt itself has often been visible without the spot. Besides this ancient spot, Cassini, in the year 1699, saw one of less stability, that did not continue of the same shape or dimensions, but broke into several small ones, whereof the revolution was but 9 hours 51 min.; and two other spots that revolved in 9 hours $52\frac{1}{2}$ min. The changes in the appearance of the spots, and the difference in the time of their rotation, make it probable that they do not adhere to Jupiter, but are clouds transported by the winds, with different velocities, in an atmosphere subject to violent agitations.

By means of the spots, which can be easily observed, the rotation of Jupiter has been determined with considerable precision. The time of rotation, according to Cassini, Maraldi, and others, is 9 hours and between 55 and 56 minutes: Schroeter makes it 9 hours 55 min. 33 sec. The inclination of his equator to his orbit is only 3° 5′ 30″, so that the variations of his seasons must be almost insensible.

The radius of Jupiter being nearly 11 times (10·86) that of our earth, and his rotation being 2·4 times more rapid, it follows that the space passed over by a point on his equator is 26 times greater than that passed over by a point of the terrestrial equator in the same time. Hence the centrifugal force is 26 times greater; and if the spheroidal form of the earth is occasioned by the diurnal motion, we may expect to find the same effects on a much larger scale exhibited in the form of Jupiter. And this is in fact observed to be the case; for according to Struve the compression of Jupiter is about $\frac{1}{14}$th of his radius, the diameter of his equator being to that of his poles as 14 to 13 nearly, while that of the earth is only $\frac{1}{300}$th. The equatorial diameter at the mean distance subtends an angle of 38″·327, the polar 35″·538; and the ellipticity is $0{\cdot}0728 = \frac{1}{13{\cdot}71}$.

The annual parallax of Jupiter is less than 12°, consequently the earth, as seen from Jupiter, will never appear at a greater distance than 11° or 12° from the sun. The digressions of Mars would be 17° 2′, those of Venus 8°, and those of Mercury only 4° 16′. An inhabitant of Jupiter must therefore be probably ignorant of the existence of Mercury, which will be almost constantly plunged in

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	Miles.
Inner diameter of smaller ring	146345
Outside diameter of ditto	184393
Inner diameter of larger ring	190248
Outside diameter of ditto	204883
Breadth of the inner ring	20000
Breadth of the outer ring	7200
Breadth of the vacant space, or dark zone	2839

The following measures were taken by Professor Struve, at Dorpat in Russia, in 1828, with a repeating wire-micrometer attached to the large refracting telescope of Fraunhofer, belonging to the observatory at that place, and may be regarded as decidedly the most accurate of any that we possess. (See *Memoirs of the Astronomical Society*, vol. iii. p. 301.)

Outer diameter of the outer ring	40″·095
Inner diameter of the outer ring	35 ·289
Outer diameter of the inner ring	34 ·475
Inner diameter of the inner ring	26 ·668
Breadth of the outer ring	2 ·403
Breadth of the division between the rings	0 ·408
Breadth of the inner ring	3 ·903
Distance of the ring from the ball	4 ·339
Equatorial diameter of Saturn	17 ·991

These dimensions are adapted to the mean distance of Saturn, 9·53877. According to the same excellent astronomer, the inclination of the plane of the ring to the ecliptic is 28° 5′·9.

In observing the ring with very powerful telescopes, some astronomers have remarked, not one only, but several dark concentric lines on its surface, which divide it into as many distinct circumferences. In common telescopes these are not perceptible; for the irradiation, by enlarging the space occupied by each ring, causes the intervals between them to disappear, and the whole seems blended together in one belt of uniform appearance. (See fig. 103.) Struve, however, noticed no trace of the division of the ring into many parts.

Rotation of the ring.

By means of some spots observed on the surface of the ring, Herschel found that it revolves in its own plane in 10 hours 32 minutes 15·4 seconds; and Laplace arrived at the same result from theory. It is particularly worthy of remark, that this is the period in which a satellite, having for its orbit the mean circumference of the ring, would complete its revolution according to the third law of Kepler. This circumstance furnishes a physical explanation of the reason why the ring is able to maintain itself about the planet without touching it; or at least brings the fact within the general law by which the planets are sustained in their orbits. The centrifugal force resulting from its rotation, and the attraction of the planet, suffice to maintain its equilibrium.

Rotation of Saturn.

From observations of some obscure belts, and a very conspicuous spot on the surface of Saturn, Herschel concluded that his rotation is performed in 10 hours 16 minutes, on an axis perpendicular to the belts and to the plane of the ring; so that the planes of the planet's equator and ring coincide. According to the same astronomer, the ratio of the equatorial and polar diameters of Saturn is 2281 to 2061, or nearly 11 to 10. He also believed that the globe of Saturn appeared to be flattened at the equator as well as at the poles. The compression he thought to extend to a great distance over the surface of the planet, and the greatest diameter to be that of the parallel of 43° of latitude, where, consequently, the curvature of the meridians is also the greatest. The disk of Saturn, therefore, resembled a square of which the four corners have been rounded off. According to the more recent measures of Bessel and Main, this idea is proved to be erroneous, and the shape of the planet is that of an exact spheroid of revolution. (See Supplement to Part II.)

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Saturn is attended by eight satellites, but so small that they can only be seen by the help of powerful telescopes. Huygens first discovered one of these satellites in 1655, the sixth in the order of distance, and the largest. Four others were discovered about twenty years afterwards by Dominic Cassini; and Sir W. Herschel, in 1789, discovered two new satellites, at a time when the ring was visible only in a telescope of forty feet. The orbits of these are interior to those of the five satellites formerly discovered, but exterior to the ring, though so near to it that it is only when the ring disappears that they can be seen. Lastly, an eighth satellite was discovered almost simultaneously by two observers in 1848. All the satellites appear to revolve in the plane of the ring, with the exception of the two nearest.

Satellites of Saturn.

Uranus.

Uranus is the remotest planet belonging to the system, and is scarcely visible excepting through the telescope. His distance from the sun is nineteen times the mean radius of the orbit of the earth, or about 1800 millions of miles; and his sidereal revolution is performed in rather more than 84 years. His diameter is about 35,112 English miles, or nearly six and a half times that of the earth, and, seen from the earth, subtends an angle of only 4″, even at the time of his opposition. The apparent diameter of the sun, seen from this planet, is 1′ 40″; consequently the surface of the sun will there appear 400 times less than it does to us, and the light and heat which is received will be less in the same proportion. Analogy leads us to infer that Uranus is opaque and revolves on his axis, but of this there is no direct proof. Laplace has concluded from theory, that the time of his diurnal rotation cannot be much less than that of Jupiter and Saturn, and that the inclination of his equator to the ecliptic is very inconsiderable. His density is supposed to exceed somewhat that of the earth. Schroeter thinks that certain variations in the appearances of his disk indicate that great changes are going on in his atmosphere.

This planet was discovered by Sir W. Herschel at Bath on the 13th of March 1781. His attention was attracted to it by the largeness of its disk in the telescope, which exceeded that of stars of the first magnitude, while to the naked eye it was scarcely, if at all, visible. In the course of a few days its proper motion became sensible, consequently it could not be a fixed star. Herschel at first took it for a comet, but it was soon perceived that it described a path which, instead of resembling the eccentric orbits of the comets, was almost circular, like that of the planets. It was then recognized to be one of the principal planets of the solar system; and the observations of the last fifty years have not only confirmed this fact, but afforded data from which the elements of its orbit have been determined with great precision. Herschel gave it the name of the *Georgium Sidus*, in honour of his royal patron George III. Foreigners for some time generally called it the *Herschel*, after its discoverer; but the mythological name of *Uranus*, suggested by the late Professor Bode of Berlin, is now generally adopted. In 1787 Herschel discovered that it was attended by two satellites; he subsequently discovered four others, but they have been never reobserved, and the exact number of the satellites of Uranus is still uncertain. Two additional satellites interior to all the others have been recently discovered. (See Supplement to Part II.)

Before concluding this section, it will be proper to take notice of the following curious relation of the numbers

which express, approximately at least, the distances of the planets from the sun. It was first pointed out by Bode, and, though purely empirical, and not even very accurate, served to confirm the German astronomers in their anticipations of the discovery of a new planet between the orbits of Mars and Jupiter.

Let the number 10 be assumed to represent the semidiameter of the earth's orbit; then the semidiameters of the orbits of the other planets may be expressed in round numbers as follows:—

Mercury...4	
Venus.....7	$= 4 + 3\cdot2^0$
Earth.....10	$= 4 + 3\cdot2^1$
Mars.....16	$= 4 + 3\cdot2^2$
Ceres.....28	$= 4 + 3\cdot2^3$
Jupiter...52	$= 4 + 3\cdot2^4$
Saturn...100	$= 4 + 3\cdot2^5$
Uranus..196	$= 4 + 3\cdot2^6$

It will be remarked that every succeeding term of this series of numbers, after the second, is the double of the preceding, minus 4; the general term being $4 + 3\cdot2^{n-2}$, commencing with Venus, and n indicating the rank of the planet.

A view of the proportional magnitudes of the orbits and disks of the planets, as also of the comparative magnitudes of the sun seen from each planet, is given in fig. 104.

On the subjects contained in this section the following works may be consulted: Galileo, *Nuntius Sidereus;* Simon Marius, *Mundus Jovialis anno* 1609 *detectus*, &c. 1614; Cassini, *Martis circa proprium axem revolubilis Observationes Bononienses*, Bonon. 1666; Idem, *Disceptatio Apologetica de Maculis Jovis et Martis*, Bonon. 1667; Idem, *Nouvelles Découvertes dans le Globe de Jupiter*, Paris, 1690; Bianchini, *Hesperi et Phosphori Nova Phænomena*, 1728; Cassini, *Elemens d'Astronomie*, 1740; Schroeter, *Aphroditographische Fragmente*, Helmstadt, 1796; Idem, *Lilienthalische Beobachtungen der neu entdeckten planeten*, Göttingen, 1805; Gauss, *Theoria Motûs Corporum Cœlestium*, Hamburgi, 1801; Idem, *Journal of Gotha*, 1811; Laplace, *Mécanique Céleste*, tome iv. p. 135; Idem, *Système du Monde;* Delambre, *Astronomie*, tome ii. chap. xxvii.; Schubert, *Traité d'Astronomie Théorique*, tome ii. Petersburg, 1822; and the numerous papers of Sir W. Herschel in the *Philosophical Transactions.*

Sect. IV.—*Of the Orbits of the Satellites.*

In order to establish a theory of the motions of the satellites, the first thing necessary is to ascertain the directions in which they move with reference to the primary planet. Now, it is observed that their motion is sometimes towards the east, and at other times towards the west; but that the satellites are never occulted except in passing from the west to the east of the planet. When an occultation occurs the satellite is always moving eastward; on the other hand, the satellite is always moving westward when it appears on the planet's disk. From this it results that the true motions of the satellites around the planets are from west to east, according to the order of the signs, or in the same directions as the motions of the planets about the sun. This fact, which holds true of the moon, and the satellites of Jupiter and Saturn, is one of the most remarkable in the planetary system. With regard to the satellites of Uranus, their motions are performed in orbits almost perpendicular to the ecliptic; they cannot therefore with propriety be said to be either direct or retrograde.

The eclipses of the satellites of Jupiter present an easy method of determining their mean motions and periodic times; and, by reason of the small inclinations of the orbits, these are of very frequent occurrence; for the first three satellites traverse the shadow of Jupiter in every revolution, and the fourth only passes by it sometimes, in consequence of the greater inclination of its orbit. If the instants can be observed at which a satellite enters and emerges from the shadow, the middle point of time between these two instants will be that of the heliocentric conjunction of the satellite with its primary. The interval between two central eclipses gives the *synodic period* of the satellite; whence, since the motion of the primary is known, the *sidereal period* of the satellite, and its mean angular motion with regard to the straight line joining the centres of the sun and the planet, are easily deduced. Instead of two successive eclipses, it is preferable to compare two that are separated from each other by a long interval of time; the interval divided by the number of sidereal revolutions will give the mean time, unaffected by any periodic inequalities which may exist in consequence of the mutual action of the satellites on one another. In order to render the result as accurate as possible, those eclipses are chosen which take place when the planet is nearly in opposition.

The distances of the satellites from their primary are ascertained by measurement with the micrometer, at the time of the greatest elongations. On comparing the distances with the times of revolution, the beautiful law of Kepler is found to prevail; and, as in the system of the planets, so in the various systems of the satellites, the squares of the periodic times vary as the cubes of the mean distances from the central body. The distances of the satellites of Jupiter and Saturn, compared with the diameters of their respective primaries, are represented in fig. 105.

The inclinations of the orbits of the satellites of Jupiter, and the positions of their nodes, together with the other elements of their elliptic motion, are determined by means of their eclipses. The plane of the orbit of the first satellite nearly coincides with the plane of the equator of Jupiter, the inclination of which to the plane of his orbit is 3° 5′ 30″. The inclination of the orbit of the second to the plane of the planet's equator is 27′ 49″·2. Its nodes have a retrograde motion on that plane, and go through an entire circuit in the space of 30 years. The orbit of the third is inclined to the equator of Jupiter in an angle of 12′ 20″; and the line of the nodes retrogrades through a whole circumference in 142 tropical years. Hence the inclinations of the orbits of these two satellites to the orbit of Jupiter are variable; that of the second varying between 3° 19′ 24″·6 and 2° 51′ 35″·4, and that of the third between 3° 17′ 50″ and 2° 53′ 10″. The inclination of the orbit of the fourth satellite to the orbit of Jupiter is also variable. Its nodes have a retrograde motion, and complete a revolution in 531 years. Since the middle of the last century the inclination of this satellite has been observed to increase, and the motion of its nodes to diminish. (Laplace, *Mécanique Céleste*, tome iv. livre viii.)

The orbits of the four satellites are doubtless elliptical, but those of the first and second are so small that it has been found impossible to determine their eccentricity. The eccentricity of the third is perceptible, that of the fourth much more so. According to Laplace, the greatest equation of the centre of the third, at its maximum in 1682, amounted to 13′ 16″·4, and at its minimum in 1777, only to 5′ 7″·5. The eccentricity of the orbit of the fourth is still greater, and also subject to considerable variations. The line of the apsides has a direct motion, amounting to 42′ 58″·7 annually. The great in-

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fluence of the compressed figure of Jupiter on these elements gives each of the orbits an eccentricity peculiar to it; but each is also affected by the eccentricities of the others. The mutual perturbations of the satellites greatly affect their motions, and render their analytical theory exceedingly complicated and difficult.

On comparing the mean longitudes with the mean motions of the first three satellites of Jupiter, Laplace discovered the two following relations, which, by reason of their remarkable simplicity, may perhaps be regarded as among the most curious discoveries ever made in astronomy. Denoting by m', m'', m''', the mean motions of the three satellites respectively, and their mean longitudes by l', l'', l''', these laws are expressed by the formulæ,

$$m' + 2m''' - 3m'' = 0$$
$$l' + 2l''' - 3l'' = 180°;$$

that is to say, the mean sidereal motion of the first, added to twice that of the third, is equal to three times that of the second; and the mean longitude of the first satellite, plus twice that of the third, minus three times that of the second, is always equal to a semicircumference. The first of these relations is true of the synodical as well as of the sidereal revolutions; and it follows from the second, that the first three satellites can never be eclipsed at the same time, because in that case their longitudes would be equal, or $l' + 2l''' - 3l'' = 0$. These results of theory agree so nearly with observation, that we are tempted to regard them as rigorously exact, and to ascribe the slight differences that may be perceptible to the unavoidable errors of observation, and to the periodic inequalities in the motions of the satellites, by reason of which their true motions are alternately greater and smaller than their mean motions. We must therefore infer that these relations depend on a physical cause, by which they will be preserved for ever, or at least during a long series of ages, notwithstanding the small oscillations to which, from various sources of perturbation, the mean longitudes of the satellites are subject.

From observations of the eclipses of Jupiter's satellites, Roemer was led to the very important discovery of the successive propagation of light. The times at which these eclipses happen are found to differ from the times computed from the sidereal revolutions of the satellites, being sometimes earlier and sometimes later, according to the position of Jupiter relatively to the sun and the earth. When Jupiter is in opposition with the sun, and his distance from the earth consequently less than his distance from the sun by the whole radius of the earth's orbit, the satellites are eclipsed sooner than they ought to be according to computation. On the contrary, when Jupiter is in conjunction, and his distance from the earth greater than his distance from the sun by the same quantity, the eclipses happen later. These differences, which are exactly the same for all the satellites, cannot be ascribed either to the eccentricity of the orbit of Jupiter, or to inequalities in their motion; for the oppositions and conjunctions of the planet correspond successively to all the different points of his orbit, and the eclipses also happen when the satellite is at different points of its own orbit. The simplest and most natural way of explaining the phenomenon is to suppose that the light reflected from the satellites is not transmitted to the earth instantaneously, but occupies a sensible portion of time in traversing the diameter of the terrestrial orbit. When Jupiter is near his conjunction, the eclipses are observed to happen about 16 minutes 26 seconds later than when he is near his opposition; the difference between his distances from the earth in these two positions is equal to the diameter of the earth's orbit, supposing the orbits to be circular: it follows, therefore, that light employs 16 minutes 26 seconds in traversing the terrestrial orbit, and consequently the half of that time, or 8 minutes 13 seconds, in coming from the sun to the earth. The exact agreement of this hypothesis with observation renders its truth unquestionable. The fact of the successive transmission of light led to another discovery of the utmost importance in astronomy, namely, the aberration.

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The eclipses of Jupiter's satellites are useful in determining the longitude of places on the earth, and on this account the theory of the motions of these bodies has been cultivated with the most laborious care. The epochs at which the eclipses take place are calculated in advance, and inserted in the *Ephemerides*. On comparing these epochs, computed for a given meridian, with the immediate results of observation made in another place at a given hour, the difference of time is obtained, whence the difference of longitude is immediately deduced. The method is the same as for the eclipses of the moon. Unfortunately, by reason of the magnifying power required to render the satellites visible, it cannot be employed at sea, the instability of the vessel rendering the telescopes unserviceable. The tables of Delambre, which were computed from the theory of Laplace, and the comparison of an immense number of observations, give the places of the satellites with all the precision which it is perhaps possible to obtain.

The satellites of Saturn have not the practical utility of those of Jupiter, because, by reason of their great distance, their eclipses are invisible; and indeed some of them cannot be perceived at all, excepting through telescopes of extraordinary power. Their periods, mean motions, and some of the other elements of their orbits, are determined by the micrometrical measurement of their greatest digressions from their primary. At the time of their greatest digressions they are always situated in the same straight line with the greater axis of the ring, and their distances from Saturn are then equal to the semi-transverse axes of their apparent orbits. In their conjunctions the minor axes of their apparent ellipses seem only half as great as their transverse axes, whence it is inferred that the sine of their inclination is one half, and consequently that the inclination itself is about 30°, which is nearly the inclination of the ring. Hence the satellites seem to move in the plane of the ring. The only one which deviates considerably from that plane is the seventh. From certain observations made by Bernard in 1787, Lalande makes the inclination of this satellite 22° 42′ to the orbit of Saturn, or 24° 45′ to the ecliptic. There exists, however, considerable uncertainty with regard to the inclination of the orbits of the satellites, as well as with regard to that of the ring.

According to the theory of Laplace, the spheroidal figure of Saturn, of which the compression is very considerable, must maintain the ring, and the orbits of the interior satellites, in the plane of his equator. All that is certain is, that the inclination of the orbits of the first five satellites to the equator of the planet is insensible at the distance of the earth; consequently all the satellites, excepting the seventh, and probably also the sixth, will appear, as well as the ring, to move in the plane of the equator. The orbit of the seventh satellite preserves the same mean inclination to the plane of the equator of the planet; and the line of its nodes has a retrograde motion nearly uniform.

The orbit of the sixth satellite is elliptical. For the meridian of Paris its longitude in 1800 was 67° 25′ 47″; that of its inferior apside 203° 35′ 7″. Its mean motion in 36525 days is 2290 revolutions + 202° 12′; in one day

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22° 34′ 37″·186. The eccentricity is ·04887; and its greatest equation 5° 36′ 8″. By particular observations on this satellite, Bessel found its inclination to the ecliptic to be 24° 30′, or 25° 55′; differing very sensibly from that of the ring or the equator of the planet. It is, however, not improbable that these two planes may have some inclination to each other. (Delambre, *Astronomie Théorique et Pratique*, tome iii. p. 510.)

The satellites of Uranus can be perceived with still greater difficulty than those of Saturn. The orbits of these satellites are almost perpendicular to the ecliptic. The elements of the second and fourth have been determined by actual measurement; the periods of the two others have been theoretically deduced from the third law of Kepler. The inclination of the fourth is 89° 30′, or 90° 30′, and the ascending node 171° or 249°, according as it is conceived to be direct or retrograde.

The following table exhibits the mean distances and sidereal revolutions of the satellites of Jupiter, Saturn, and Uranus (all, except the 2d and 4th, very doubtful).

MEAN DISTANCES. (The radius of the planet being = 1.)		SIDEREAL REVOLUTIONS, According to Laplace.	According to Delambre.
Jupiter.		Days.	d. h. m. s.
1st satellite	5·81296	1·7691378	1 18 28 35·94537
2d.....	9·24868	3·5511810	3 13 17 53·73010
3d.....	14·75240	7·1545528	7 3 59 35·82511
4th.....	25·94686	16·6887697	16 18 5 7·02098
Saturn.		Days.	d. h. m. s.
1st satellite	3·080	0·94271	0 22 37 32·9
2d.....	3·952	1·37024	1 8 53 8·9
3d.....	4·893	1·88780	1 21 18 26·2
4th.....	6·268	2·73948	2 17 44 51·2
5th.....	8·754	4·51749	4 12 25 11·1
6th.....	20·295	15·94530	15 22 41 13·1
7th.....	59·154	79·32960	79 7 53 42·8
Uranus.		Days.	d. h. m. s.
1st satellite	13·120	5·8926	5 21 25 0·
2d.....	17·022	8·7068	8 17 1 19·
3d.....	19·845	10·9611	10 23 4
4th.....	22·752	13·4559	11 11 5 1·5
5th.....	45·507	38·0750	38 1 49
6th.....	91·008	107·6944	107 16 40

CHAP. V.

OF COMETS.

The comets form a class of bodies belonging to the solar system, distinguished from the planets by their physical appearances and the great eccentricities of their orbits. By reason of the smallness of their diameters, and a nebulosity which renders them ill adapted to reflect the rays of light, the greater part of them are only visible in the telescope, and continue to be so only during a short period of time; for as they advance to and recede from the sun almost in straight lines, and with prodigious velocities, they are soon carried far beyond the limits of vision. They have received the name of comets (*coma*, hair) from the *bearded* appearance which they frequently exhibit.

SECT. I.—*Of the Orbits of Comets.*

The comets are not more remarkably contrasted with the planets in the singularity of their physical appearances, than in the directions of the paths which they follow in space. While the orbits of all the planets are confined within a narrow zone, or to planes not greatly inclined to the ecliptic, those of the comets are inclined in all possible angles, and some of them are even observed to be perpendicular to the ecliptic. Nor is the contrast less striking with regard to the figures of the orbits, which, instead of being nearly circular, like those of the planets, have the appearance of being almost rectilinear. Kepler was of opinion that the cometary orbits are straight lines; Cassini supposed them to be very eccentric circles; and Tycho was for some time of the same opinion, but he afterwards found that the hypothesis of the eccentric circle would not satisfy the observations of the comet of 1577. Hevelius seems to have been the first who discovered, by means of a geometrical construction, that the orbits might be represented by parabolas; and Dörfel first calculated their elements on this hypothesis. After it was known, however, that certain comets return to the sun in the same orbits, it became necessary to adopt an opinion, already probable from analogy, that, in conformity with the laws of Kepler, the cometary orbits are ellipses having the sun in one of the foci. This hypothesis is now universally admitted; but as the ellipses are in general extremely elongated, and the comets are only visible while they describe a small portion of their orbits on either side of their perihelia, their paths during the time of their appearance differ very little from parabolas; whence it is usual, on account of the facility of computation, to assume that they really move in parabolic curves. Newton employed the hypothesis of an elliptic motion to compute the orbit of the famous comet of 1680. Since that time the orbits of more than a hundred and fifty different comets have been computed on the elliptic hypothesis, and their elements determined so as to satisfy all the observations. It is possible that the orbits of some comets may be in reality parabolic; but in this case the comet, after having passed its perihelion, would recede to an infinite distance from the sun, and never again visit our system. Burckhardt imagined that the observations of the comet of 1771 were best represented by supposing the orbit to be an hyperbola. In fact, it is demonstrated in the *Principia*, and every treatise on Physical Astronomy, that the species of curve which one body describes about another, in virtue of an attractive force varying inversely as the square of the distance, depends only on its velocity of projection. The curve must necessarily be a conic section; but it may be an ellipse, a parabola, or an hyperbola, according as the primitive impulsive force falls within or exceeds certain assignable limits.

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If the comets moved in parabolas or hyperbolas, and had consequently only a temporary connection with the solar system, the determination of their orbits would be a matter of mere curiosity, and of no consequence whatever to astronomy. But it is only by the accurate determination of the elements of their orbits that it can be discovered whether those bodies ever revisit the system; for the appearances which they exhibit, depending on the situation of the earth in its orbit with relation to them at the time they are visible, are far too variable and uncertain to afford any sure means of recognising them. The comet of 1811 was scarcely visible in the months of April and May; it was subsequently lost in the sun's rays, and, having passed its perihelion, re-appeared in August with a splendour and magnificence that rendered it an object of admiration. It is therefore only by observing that a comet follows the same orbit in its successive returns to the sun that we can be assured of its identity. But even the determination of the orbit is not always sufficient to lead to the detection of a comet in a

subsequent revolution; for if, in the course of the previous one, it came within the sphere of attraction of Jupiter, or any of the larger planets, the elements of its orbit may have been greatly or entirely changed. The orbit of the comet of 1770 was calculated by Lexell, and subsequently by Burckhardt, and both these astronomers found that the observations could only be represented by an ellipse in which the time of revolution was five years and a half; yet the comet has never been seen since, or at least seen moving in the same orbit. Hence it is concluded with certainty that the attraction of Jupiter, near which planet it approached, was so great as to compel it to move in a totally different ellipse. Other causes also conspire to render the chances of the discovery of periodic comets extremely small. In the first place, it is only within a very small portion of their orbits that they are visible; and this, on account of its proximity to the sun, is passed over with inconceivable rapidity. But in proportion as they recede from their perihelia the solar action diminishes; and, towards the aphelion of its orbit, a comet may be almost motionless, and for this reason not return for thousands of years. In the second place, it may happen, that during the greater part of the time the comet continues in the visible portion of its orbit, it may rise above the horizon only during the day, in which case it will be invisible, and may consequently pass through our system without being observed. The comet of 1818 was present in all its splendour long before it became visible, but in full day. Seneca relates a very curious instance of one having been seen during a total eclipse of the sun, in the year 60 before our era. A third cause of uncertainty consists in the difficulty of observing their true places with sufficient precision to enable the elements of their orbits to be exactly determined. The small comets are only nebulous points, which can be distinguished with difficulty; the larger ones are surrounded with a variable, ill-defined, and indistinct nebulosity. The comet of 1729 continued visible during six months: its orbit was computed by three different astronomers, whose results were far from coinciding. The same uncertainty exists with regard to the orbits of several other comets. When, therefore, all these circumstances are taken into consideration, it will not appear surprising that, although the elements of above 150 comets have been computed, there are only three which are certainly known to have been observed in their successive revolutions.

The most remarkable periodic comet with which we are acquainted was made known to astronomers by Dr Halley. That active and indefatigable genius, having perceived that in 1682 the elements of its orbit were nearly the same as those of two comets which had respectively appeared in 1531 and 1607, concluded that the three orbits belonged to the same identical comet, of which the periodic time was about 76 years. After a vague estimate of the perturbations it must sustain from the attraction of the planets, Dr Halley predicted its return for 1757,—a bold prediction at that time, but justified by the event, for the comet again made its appearance as was expected, though it did not pass through its perihelion till the month of March 1759, the attraction of Jupiter and Saturn having caused, as was computed by Clairaut previously to its return, a retardation of 618 days. This comet had been observed in 1066; and the accounts which have been preserved represent it as having then appeared to be four times the size of Venus, and to have shone with a light equal to a fourth of that of the moon. History is silent respecting it from that time till the year 1456, when it passed very near to the earth: its tail then extended over 60° of the heavens, and had the form of a sabre. An object so striking and so terrific could not fail, in a superstitious age, to excite universal dismay, and be regarded as portentous of the greatest calamities to the human race, if not of the destruction of the world. Accordingly Pope Calixtus ordered public prayers to be said over Christendom, in which he exorcised the comet, and the Turks, who had at that time made themselves masters of Constantinople, and overthrown the eastern empire. Dr Halley's comet returned to its perihelion in 1835; and the splendour of its appearance rendered it once more an object of universal interest; it was well observed in almost every observatory. The following table of its elements in 1835 is given by Pontécoulant (*Théorie Analytique du Système du Monde*, tome ii. p. 147):

Instant of the passage through the perihelion in October 1835	31d.2
Semiaxis major	17 ·98355
Ratio of the eccentricity to the semiaxis major	0 ·967453
Place of the perihelion on the orbit	304° 34′ 19″
Longitude of the ascending node	55 6 59
Inclination	17 46 50

Two other famous comets whose periodic returns have been verified by observation have received the names of Encke and Biela, the astronomers who first computed their orbits, or recognised them as having been observed in their previous revolutions. The first returns to its perihelion in 1208 days, and the second in 2440 days. Encke's comet, although its identity was not discovered till 1818, has been frequently observed, as in 1789, 1795, 1801, and 1805, and on these occasions it exhibited very different appearances, having been seen with and without a nucleus, with and without a tail,—circumstances which account for its having so long escaped being recognised as a regular attendant on the sun. In its returns to its perihelion in 1808, 1812, and 1815, it escaped detection; but it re-appeared in 1818, and it was from the observations of this year that Encke computed the elliptic elements of its orbit. On its next return, in 1822, it was invisible in Europe; but it was observed at Paramatta, in New South Wales, during the whole month of June, and the time of its perihelion passage was found to differ only by about three hours from that previously computed by Encke. On its returns in 1825 and 1828 its observed and computed places agreed equally well. The following, according to Pontécoulant, are its elements for 1829–30, computed from the observations at Paramatta:

Passage through the perihelion, 1829, January 10d.573	
Mean diurnal motion	1069 ·5570
Eccentricity	0 ·8446862
Place of perihelion	157° 18′ 35″
Longitude of ascending node	334 24 15
Inclination	13 22 34.

Encke's comet presents in some respects a considerable analogy with the planet Ceres, the inclination and greater axis of its orbit being the same, while its sidereal revolution is only 46 days shorter than that of Vesta. The orbit is, however, greatly more elongated, for its perihelion falls within the orbit of Mercury, and its aphelion is situated between Jupiter and the new planets. The perturbations it sustains are chiefly occasioned by the attraction of Jupiter, that of the earth and Venus being extremely small, while the action of Mercury is insensible.

A third comet of short period with which our knowledge of the solar system has been enriched receives its name from Biela, by whom it was first perceived in Bohemia, on the 27th of February 1826. The parabolic elements computed from the first observations presented a striking resemblance with those of two comets which had been observed in 1772

and 1806, which induced MM. Clausen and Gambart, the first at Marseilles and the second at Altona, to compute the elements of the three comets on the hypothesis of elliptic orbits; and, after some attempts, each found an ellipse which represented all the observations so accurately as to leave no doubt of the identity of the comet. Its period is six years and about nine months, and it returned to its perihelion in November 1832, about the same time with Encke's. The following table of its elements was computed from the observations of 1826, and the theory of the perturbations (Pontécoulant, tome ii. p. 158):—

Passage through the perihelion 1832, November	27d.4808
Eccentricity	0·7517481
Place of the perihelion	109° 56′ 45″
Longitude of ascending node	248 12 24
Inclination	13 13 13
Semiaxis major	3·53683

Besides the periodical comets which have been mentioned, there are two others of long period, of which the orbits are supposed to be known, though their returns to their perihelia have not yet been verified. The first is that which appeared in 1680, and of which Newton computed the period to be 575 years. It may therefore be identical with those which are recorded in history to have appeared in 1106, 531, 34 B. C. and 619 B. C. The second is that which appeared in 1556, and is supposed to have made a former visit in 1264. This comet is expected to appear again in 1858.

The following table, taken from one given by Delambre in the third volume of his *Astronomie*, shows the comparatively small distances within which the greater part of the comets hitherto observed approach to the sun, and the apparently fortuitous inclinations of the planes of their orbits to that of the ecliptic. Supposing the sun's distance from the earth to be unity, then, of 120 comets, there are

5 whose perihelion distance is less than	0·1
3	between 0·1 and 0·2
6	0·2 and 0·3
11	0·3 and 0·4
10	0·4 and 0·5
22	0·5 and 0·6
12	0·6 and 0·7
11	0·7 and 0·8
8	0·8 and 0·9
9	0·9 and 1
21	1 and 2
1	equal to 2·293
1	4·069.

Of the same number there are

4 whose inclination is between	1° and 5°
3	5 and 10
4	10 and 15
3	15 and 20
2	20 and 25
2	25 and 30
7	30 and 35
2	35 and 40
4	40 and 45
1	45 and 50
3	50 and 55
4	55 and 60
7	60 and 65
3	65 and 70
3	70 and 75
3	75 and 80
4	80 and 85
2	85 and 90.

The motions of the above 61 are direct; those of the remaining 59 are retrograde, and their orbits are distributed over the whole quadrant in the same random manner. This circumstance sufficiently indicates that the mechanical causes, whatever they were, which gave the same direction to the two motions of translation and rotation of all the planets and satellites, exercised no influence on the comets. Hence many astronomers have entertained the idea that these bodies have only a casual or transient connection with the planetary system.

Sect. II.—*Of the Appearances and Physical Constitution of Comets.*

Of all the celestial phenomena, those of the comets are the most striking, and the most calculated to impress the ignorant with the idea of supernatural agency. Appearing suddenly in the heavens, and under aspects the most uncommon and terrific, they have been almost universally regarded as visible demonstrations of the wrath, and harbingers of the vengeance, of offended deities. These superstitious terrors, arising from that vain propensity of the mind of man to regard the universe as created for himself alone, have only been dissipated by the progress of sound philosophy, and a more extended acquaintance with the riches of nature, and the endless variety of her productions.

The appearances exhibited by the comets are exceedingly diversified, and sometimes extremely remarkable. That which appeared in the year 134 B. C., at the birth of Mithridates, is said to have had a disk equal in magnitude to that of the sun. Ten years before this, one was seen, which, according to Justin, occupied a fourth part of the sky, that is, extended over 45°, and surpassed the sun in splendour. Another, equally remarkable, appeared in the year 117 of our era; and in 479 there was one of which the disk, according to Freret, was of such magnitude that it might have occasioned the extraordinary eclipse of the sun which took place about that time. In 400 one was observed, which is said, on the authority of Gainas, to have resembled a sword, and to have extended from the zenith to the horizon. That of 531 was of greater magnitude still, and its appearance more terrific. Those which appeared in 1066 and 1505 exhibited disks larger than that of the moon. It is, however, highly probable that all these accounts have been greatly exaggerated, through the ignorance and credulity of the historians by whom they are related; for, since comets have been observed by astronomers, no instances have occurred in which their magnitudes and appearances have been so extraordinary. The most remarkable among those of which we possess accurate accounts appeared in the years 1456, 1618, 1680, 1744, 1759, 1769, 1807, and 1811.

Fig. 106 is a representation of the celebrated comet of 1680, taken from Lemonnier's *Histoire Céleste*. It exhibits the nucleus or disk with its surrounding atmosphere. Above is a sort of ring, wider at the summit, and narrower towards the sides. A *coma* or beard succeeds the ring; and lastly, an immense train of luminous matter, somewhat less vivid than the nucleus. This luminous train, or tail as it is called, is by far the most singular and striking feature presented by the comets. That of the comet of 1744 was one of the most remarkable. It was divided into six branches, all diverging, but curved in the same direction; and between the branches the stars were visible. It is represented in fig. 107. The tail of the comet of 1811 was composed of two diverging parts inclined to each other in an angle which varied from 90 to 15 or 20 degrees. These branches were curved in opposite directions, and descended from the nucleus like a veil: between the

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branches, and surrounding the nucleus, was a space comparatively obscure.

The nucleus, which is the densest and most luminous part, may be said to form the true body of the comet. It is, however, so far from having the dense and solid appearance of the planets, that some astronomers have imagined it to be diaphanous, and even supposed that they have observed stars through it. But supposing such an observation certain, it may be accounted for with much greater probability by the effects of refraction; and it is besides extremely difficult to distinguish the nucleus from the surrounding nebulosity. If the nucleus were an opaque globular body, it would exhibit phases like Venus or Mars, according to its different positions with relation to the sun and the earth; and such were observed, or at least were supposed to be observed, in the case of the comet of 1682, by Hevelius, Picard, and Lahire. But the nebulosity renders the phases exceedingly obscure and indistinct, and prevents the true body of the comet from being seen; in the same way as a globe of roughened glass prevents us from distinguishing the form of the flame of an inclosed lamp. The real nucleus has probably never been observed by any astronomer; and, from the appearances, we are led to infer that a comet, at least near its perihelion, is only an agglomerated mass of vapours. As it recedes from the perihelion, the vapours may be condensed by cold into a solid substance. This hypothesis is also favoured by the extreme smallness of the density of the comets, which is known certainly from the circumstance that they produce no appreciable effect on the motions of the planets. The comet of 1770 traversed the system of Jupiter's satellites without causing any sensible perturbation of those small bodies. This comet also passed very near the earth; and Laplace calculated, that if its mass had been equal in density to that of the earth, the effect of its attraction would have increased the length of the sidereal year by two hours and twenty-eight minutes. But since its influence was altogether insensible, it is certain that its mass was not equal to the five thousandth part of that of the earth, and probably much inferior even to this quantity.

If the nuclei of comets are solid, the matter of which they are composed must be extremely fixed in order to enable them to resist the intense heat they necessarily experience in their approaches to the sun. According to the computation of Newton, the great comet of 1680, at its perihelion, was only distant from the sun by the 163d part of the semidiameter of the earth's orbit, where it would be exposed to a heat above 2000 times greater than that of red-hot iron,—a temperature of which we can form no conception, and which would instantly dissipate any substance with which we are acquainted.

In order to explain the singular phenomena of the train of light which frequently attends the comets, the following theory was proposed by Newton. The comets move in very eccentric orbits, and consequently, towards their perihelia, approach very near to the sun. The excessive degree of heat they sustain near this point of their orbits must convert into vapour every substance capable of vaporization; and hence the prodigious extent of their atmosphere in comparison of the smallness of their nuclei. When this atmosphere has acquired all the volatility of which it is susceptible, the impulsion its vapours receive from the solar rays, however feeble that force may be conceived to be, is sufficient to put them in motion, and drive them off in a direction opposite to the sun. Thus it is remarked, that the tail becomes most conspicuous after the comet has passed the perihelion, and that its direction, as was first observed by Appian, is the straight line joining the centres of the sun and comet. The slight curvature which is generally observed may be accounted for by combining the motion given to the vapours by the impulsion of the sun's rays with the motion of the comet in its orbit; for the detached vapours are driven by the impact of the luminous particles beyond the sphere of the comet's attraction, and consequently cease to follow the direction of the nucleus. Hence the curvature of the tail must be greatest towards its extremity; and this is observed to be actually the case. It may be remarked, however, that although this hypothesis serves to explain the phenomena when all the branches of the tail are bent in the same direction, it is inapplicable when the directions of the curvature are opposite, as was the case with regard to the comet of 1811. In fact, no ultimate reasons for several of the phenomena exhibited by comets have yet been given which can be considered as entirely satisfactory.

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The discovery of the periodic returns of certain comets necessarily put an end to the apprehensions and terrors which their unusual appearances were well calculated to excite, and proved them to be permanent bodies belonging to the same system, and acted on by the same laws, as the planets. But this very discovery gave rise to apprehensions of another kind, more natural, though, when closely examined, hardly more reasonable. Since the comets are so numerous, and their orbits traverse the planetary system in all directions, and come within the orbit of the earth, is there not a probability that some of them may come into contact with our globe, and destroy it by the direct collision; or at least approach so near as to produce the most disastrous effects by their attraction? Halley found that the comet of 1680 had approached its perihelion about the time of the universal deluge, and thought it probable that that great catastrophe might have been immediately occasioned by the earth's being enveloped in the aqueous vapours of its tail,—an idea which was afterwards more fully developed by Whiston. Lalande and Maupertuis have minutely detailed the terrible effects which might be produced by the shock of a comet, or even by its approach to our earth. The vapours brought by the tail would mingle with the atmosphere, and render it less respirable. The attraction of the nucleus would destroy the equilibrium of the ocean, and cause extraordinary inundations, which might sweep off the greater part of the human species. The direct shock might change the position of the earth's axis, or even cause the earth to leave its present orbit. It might then become a satellite of the comet, and be carried away with it to the extreme limits of the sun's attractive influence: or, as the mass of the comet would probably be inferior to that of the earth, the earth would carry the comet along with it in its orbit, and thus acquire a second moon: and it has even been surmised that the moon we actually enjoy may owe its origin to an accidental occurrence of this kind. But all these reveries have disappeared before the calculus, by which it is demonstrated that the orbit of the moon can never at any time have been greatly different from what it now is. The collision of a comet with the earth is not an impossible event; though so infinitely little probable, that it can never excite any just cause of alarm. The conjunctions of the planets anciently caused terrors still more unreasonable; and the eclipses, which now scarcely attract the notice of the vulgar, long rivalled the comets in the terrors which they occasioned to the inhabitants of the earth.

Various opinions have been entertained respecting the nature, and formation, and uses of the comets. Newton supposed that, as some of them pass so near to the sun as

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to be involved in all probability within his atmosphere, the resistance they must consequently experience will cause them to approach nearer and nearer to the great luminary at every successive revolution, till at last they are precipitated into his substance; hence their use in the system may possibly be to repair the losses which the sun sustains from the constant emission of light. Whatever destinies they may be appointed to fulfil, the recent discovery of several comets of short periods must be regarded as of great importance to astronomy, inasmuch as the frequency of their appearance will enable observers to take notice of any great changes with which either their masses or orbits may be affected.

With regard to the actual number of comets belonging to the solar system, there are no data from which we can form any probable conjecture. Those only (with two or three exceptions) which come within the orbit of the earth are visible to us, and nearly 200 have been observed since the discovery of the telescope. If, then, we suppose them to be equally distributed throughout the whole system, it would follow that the number of comets coming within the sphere of Uranus, the radius of which is twenty times that of the earth's orbit, amounts to 1,200,000 (the cube of 20 multiplied into 150), assuming the average period of their revolutions to be that in which 150 have come within the sphere of the earth. Such computations, however, are scarcely deserving of notice.

On the subject of comets, the reader may consult Aristotle, *Meteorol.* lib. i. cap. vi.; Seneca, *Quæst. Natural.* vii.; Hevelii *Cometographia;* Newton, *De Mundi Systemate,* and *Princip.* lib. iii. prop. 42; Halley, *Synopsis Astronomiæ Cometicæ,* and *Phil. Trans.* vol. xxiv.; Euler, *Mém. Acad. Berlin,* 1756; Dionis du Sejour, *Essai sur les Comètes,* Paris, 1775; Lexell, *Phil. Trans.* 1779; Clairaut, *Mém. Acad. Paris,* 1760; Lambert, *Lettres Cosmologiques,* and *Mém. Acad. Berlin,* 1771; Bode, *ibid.* 1786, 1787; Sir H. Englefield *on the Orbits of Comets,* 4to, London; Pingré, *Cométographie,* 2 vols. 4to, Paris, 1784; Laplace, *Mécanique Céleste,* tome iv. p. 193, and *Système du Monde,* 4to, p. 127; Delambre, *Astronomie Théorique et Pratique,* tome iii. chap. xxxiii.; also the *Connoissance des Tems, Memoirs of the Astronomical Society,* and the various scientific Journals. (See also Supplement.)

CHAP. VI.

OF THE FIXED STARS.

After having treated of the different classes of bodies which compose the solar system, it only remains for us to inquire what observation has been able to discover respecting that innumerable host which "studs the galaxy,"—that multitude of brilliant points which, on account of their always sensibly retaining the same relative positions, have received the name of *Fixed Stars.*

SECT. I.—*Of the Arrangement of the Fixed Stars.*

The great multitude of stars visible even to the naked eye renders it impossible to distinguish each by a particular name: astronomers have accordingly, for the sake of reference, formed them into groups, to which they give the name of *Constellations* or *Asterisms.* To the different constellations the early astronomers gave the names of men, and animals, and other familiar objects, from some fancied resemblances or analogies, which, for the most part, are not easily traced. These denominations, consecrated by ancient usage, are preserved in modern catalogues; and the practice of delineating the object itself on celestial globes and charts has been only recently, if it has yet altogether, been abandoned. The ancients likewise distinguished some of the brightest stars in the different constellations by particular names; but when it was wished to include others less conspicuous, it became necessary to have recourse to a different mode of proceeding. According to the usual method, first introduced by Bayer in his *Uranometria,* each of the stars in every constellation is marked by a letter of the Greek alphabet, commencing with the most brilliant, which is designated by α, the next most conspicuous is called β, the third γ, and so on. When the Greek letters are exhausted, recourse is had to the Roman or Italic; but even with the help of these the nomenclature cannot be extended far, and the simplest and most comprehensive method is undoubtedly to employ the ordinal numbers to particularize the stars belonging to each constellation. It requires to be remarked, that the order of the letters indicates only the relative brilliancy of the stars in the same constellation, without any reference to those in other parts of the heavens. Thus α *Aquarii* is a star of the same order of brightness as γ *Virginis.* The stars of the first order of brightness are likewise denominated stars of the *first magnitude;* those of a degree inferior in brightness are said to be of the *second magnitude;* and so on with the third, fourth, &c. Below the sixth the same denominations are continued; but the stars of the seventh and inferior magnitudes are no longer visible to the naked eye, and are therefore called *telescopic stars.* It is obvious that, in conferring these denominations, it has been assumed that the brilliancy of the stars is proportional to their magnitudes,—an hypothesis at least extremely doubtful. The terms are however only used for the sake of distinction, and no exact ideas can be attached to the numbers. Observers are even at variance on the subject, certain stars being regarded by some of them as being of the first, which are considered by others as being only of the second magnitude.

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A few stars have preserved the names conferred on them by the Greek or Arabian astronomers. Some of those names, belonging to stars of the first magnitude, are the following:—*Sirius,* in the right shoulder of Orion; *Rigel,* in his left foot; *Aldebaran,* or the eye of the Bull; *Capella; Lyra; Arcturus; Antares; Spica Virginis; Regulus,* or the heart of the Lion; *Canopus; Fomalhaut; Acharnar,* &c.

The number of constellations given by Ptolemy is 48. They do not comprehend all the stars in his catalogue, and those not included in the figures are called by him *unformed stars* (αμορφωτοι, *informes*), and given at the end of that constellation to which they are nearest. The following table includes Ptolemy's constellations, and those which have been added by the moderns.

PTOLEMY'S CONSTELLATIONS.

North of the Zodiac.

1. Ursa Minor,	The Little Bear.
2. Ursa Major,	The Great Bear.
3. Draco,	The Dragon.
4. Cepheus,	Cepheus.
5. Bootes, *Arctophylax.*	
6. Corona Borealis,	The Northern Crown.
7. Hercules, *Engonasin,*	Hercules kneeling.
8. Lyra,	The Harp.
9. Cygnus, *Gallina,*	The Swan.
10. Cassiopeia,	The Lady in her Chair.
11. Perseus,	Perseus.
12. Auriga,	The Waggoner.

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13.	Serpentarius, *Ophiuchus,*	Serpentarius.
14.	Serpens,	The Serpent.
15.	Sagitta,	The Arrow.
16.	Aquila, *Vultur,* et Antinous,	The Eagle and Antinous.
17.	Delphinus,	The Dolphin.
18.	Equulus, *Equi Sectio,*	The Horse's Head.
19.	Pegasus, *Equus,*	The Flying Horse
20.	Andromeda,	Andromeda.
21.	Triangulum,	The Triangle.

In the Zodiac.

22.	Aries,	The Ram.
23.	Taurus,	The Bull.
24.	Gemini,	The Twins.
25.	Cancer,	The Crab.
26.	Leo,	The Lion, to which he joined some stars of Berenice's Hair.
27.	Virgo,	The Virgin.
28.	Libra, *Chelæ,*	The Scales.
29.	Scorpio,	The Scorpion.
30.	Sagittarius,	The Archer.
31.	Capricornus,	The Goat.
32.	Aquarius,	The Water-bearer
33.	Pisces,	The Fishes.

Southern Constellations.

34.	Cetus,	The Whale.
35.	Orion,	Orion.
36.	Eridanus, *Fluvius,*	Eridanus, *the River.*
37.	Lepus,	The Hare.
38.	Canis Major,	The Great Dog.
39.	Canis Minor,	The Little Dog.
40.	Argo Navis,	The Ship.
41.	Hydra,	The Hydra.
42.	Crater,	The Cup.
43.	Corvus,	The Crow.
44.	Centaurus,	The Centaur.
45.	Lupus,	The Wolf.
46.	Ara,	The Altar.
47.	Corona Australis,	The Southern Crown.
48.	Piscis Australis,	The Southern Fish.

The constellations added by Hevelius are the following:—

1.	Antinous,	Antinous.
2.	Mons Menelai,	Mount Menelaus.
3.	Asterion et Chara,	The Greyhounds.
4.	Camelopardalus,	The Giraffe.
5.	Cerberus,	Cerberus.
6.	Coma Berenices,	Berenice's Hair.
7.	Lacerta,	The Lizard.
8.	Lynx,	The Lynx.
9.	Scutum Sobieski,	Sobieski's Shield.
10.	Sextans,	The Sextant.
11.	Triangulum,	The Triangle.
12.	Leo Minor,	The Little Lion.

The constellations added by Halley in the southern hemisphere are,—

1.	Columba Noachi,	Noah's Dove.
2.	Robur Carolinum,	The Royal Oak.
3.	Grus,	The Crane.
4.	Phœnix,	The Phœnix.
5.	Pavo,	The Peacock.
6.	Apus, *Avis Indica,*	The Bird of Paradise.
7.	Apis, *Musca,*	The Bee or Fly.
8.	Chamæleon,	The Chameleon.

One of the most important objects of practical astronomy is the formation of catalogues of the fixed stars, in which their positions are determined for a given epoch; for it is only by means of registered observations that the state of the heavens can be compared at different times, and any changes which take place be detected. The apparent place of a star is easily determined by observation; but in order to render such observations available for the purposes of comparison, the mean place of the observed star must be computed and reduced to a given epoch; and this reduction, which involves a knowledge of the precession, nutation, aberration, and in general of all the motions which affect the star's apparent place, is only accomplished by a laborious process of calculation. Theoretical Astronomy

The principal catalogues of the stars which we possess are the following:— Catalogues of stars.

Ptolemy's catalogue, which contains 1022 stars. The positions are referred to the ecliptic, and the longitudes are for the year 137 of our era. It is supposed that the greater part of the observations on which it is founded were made and computed by Hipparchus 267 years before, and that Ptolemy merely reduced them to his epoch by adding to each of the longitudes 2° 40′, which, according to him, was the amount of the precession of the equinoxes in that interval. This catalogue forms part of the Almagest.

The catalogue of Ulugh Beigh, containing 1017 stars.

Tycho's catalogue, which contains only 777 stars, in 45 constellations.

Riccioli's catalogue, which contains 1468 stars. Part of it, however, was merely copied from more ancient catalogues.

Bayer's catalogue, containing 1762 stars, in 72 constellations. It was published in his *Uranometria* in 1603. The third edition of this work appeared at Ulm in 1661.

The catalogue of Hevelius, which contains 1888 stars, of which it gives the latitudes, longitudes, right ascensions, and declinations, for the year 1661. Published in his *Prodromus Astronomiæ* in 1690.

Flamsteed's catalogue, containing 2884 stars. Published in the *Historia Cœlestis Britannica* in 1725. A less perfect edition was given by Halley in 1712.

Catalogues of Lacaille.—The first of these, published in his *Astronomiæ Fundamenta,* contains 397 stars; the second, which is given in his *Cœlum Australe Stelliferum,* contains 1942 of the stars in the southern hemisphere; and the third, which was reduced from his observations by the celebrated Bailly, contains the places of 515 zodiacal stars.

Mayer's catalogue, containing 998 zodiacal stars. It appeared in his *Opera Inedita,* Göttingen, 1775, and was reprinted in the *Connoissance des Tems* for 1778.

Bradley's catalogue, containing 587 stars. This was published in the first volume of his observations, edited by Hornsby, in 1798. The positions of 389 stars, calculated from Bradley's observations, had been given by Mason in the *Nautical Almanack* in 1773. Bradley's observations extended to 3000 stars, but the greater part of them remained useless to astronomy till they were reduced and made the subject of discussion by Bessel in his *Fundamenta Astronomiæ,* Regiomonti, 1818.

Maskelyne's catalogue of 36 stars.

Cagnoli's catalogue, containing 501 stars. Published in the *Memoirs of the Italian Society.*

Bode's catalogue, which contains 17,240 stars, reduced from the observations of various astronomers.

Piazzi's catalogue, which contains 6748 stars, reduced to the year 1800. In 1814 Piazzi published a new catalogue, comprising 7646 stars.

Zach's catalogue, inserted in his *Tabulæ speciales Aberrationis et Nutationis,* Gothæ, 1806.

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Catalogue of the Astronomical Society of London, containing 2881 stars, published in the second volume of their *Memoirs*. Almost all the stars comprised in this catalogue are to be found in the catalogues of Bradley or Piazzi, from which they have been reduced to the year 1830.

In addition to the above, the records of great masses of observations may be found in the *Philosophical Transactions*, the *Connoissance des Tems*, and the various astronomical and scientific Journals. Lalande has registered in the *Memoirs of the Academy of Paris*, and his *Histoire Céleste*, the positions of no fewer than 50,000; and Bessel, of the Königsberg Observatory, who continues to explore the heavens with unabated zeal, has already examined an equal number. Astronomers are now aware of the importance of extending their researches to the most minute sidereal objects. (See Supplement.)

Sect. II.—*Of the Parallax, Distance, Magnitude, and Number of the Fixed Stars.*

The fixed stars being the points of departure from which all the celestial motions are estimated, one of the first objects in astronomy is to determine the amount and law of all the minute variations of position, real or apparent, to which they are subject. One of the most obvious consequences of the hypothesis of the annual motion of the earth is the existence of an annual parallax of the stars; but on account of the enormous distances of these bodies, this effect of the earth's motion is so small that it cannot be easily measured; and there are even now very few cases in which, with the utmost refinements of methods and instruments, a measurable parallax has been detected. The longest line which nature has furnished us with the means of actually measuring, is the circumference of our own globe. From this geometry teaches us how to find its diameter; and the diameter we employ as a scale with which to compare the distances of the sun and moon, and the other bodies of the solar system. But experience shows us that this scale, large as it is in our conceptions, is only an insensible point in comparison of the distances of the fixed stars. Astronomy has furnished us with another base, about 24,000 times longer than the former, or above 190 millions of miles. This is the diameter of the earth's orbit, which is most conveniently used for expressing the distances of the planets and comets from the sun. Yet even this line is in general insensible when compared with the distances of the stars; for, on observing the same star from its two extremities, at the end of six months, no variation whatever is perceptible in the star's position, after the proper corrections have been made for the small effects produced by different and known causes. The limits of the errors of modern observations cannot well be supposed to exceed 1″. It follows, therefore, that, seen from the distance of the fixed stars, the diameter of the ecliptic, which exceeds 190 millions of miles, subtends an angle of less than 1″. Had the annual parallax exceeded this small quantity, it could scarcely have escaped the multiplied efforts that have been made to detect it, not only by Bradley, whose observations, undertaken for the express purpose of determining the parallax of the stars, conducted him to the grand discoveries of the aberration and nutation, but also by other observers furnished with the more delicate instruments of the present day; and particularly the observations made with the splendid instruments of the Royal Observatory of Greenwich. A long controversy was carried on, extending from the year 1810 to 1824, between Dr Brinkley and Mr Pond, on the subject of the annual parallax of some of the brightest stars, Brinkley asserting that he had found large parallaxes, and Pond denying the existence of any measurable parallaxes. Brinkley's conclusions are now generally acknowledged to have been erroneous. Brinkley did not observe any parallax in the case of the stars of the constellation *β Cygni*, some of which, having a very sensible proper motion, may, with great probability, be considered as being at a less distance from the earth; but in *Wega* (α Lyræ) he found a parallax of 1″·13, and one of 1″·42 in the star *Altair*, in Aquilæ. Bradley supposed the parallax of Sirius to amount to 1″. These facts are, however, disproved by other eminent observers. In a series of 14 stars Struve found the parallax to be negative; that is, the small change of position which the observations seemed to indicate was in a direction contrary to what it would have been if it had arisen from the annual motion of the earth. Mr Pond, the Astronomer Royal, thought the probable value of the parallax could not exceed 0″·018, a quantity so extremely minute as to be altogether lost in the uncertainties of instrumental errors, and the errors of refraction, which are at least 20 times greater.

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Let us concede for a moment the disputed parallax of 1″, and inquire what must be the corresponding distance of the star. The semidiameter of the terrestrial orbit being taken at 95 millions of miles, the distance of a star whose parallax is 1″ will be expressed by $\frac{1}{\text{sin. } 1''} \times 95000000 = 206264 \times 95000000 = 19{,}595{,}080{,}000{,}000$, or about 20 trillions of English miles. To assist the imagination in forming some idea of this almost inconceivable distance, we may calculate that a ray of light which darts from the sun to the earth in the space of 8 min. 7 sec., would require 206264 × 8 min. 7 sec., or 3 years and 216 days, to reach us from the star. A spider's thread before the eye of a spectator placed at the same distance would suffice to conceal the orbit of the earth; and the breadth of a hair would blot out the whole planetary system. But a star having a parallax of 1″ is at a moderate distance in comparison of innumerable others, in which no parallactic motion whatever can be distinguished. Supposing the distance of one of these to be only a thousand times greater, a ray of light darted from it would travel between 3000 and 4000 years before it reached the earth; and if the star were annihilated by any sudden convulsion, it would appear to shine in its proper place during that immense period, after it had been extinguished from the face of the heavens. Pursuing speculations of this kind, we may conceive, with Huygens, that it is not impossible that there may exist stars placed at such enormous distances, that their light has not yet reached the earth since their creation.

Magnitude of the stars.

When viewed with the naked eye, the magnitudes of the stars appear to be very different,—a circumstance which may be attributed either to a real diversity of brightness, or, which is more probable, to the great differences in their distances. The sensible magnitudes which they exhibit when viewed in this manner are owing only to the numerous reflections of the rays of light from the aerial particles surrounding the eye; as is proved by looking at them through a long tube, which prevents any rays from reaching the eye excepting those which come directly from the star. In the telescope their dimensions are entirely inappreciable: the greater the power with which they are viewed, the smaller are their apparent diameters, because they are then more completely divested of the effects of irradiation. A star having a diameter of 1″, and an annual parallax of 1″, would be more than a million of times larger than the sun. Nevertheless, Sir W. Herschel assures us, that, by means of the great powers which his telescopes carried, he had seen the disks of some stars perfectly round, and had even succeeded in measuring

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their apparent diameters. He found the diameter of *Wega* to be $\frac{1}{3}''$, that of *Aldebaran* $1''{\cdot}5$, and that of *Capella* $2''{\cdot}5$. Supposing the measurement accurate, and the annual parallax of this last not to exceed $1''$, its volume would be equal to 20 million times that of the sun.

Number of the stars.

With regard to the number of the stars, it is altogether impossible to form any satisfactory conjecture. Of those which are visible to the naked eye, the number does not, probably, at any time, exceed 1000, although, from the effect of their twinkling, and the confused manner in which they are seen, one is apt to suppose them to be much more numerous; but in the telescope they are prodigiously multiplied. Within the limits of a space extending 15° by 2°, Herschel counted no fewer than 50,000. In the single constellation of the Pleiades, instead of 6 or 7, which can be distinguished by the unassisted vision, Hooke, with a telescope of 12 feet, counted 78; and in telescopes of greater power the number appears to be vastly larger. Although, by reason of their very unequal distribution, no accurate estimate can be formed of the number contained in the whole sphere by the examination of any small portion of it, yet there is some reason to conclude that there cannot be less than 75 millions of stars altogether visible in a good telescope. Baron Zach estimates that there may be at least a thousand millions of stars in the entire heavens, without reckoning (what may probably exist) opaque bodies which cannot be perceived, and stars whose light has been extinguished. It is, however, evident that all estimates of this sort have no other limit than such as is imposed by the imagination. If an observer could be transported to the remotest star visible in his telescope, he would probably see extending before him in the same direction, a firmament equally rich and splendid as that which he beholds from our own insignificant planet.

Sect. III.—*Of the Proper Motions of the Stars.*

In Chap. II. four different causes of apparent motion with regard to the stars have been explained; namely, the precession of the equinoxes, the nutation of the earth's axis, the secular diminution of the obliquity of the ecliptic, and the aberration of light; all which are occasioned by the various motions proper to the earth, and for that reason are called apparent motions. But if, after due allowance has been made for the effects produced by them, it should happen that the observed place of any star, or number of stars, does not correspond with former observations, a new and peculiar motion would be indicated, which must be explained by a new hypothesis. Now there are obviously two ways of accounting for such a phenomenon, namely, a parallactic motion and a proper motion, from either of which the observed variation of position may result. It has already been shown that the annual parallax, or that apparent alteration in the places of the fixed stars which might be expected from the motion of the earth in its orbit, is insensible; but we may suppose, and indeed observation has even rendered it probable, that the sun, accompanied by his whole train of planets and comets, is in motion in space; and if this is the case, the stars must appear to change their relative situations as soon as the sun has described a space bearing a sensible ratio to their distance. The resulting motion would thus partake of the nature of parallax, and is hence termed parallactic. The other method of accounting for any observed alteration in the mutual position of the stars, is to ascribe to them a proper motion, instead of supposing them to be absolutely fixed. On this supposition the motion is real; yet it may happen that the observed changes of position result from the combined effects of a real and parallactic motion. The effects of these motions are in their nature sufficiently distinct, although, on account of the extremely minute quantities to be determined, and the uncertainty that still exists as to the exact amount of some of the apparent motions with which they are blended, it may for centuries to come be found impossible to separate them. If all the stars forming a group, or situated in the same quarter of the heavens, appear to recede from or approach to each other, their motions may with reason be ascribed to the translation of the solar system in space, and consequently be parallactic: but if, on the contrary, some appear stationary, while others appear to move in different directions, the phenomena will indicate a real change in the positions of the stars.

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From the analogy of our own system we are naturally induced to extend the principle of gravity to the sphere of the stars, and to suppose, as a necessary consequence, that none of the celestial bodies are in a state of absolute repose. Their mutual attraction must communicate to them a motion which would end in uniting them all in the same mass unless it were counteracted by a centrifugal force: hence the stars are supposed to move about distant centres in orbits analogous to those of the planets. But if the stars are not absolutely at rest in space, their motions must be extremely slow, inasmuch as the actual state of the heavens corresponds entirely with the descriptions that have been given of it by Hipparchus and Ptolemy. Ptolemy has transmitted to us a great number of observations on the relative situations of the fixed stars, made by Hipparchus, whose method was to observe those which are situated in an arc of the same circle, or which can be intersected by the same straight line; and he assures us that he himself, after an interval of 260 years, could perceive no alteration. In order to furnish posterity with the means of pursuing similar inquiries, Ptolemy added the positions of many other stars determined by his own observations; and we owe to his labours the certain knowledge that the relative positions of the stars, notwithstanding the numerous displacements of the ecliptic and equator, are at present nearly the same as they were 2000 years ago. The ancient observations were, however, of too rude a nature to admit of any satisfactory conclusion being deduced from them respecting the minute quantities in question. The accurate instruments of the present day have enabled observers to remark some changes of position too decided to admit of doubt; hence astronomers have inferred a proper motion in several stars, as well as a translation of the sun and the planets in space. From the comparison of a great number of observations, Sir W. Herschel was of opinion that many of the proper motions might be explained by supposing the solar system to have a motion directed towards the star λ in the constellation Hercules. Bessel, having subjected to a rigorous comparison a much greater number of the proper motions indicated by comparing the catalogues of Bradley, Mayer, Piazzi, &c. arrived at the conclusion that many points might be assigned in the sphere, some of them even diametrically opposite to each other, situated in the direction of those motions; but that, in whatever direction the sun is supposed to move, so many proper motions will remain unaccounted for, that there is no reason for preferring one point to another. It has since been demonstrated, however, by astronomers, that Bessel's conclusion was erroneous, and that Herschel's idea was correct. The conspicuous proper motions of the stars which have hitherto been remarked are subject to an assignable law, and are not directed to arbitrary points in space; and it is only after eliminating the effects of the solar motion, that the real proper motions can be inferred. It is, how-

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ever, on the whole, probable that they are due, in part at least, to a real displacement of the stars, and not to a general translation of the solar system.

As early as the beginning of the present century, astronomers had detected proper motions in a great number of stars, the rates of which they inserted in their catalogues along with those of the precession; but great discrepancies existed in their conclusions. Baron Zach, comparing Maskelyne's observations of the right ascensions of the Greenwich stars, reduced to 1802, with those of Bradley, reduced to 1760, found results which differ from those of Maskelyne himself, not only in *amount*, but in several instances even in the *direction* of the supposed proper motions. For example, the proper motions (in right ascension) of *γ Pegasi*, *α Ceti*, *Rigel*, *Sirius*, *Spica*, *γ* and *β Aquilæ*, *α Cygni*, *α Aquarii*, and *α Pegasi*, are all *positive* according to Zach, while Maskelyne considered them as being all *negative*. Such was the uncertainty respecting the proper motions even of the Greenwich stars, which, by reason of the frequent observations they had undergone, and the rigorous scrutinies to which they had been subjected, were probably those whose places had been the most accurately determined of any in the whole heavens. But the motions are so slow that they must remain, for a considerable number of years at least, blended with the errors of observation. The double star 61 *Cygni* is indeed demonstrated to have an annual proper motion of + 5″·06 in right ascension, and 3″·34 in declination; but in general the rates are confined within much narrower limits, and appear to amount only to a fraction of a second. The number of stars in which this proper motion has been supposed to be observed is, as we have already noticed, very considerable. M. Bessel, by a comparison of 2959 stars out of Bradley's catalogue with the same stars in the catalogue of Piazzi, found that 425 of them had an annual proper motion, amounting to more than 0″·2, in the arc of a great circle. The following table, published by Mr Baily in the second volume of the Memoirs of the Astronomical Society, contains a list of all those stars observed by Bradley and Mayer, whose annual proper motions, according to Piazzi, as given in his catalogue, amount to 0″·5 either in right ascension or declination. The *positive* sign, in the column of declinations, denotes a motion towards the north, the *negative* a motion towards the south. The numbers prefixed are those of Flamsteed, unless when inclosed within a parenthesis, in which case they are those of Piazzi.

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Star.	Proper motion in Æ.	Proper motion in D.	Star.	Proper motion in Æ.	Proper motion in D.
11 β Cassiopeiæ	+ 0″·82		5 θ Centauri	— 0″·63	
24 η Ditto	+ 1·78	— 0″·72	16 α Bootis	— 1·17	— 1″·96
37 μ Andromedæ	+ 1·20		19 λ Ditto	— 0·55	
1 Polaris	+ 1·47		23 θ Ditto	— 0·80	— 0·54
37 δ Cassiopeiæ	+ 0·64		44 Ditto	— 0·91	
107 Piscium		— 0·57	41 γ Serpentis		— 1·31
52 τ Ceti	— 1·86	+ 0·84	49 Libræ	— 0·75	
13 θ Persei	+ 0·67		18 Scorpii		— 0·53
12 Eridani	+ 0·64	+ 0·82	40 ζ Herculis	— 0·70	
23 δ Ditto		— 0·60	26 ε Scorpii	— 0·65	
27 μ′ Ditto		— 0·59	36 α Ophiuchi	— 0·59	— 1·25
40 d Ditto	— 2·21	— 3·60	30 Scorpii	— 0·58	— 1·24
1 Orionis	+ 0·54		22 ε Ursæ Min	— 0·82	
104 m Tauri	+ 0·69		27 f Draconis	— 0·51	
15 δ Leporis		— 0·62	86 μ Herculis		— 0·84
9 α Can. Maj.	— 0·51	— 1·14	70 p Ophiuchi		— 1·17
10 α Can. Min	— 0·71	— 0·98	58 η Serpentis	— 0·67	— 0·68
78 β Geminorum	— 0·72		44 χ Draconis	+ 1·72	
15 ψ³ Cancri	— 0·60		(50) Sagittarii		— 0·54
9 ι Ursæ Maj	— 1·05		31 b Aquilæ	+ 0·92	+ 0·72
81 π Cancri	— 0·55		3 Cygni		— 0·72
25 θ Ursæ Maj	— 1·80	— 0·60	61 σ Draconis	+ 1·28	— 2·12
29 υ Ditto	— 0·60		53 α Aquilæ	+ 0·51	
7 α Crateris	— 0·59		60 β Ditto		— 0·54
63 χ Leonis	— 0·53		15 z Sagittæ	— 0·50	
53 ξ Ursæ Maj	— 0·52	— 0·64	(29) τ Sagittarii	+ 1·24	+ 0·76
94 β Leonis	— 0·53		1 κ Cephei	— 0·80	
5 β Virginis	+ 0·76		3 η Ditto		+ 0·81
16 c Ditto	— 0·55		61 Cygni	+ 5·38	+ 3·30
5 κ Draconis	— 0·50		3 Piscis Aust	— 1·09	
3 Canum Ven	— 1·02		65 τ Cygni		+ 0·50
29 γ Virginis	— 0·72		(36) Lacertæ	+ 0·75	— 0·80
43 δ Ditto	— 0·65		6 γ Piscium	+ 0·78	
43 Com. Ber	— 1·19	+ 0·94	17 ι Ditto		— 0·55
61 Virginis	— 1·30	— 1·08	(249) Ditto	+ 0·70	
70 Ditto		— 0·53	85 Pegasi	+ 0·90	— 1·15
85 η Ursæ Maj	— 0·50				

The proper motions of the stars are not susceptible of direct observation or measurement: they are only indicated by the minute differences which remain after applying to the observed position of any given star the corrections due to all the apparent motions with which we are acquainted. Thus, let M and M′ be the mean places of any given star

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at two different epochs, the interval between which is t years; P the annual precession of the equinoxes, and x the annual motion of the star in right ascension. It is obvious that x will be given by the formula

$$x = \frac{M - M'}{t} - P;$$

so that the value of x, or the amount of the proper motion, is dependent not only on the accuracy of the observations, and on the computations from which M and M', the mean places of the star, have been deduced, but also on the quantity P, which is calculated by a method of approximation not entirely exact. For all these reasons it is easy to see that the determination of the proper motions must be attended with considerable uncertainty, and that hundreds, probably thousands, of years will be required to develope their rates and directions, and assign the distant centres round which they are performed. (See Supp.)

Sect. IV.—*Of Variable and Double Stars, Nebulæ, and the Milky Way.*

The periodical variations of brilliancy to which some of the fixed stars are subject, may be reckoned among the most remarkable of the phenomena exhibited by those bodies. Several stars, formerly distinguished by their splendour, have entirely disappeared; others are now conspicuous which do not seem to have been visible to the ancient observers; and there are some which alternately appear and disappear, or of which the light at least undergoes great periodic variations. Some seem to become gradually more obscure, as δ in the *Great Bear;* others, like β in the *Whale*, to be increasing in brilliancy. Some stars have all at once blazed forth with great splendour, and, after a gradual diminution of their light, have again become extinct. The most remarkable instance of this sort is that of the star which appeared in 1572, in the time of Tycho. It suddenly shone forth in the constellation Cassiopeia with a splendour exceeding that of stars of the first magnitude, even of Jupiter and Venus at their least distances from the earth, and could be seen with the naked eye on the meridian in full day. Its brilliancy gradually diminished from the time of its first appearance, and at the end of sixteen months it entirely disappeared, and has never been seen since. During the whole time of its apparition its place in the heavens remained unaltered, and it had no annual parallax; its distance was consequently of the same order as that of the fixed stars. Its colour, however, underwent considerable variations. Tycho describes it as having been at first of a bright white; afterwards of a reddish yellow, like Mars or Aldebaran; and, lastly, of a leaden white, like Saturn. Another instance of the same kind was observed in 1604, when a star of the first magnitude suddenly appeared in the right foot of Ophiuchus; it presented phenomena analogous to the former, and disappeared in like manner after some months. Kepler wrote a book on this singular apparition. These instances sufficiently prove that the stars are subject to great physical revolutions.

A great number of stars have been observed whose light seems to undergo a regular periodic increase and diminution, and these are properly called *variable* stars. One in the *Whale* has a period of 334 days, and is remarkable for the magnitude of its variations. From being a star of the second magnitude, it becomes so dim as to be seen with difficulty through powerful telescopes. Some are remarkable for the shortness of the period of their variation. *Algol* has a period of between two and three days, δ *Cephei* one of $5\frac{1}{3}$ days, β *Lyræ* one of $6\frac{2}{3}$ days, μ *Antinoi* one of 7 days. The regular succession of these variations precludes the supposition of their being occasioned by a real or permanent destruction of the stars; neither can they be supposed to arise from a change of distance; for as the stars invariably retain their apparent places, it would be necessary to suppose that they approach to and recede from the earth in straight lines,—an hypothesis which is at least extremely improbable. The most probable supposition is, that the stars revolve, like the sun and planets, about an axis; and that the surfaces of the variable stars are unequally covered with dark spots, or unequally fitted to emit light; whence their dark sides will be turned towards us after certain intervals by the effect of rotation. In this way Newton accounted for the phenomena. Other astronomers have devised different explanations. Maupertuis supposed that the figure of the stars is not globular, but flat, and that the variations of brilliancy depend on the angle which their flat sides make with the visual ray,—an angle which will be constantly varying if the stars are endowed with a rotatory motion. Others, again, have imagined that the partial obscurations of the stars may be occasioned by their being eclipsed by opaque bodies or planets revolving round them.

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Multiple stars.

On examining the stars with telescopes of considerable power, many of them are found to be composed of two or more stars placed contiguous to each other, or of which the distance subtends a very minute angle. This appearance is probably in many cases owing solely to the optical effect of their position relative to the spectator; for it is evident that two stars will appear contiguous if they are placed nearly in the same line of vision, although their real distance may be immeasurably great. There are, however, many instances in which the angle of position of the two stars varies in such a manner as to indicate a motion of revolution about a common centre; and in this case the two stars form a binary system, performing to each other the office of sun and planet, and connected together by gravity or some equivalent principle. The recent observations of Herschel, Dawes, South, and Struve, have placed this fact beyond doubt. Motions have been detected so rapid as to become measurable within very short periods of time; and at certain epochs the satellite or feebler star has been observed to disappear, either on passing behind or before its primary, or by approaching so near to it that its light has been absorbed by that of the other. The most remarkable instance of a regular revolution of this sort is that of the double star ξ *Ursæ Majoris*, in which the angular velocity is $6°{\cdot}4$ annually, so that the two stars complete a revolution about one another in the space of 60 years; and above three fourths of a circuit have been already described since its discovery in 1781. The double star p *Ophiuchi* presents a similar phenomenon, and the satellite has a motion in its orbit still more rapid. α *Castoris*, γ *Virginis*, ζ *Cancri*, ξ *Bootis*, δ *Serpentis*, and that remarkable double star 61 *Cygni*, together with several others, exhibit similar variations in their respective angles of position.

The examination of double stars was first undertaken by Sir W. Herschel, with a view to the question of parallax; for it is evident, and indeed had been remarked by Galileo, that the apparent distance of two stars which are very near each other will vary with the position of the earth in its orbit, unless they are both so remote that, in comparison of their distance from the earth, the diameter of the terrestrial orbit is insensible. His attention was, however, soon arrested by the new and unexpected phenomena which these bodies presented. Sir W. Herschel observed in all 2400 of them. Messrs South and Herschel have given a catalogue of 380 in the Transactions of the

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Royal Society for 1824, and South added 458 to the list in the volume for 1826. Mr Herschel has published three series of observations in the Memoirs of the Astronomical Society, containing altogether 1000 double stars; and the catalogue of M. Struve of Dorpat contains 3063 of the most remarkable. The object of these catalogues is not merely to fix the place of the star within such limits as will enable it to be easily discovered at any future time, but also to record a description of the appearance, position, and mutual distances, of the individual stars composing the system, in order that subsequent observers may have the means of detecting their connected motions, or any changes with which they may be affected. M. Struve has also taken notice of 52 triple stars, among which No. 11 of the *Unicorn*, ζ of *Cancer*, and ξ of the *Balance*, appear to be ternary systems in motion. Quadruple and quintuple stars have likewise been observed, which also appear to revolve about a common centre of gravity. Every region of the heavens furnishes examples of these curious phenomena, especially those which abound in stars; though M. Struve remarks that some parts of the milky way contain very few, while others present them in great abundance.

Some of the double stars present curious instances of contrasted colours, and generally assume the complementary tints,—a circumstance which, Mr Herschel thinks, may be owing in some degree, at least in cases where red and green, yellow and blue stars are combined in a double star, to the influence of optical deception. "When I first observed," says that ingenious philosopher, "the double star No. 881, A. 19 hours 8 minutes 56 seconds, P. D. 95° 45′ 33″, I remarked it as a case of contrasted colour, the large star being ruddy, and the small one blue. But on closer attention I perceived the small star itself to be double; yet each of the two very minute stars of which it consists appeared equally blue while the eye continued under the influence of the large one; but when this was withdrawn from the field, they appeared of no particular colour, but just like other small stars in the neighbourhood. It may be remarked further, too, that yellow stars are, generally speaking, accompanied by blue small ones, blue being the complementary tint of yellow; but when the large star has an excess of red rays, the blue verges to green, as it ought on the hypothesis of contrast. A most remarkable instance is that of No. 895 (Struve's catalogue), A. 6 hours 12 minutes, P. D. 84° 12′, in which the large star is of a full ruby red, and the smaller one of a fine green, but which colour it also loses when the large star is concealed behind the cross of the wires." (*Memoirs of the Astronomical Society*, vol. iii. p. 186.)

Nebulæ.

The *Nebulæ*, so called from their dim cloudy appearance, form another class of objects which furnish matter for curious speculation and conjecture respecting the formation and structure of the sidereal heavens. When examined with a telescope of moderate powers, the greater part of the nebulæ are distinctly perceived to be composed of clusters of little stars, imperceptible to the naked eye, because, on account of their apparent proximity, the rays of light proceeding from each are blended together, through the effects of irradiation, in such a manner as to produce only a confused luminous appearance. In others, however, no individual stars can be perceived, even through the best telescopes; and the nebula exhibits only the appearance of a self-luminous or phosphorescent patch of matter in a highly dilated or gaseous state; though it is possible that even in this case the appearance may be owing to a congeries of stars so minute, or so distant, as not to afford singly sufficient light to make an impression on the eye. In some instances the nebula presents the appearance of a faint luminous atmosphere, of a circular form, and of large extent, surrounding a star of considerable brilliancy. One of the most remarkable nebulæ is that which is situated in the sword-handle of Orion. It was discovered by Huygens in 1656, and described and figured by him in his *Systema Saturnium*. Since that time it has been examined and described by various observers, particularly Fouchy, Mairan, Le Gentil, and Messier, who have given engravings of it; and if any trust can be placed in their descriptions of so indistinct and difficult an object, it must have undergone great changes in its form and physical appearances. Unfortunately, however, no satisfactory inference can be drawn from the comparison of the different descriptions; for it is found that the same nebula, viewed on the same night with different telescopes, presents appearances so different as to be scarcely recognizable as the same object. The effects of atmospherical variations also cause great differences in its appearance, even when it is viewed through the same telescope at different times; so that it is scarcely possible that any two observers will be found to agree in their delineations of its outline. Sir J. Herschel, in the second volume of the Memoirs of the Astronomical Society, has given a detailed description of this nebula as it appeared in his twenty feet reflector in 1824, together with a drawing which, on account of the superiority of his telescope, is probably a much more correct representation of the object than any which previously existed. Fig. 108 is copied from that drawing. Of that portion of the nebula which he calls the Huygenian region Mr Herschel gives the following account: "I know not how to describe it better than by comparing it to a curdling liquid, or a surface strewed over with flocks of wool, or to the breaking up of a *mackarel sky* when the clouds of which it consists begin to assume a cirrous appearance. It is not very unlike the mottling of the sun's disk, only (if I may so express myself) the grain is much coarser, and the intervals darker; and the flocculi, instead of being generally round, are drawn out into little wisps. They present, however, no appearance of being composed of small stars, and their aspect is altogether different from *resolvable nebulæ*. In the latter we fancy that we see stars, or that, could we strain our sight a little more, we should see them; but the former suggests no idea of stars, but rather of something quite distinct from them."

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Plate LXXXVIII

Another very remarkable nebula is that in the girdle of Andromeda, which, on account of its being visible to the naked eye, has been known since the earliest ages of astronomy. It was re-discovered in 1612 by Simon Marius, who describes it as having the appearance of a candle seen through horn, that is, a diluted light, increasing in density towards a centre. Le Gentil mentions that its figure had appeared to him for many years round, but that in 1757 it had become oval. He also remarks that its light was perfectly uniform in all parts,—a fact which is quite at variance with its present appearance, and which, if true, argues that the nebulous matter is in a rapid state of condensation. "At present," says Sir J. Herschel, in the volume above referred to, "it has not, indeed, a star or any well-defined disk in its centre; but the brightness, which increases by regular gradations from the circumference, suddenly acquires a great accession, so as to offer the appearance of a nipple, as it were, in the middle, of very small diameter (10″ or 12″), but totally devoid of any distinct outline, so that it is impossible to say precisely where the nucleus ends and the nebula begins. Its nebulosity is of the most perfect milky, absolutely irresolvable kind, without the slightest tendency to that separation

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into flocculi above described in the nebula of Orion; nor is there any sort of appearance of the smallest star in the centre of the nipple. This nebula is oval, very bright, and of great magnitude, and altogether a most magnificent object."

Sir W. Herschel, who devoted himself to the examination of every uncommon appearance in the sidereal heavens, has given catalogues of 2000 nebulæ and clusters of stars discovered by him, and has shown that the nebulous matter is distributed through the immensity of space in quantities inconceivably great, and in separate parcels of all shapes and sizes, and of all degrees of brightness between a mere milky appearance and the condensed light of a fixed star. Finding that the gradations between the two extremes were tolerably regular, he thought it probable that the nebulæ form the materials out of which nature elaborates suns and systems, and conceived that, in virtue of a central gravitation, each parcel of nebulous matter becomes more and more condensed, and assumes a rounder form; that from the eccentricity of its shape, and the effects of the mutual gravitation of its particles, it acquires gradually a rotatory motion; that the condensation goes on increasing till the mass acquires consistency and solidity, and all the other characters of a comet or planet; that by a still further process of condensation the body becomes a real star, self-shining; and that thus the waste of the celestial bodies, by the perpetual diffusion of their light, is continually compensated and restored by new formations of such bodies, to replenish for ever the universe with planets and stars. (See the *Philosophical Transactions* for 1811.) These hypotheses or conjectures give no doubt a mechanical reason for the formation of stars, but the answer to them is exceedingly obvious. Has any instance as yet been observed of a nebula being succeeded by a star, or cluster of stars, or even of becoming so much more condensed as absolutely to change its form? Till a change of this sort has been observed, the inferences are drawn from analogies too slender to entitle them to be regarded as any thing more than mere fancies and speculations. Even if every link in the chain were perfect, and the gradation distinctly traced from the most diffuse nebula to the most compact star, the facts would still be insufficient to warrant the conclusion that the celestial matter had actually undergone a transition from the nebulous to the stellar state, or that any star or nebula in the heavens ever existed in a state different from its present. Though there is little reason to hope that we shall ever obtain a full knowledge of the mysterious processes which the great Architect of the universe has employed in the formation of the celestial bodies, yet a long series of observations with such instruments as are now constructed may lead to the detection of changes sufficiently indicative of the nature of the forces by which they are produced. These cosmological speculations, however, it may be well to remark, are not of the slightest value to astronomy.

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Milky Way.

That great luminous tract which encompasses the sky like a girdle, and is called the *Galaxy* or *Milky-Way*, is supposed by Sir W. Herschel to be a nebula of which the sun forms one of the component stars; and hence it appears immensely greater than other nebulæ only in consequence of our situation with respect to it, and of its greater proximity to our system. On examining any part of it with a good telescope, we perceive a prodigious multitude of small stars, whose blended light occasions the whitish appearance which forms so remarkable an object in the heavens. Yet notwithstanding the apparent contiguity of the stars which crowd the galaxy, it is certain that their mutual distances cannot be less than a hundred thousand times the radius of the terrestrial orbit. From this we may attempt to form some notion of the inconceivable distances of the other nebulæ, some of which, probably not inferior in magnitude to the milky-way, appear only as small luminous patches in the telescope.

See Tycho *de Nova Stella anni* 1572; Hevelius, *Historiola miræ Stellæ in Collo Ceti*, anno 1660; Maupertuis, *Figure des Astres*, Œuvres, tome i. Lyon, 1756; Michel, *Phil. Trans.* 1784; Pigott, *Phil. Trans.* 1785, 1797; Lemonnier, *Mém. Acad. Par.* 1789; Lalande, *Astronomie* (885); Herschel, *Phil. Trans.* passim. (T. G.)

Supplement to Part II.

Since the last revision of the article Astronomy in this work, the discoveries in many of the branches of the science have been so various and of so much importance, that it would have been useless to attempt their incorporation in the body of the work without a total alteration of its construction. It has been, therefore, judged more convenient, as well as more useful, to add in a supplement such discoveries and improvements as have had an undoubted influence on the science in its present condition, and which hold out hopes of still greater extension for the future.

We shall preserve the same order as that used in the preceding part devoted to *Theoretical* Astronomy, and describe as briefly as possible the chief additions which have been made to the respective departments of the Planetary, Cometary, and sidereal branches of the subject.

CHAP. I.

OF THE SUN.

Sect. I.—*Of the Motion of the whole Solar System in Space.*

It has been previously mentioned (vol. iii. p. 807) that the idea of a proper motion of the sun had been embraced by Sir W. Herschel, but had been rejected as improbable by Bessel and other astronomers. The fact, however, of the existence of this motion has been now rendered incontestible by the independent labours of several astronomers, and we propose to give briefly the grounds of their several determinations.

First, with regard to theory, let us imagine that the sun has a motion (carrying, of course, the earth with it) which, for the small interval of time included by our modern observations which are of sufficient accuracy to decide the point, may be considered as uniform and rectilinear, towards a point of the heavens denoted by right ascension A and declination D. It is evident, in the first place, that the general effect of such a motion would be to produce an apparent displacement of all the stars in the heavens of such a nature as to increase the apparent angular distances of all stars towards which the motion is described, and to diminish the apparent distances of all those in the opposite quarter of the heavens. With regard to the right ascensions of all stars, then, the effect would be to produce an apparent proper motion in that element, such that the right ascensions to the left of the point towards which the sun is moving would be increased, and those to the right would be diminished; while those lying in the meridian of the solar motion would remain unaltered. Similarly with regard to the stars lying in the latter plane, the north polar distance of all to the north of the point of solar motion would be diminished, while all to the south of it would be increased.

To determine accurately the amount of apparent motion of any star in right ascension and declination, let α and δ be the right ascension and declination of any star at a linear distance r from the sun or earth. Then, if the line joining the earth or sun, and the star, make with the line of direction of the supposed motion, an angle θ; and if, in the unit of time, the linear solar motion be a, the angle of apparent displacement of the star in this plane will be $\frac{a}{r} \sin \theta$. If, now, we imagine the

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spherical triangle formed by the great circles joining the north pole of the heavens, the apex of solar motion, and the star, its three sides will be $90° - D$, $90° - \delta$, and θ; and the angle opposite to θ will be $\alpha - A$. From this it may be readily shewn that the apparent motion in R. A. is $+\frac{a}{r}\frac{\cos. D \sin. (\alpha - A)}{15 \cos. \delta}$ (expressed in time), and the motion in declination (northwards) is $+\frac{a}{r}\left\{\sin. D \cos. \delta - \cos. D \sin. \delta \cos. (\alpha - A)\right\}$. These, then, are the formulæ by which the proper motions of the stars, when deduced from comparison of observations made at distant epochs, are to be tested; and, assuming that the *solar motion does really exist*, and that, on the whole, the proper motions of the stars are to be attributed to it, the most probable values of A and D are to be deduced; and it is evident that, since there is antecedent probability of the *reality* of the motions of many of the stars, the most probable values can only be determined by the use of a tolerably large catalogue in all parts of the heavens, so that their *real* proper motions having no determinate direction, the effects will be eliminated, or nearly so, in the final result. Another difficulty arises from the circumstance that the formulæ involve the distances of the stars which, except in a very few exceptional cases, are totally unknown. This can only be obviated either by assuming, with Argelander, that, on the average, stars having the greatest proper motions are nearest to the sun; or, by introducing, with Otto Struve, some empirical law of distance derived from the apparent magnitudes. Both hypotheses are precarious; but it is likely that, with either, the average result for the position of the apex of solar motion, deduced from a large catalogue of proper motions, will be tolerably correct; and it is also not improbable that in large numbers of stars the distances will so far agree with the law of apparent magnitudes, as to give a result for the actual amount of solar motion (based on the few cases of distances actually known) not very far distant from the truth.

The first astronomer who successfully attempted a solution of the problem was Argelander, in a paper published in 1837 in the *Mémoires presentées par divers Savans* of the Imperial Academy of St Petersburg. The proper motions employed are those derived from his own catalogue of 560 stars observed at Abo, by comparison with Bradley's observed places, as given in Bessel's *Fundamenta*. The only peculiarity which we have space to notice in Argelander's treatment of the problem is, that, assuming stars with the greatest proper motions to be nearest to us, he divides them into three classes determined by the greatness of the proper motions, and deduces a separate result from each class. The final result which he deduces is, when reduced to 1800,

$$A = 259° 51'·8; \quad D = + 32° 29'·1.$$

In No. 398 of the *Astronomische Nachrichten*, Argelander gives a result obtained by Lundahl, based on a comparison of 147 stars of Pond's catalogue of 1112 stars with the *Fundamenta*, each of the stars having an annual proper motion not less than 0″·09. The result arrived at is for 1792·5,

$$A = 252° 24'·4; \quad D = + 14° 26'·1.$$

The most important paper is that of M. Otto Struve, printed in the fifth volume of the *Petersburg Transactions* for 1842. The title of the paper is *Bestimmung der Constante der Precession mit Beruchsichtigung der eigenen Bewegung der Sonnensystems*, and for it the author received the gold medal of the Royal Astronomical Society in 1850. The investigation is grounded on the proper motions of about 400 stars (chiefly double) observed at Dorpat; for determining the weights of his equations, he assumes that the distances of the stars are inversely as the apparent magnitudes; and for his final result he obtains, as the most probable values of A and D for 1790,

$$A = 261° 21'·8; \quad D = + 37° 36'·0.$$

And, by combining his observations with those of Argelander and Lundahl with proper weights he obtains, finally, for 1792·5,

$$A = 259° 9'·4; \quad D = + 34° 36'·5.$$

The most recent investigation of the direction of the solar motion is by Mr Galloway, printed in the *Philosophical Transactions* for 1847, Part I., and for which the royal medal was awarded to him. His object was to show whether the general *drift* of the southern stars indicated a motion of the sun towards the same point of the heavens as that indicated by the northern stars. For this purpose he employed the catalogue of 606 stars observed at St Helena by Mr Johnson, and the catalogue of 172 stars observed by Mr Henderson at the Cape of Good Hope; Mr Galloway's method of investigation is precisely the same as that of Argelander, excepting that he does not attempt to assign weights to his equations by any hypothesis whatever with regard to the distances of the fixed stars, considering that no greater probable accuracy could be obtained in his inquiry by the adoption either of Argelander's or of Otto Struve's assumption of the criterion of distance. The result which he obtains for the values of A and D is, for the epoch 1790,

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$$A = 260° 0'·6; \quad D = + 34° 23'·4.$$

The essential identity of this position of the apex of solar motion, derived from the southern stars, with that deduced from three separate sets of northern stars, confirms the *fact* of the existence of this motion, and shows that we have arrived at a very close approximation to its direction. The investigation of Otto Struve has also shown that its amount (0″·3 in a year) is too large to be neglected in any future cosmical speculations. The subject is therefore one of very considerable importance, and must form the basis of any future inquiries respecting the connexion of our sun and planets with that sidereal system of which they form a part.

Section II.—*Of the time of rotation of the Sun, and the physical peculiarities of his surface.*

In the preceding part of this article, the method has been explained by which astronomers have determined, with various degrees of accuracy, the time of the sun's rotation, and the position of his equator with regard to the ecliptic, by means of observations of the spots which are frequently observed on his disk. The chief observations and investigations having this object in view, were made by Scheiner, Cassini, and Lalande, at epochs included between the years 1626 and 1776. Recently several attempts have been made to obtain results of greater accuracy, by M. Laugier, Dr Petersen, and Dr Böhm of Vienna. The dissertation of the last-named astronomer has been recently printed in vol. iii. of the *Denkschriften der Mathematisch-Naturwissenschriftlichen Classen* of the Academy of Sciences of Vienna; and this paper is well worthy of the attention of the student, from the elaborate care which has been bestowed upon the mathematical treatment of the subject, as well as for the excellence of the observations carried on for some years on which the results depend.

The results deduced by Dr Böhm are, for the epoch 1834·6:

Longitude of ascending node of sun's equator, $= 76° 46'·9$.
Inclination of sun's equator to ecliptic, . . $= 6° 56'·6$.
Time of sun's rotation, $= 25$ days 12 hours 30 minutes.

The times of rotation, according to M. Laugier and Dr Petersen, are respectively,

$$25^d\ 8^h\ 10^m, \text{ and } 25^d\ 4^h\ 30^m.$$

With regard to the physical peculiarities of the surface of the sun, some important additions have been recently made by Mr Dawes, by means of an eye-piece devised by himself, which enables the observer to examine minutely, and with comfort, any separate portion of the disk. Mr Dawes' apparatus is very simple, and consists of a metallic perforated slide (the perforations being of a different size for different purposes) which crosses the eye-tube at right angles, in place of the fixed bar; that is, in the plane of the focus of the object-glass. By this means the field of view can be rendered as small as is desired for examination of a minute portion of the solar disk, the only light and heat reaching the eye being those transmitted from that portion. This eye-piece has since been adopted by other astronomers, and Mr Dawes was rewarded almost immediately after its application by the discovery of two facts of considerable importance in the theory of the solar spots.

The first discovery relates to the existence of a stratum of comparatively faint luminosity, which he denominates a *cloudy stratum*, giving the impression of considerable depth below the second luminous stratum, which forms the *shadow* or *pen-*

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umbra usually seen round the nucleus of a spot. This stratum appears to be not self-luminous, but of such a nature as to absorb a vast quantity of light and to reflect very little. The [illegible] presenting rather a mottled or cloudy surface, and occasionally some very small patches are very decidedly more luminous than the rest. In all spots of considerable size, a *black opening* is perceivable in the cloudy stratum, which is proved to be, if luminous at all, less so than our own atmosphere when illuminated by the direct rays of the sun.

The second curious fact discovered by Mr Dawes is that of the rotation of the spots. This phenomenon was seen remarkably in the case of a spot sketched on January 17 and January 23 of the year 1852; by which it became evident that in this interval the spot had rotated through 180°. If we accept the usual hypothesis, that the spots are vast disturbances in the atmosphere of the sun, revealing to us for a time part of his surface, what an idea does this present to us of the magnitude of the operations of nature in this stupendous globe! A mass of aeriform or gaseous fluid, whose diameter is frequently more than 100,000 miles, is agitated by a rotating storm similar probably to those which sometimes devastate the surface of our own planet. In the above instance, the mass must have taken about twelve days to complete a revolution; and therefore, though the angular velocity is moderate, yet the outer circle would be moving with the enormous velocity of about 600 miles per hour, a velocity in fact ten times greater than that of the fiercest hurricanes which have at times laid waste portions of the surface of the earth.

With regard to the *faculæ*, Mr Dawes has had opportunities of proving the correctness of Sir J. Herschel's supposition, that they are in reality great waves or undulations projecting beyond the general surface of the solar disk. He says, "The faculæ are best seen near the east and west edges of the sun's disk, where they give the impression of narrow ridges, whose sides are there presented to view. . . . . They are rarely seen as actual projections from the limb. On one occasion, however, I had an opportunity of observing a satisfactory confirmation of the idea that they are ridges or heapings up of the luminous matter. . . . . A large bright streak or facula was observed to run, as usual, nearly parallel to the sun's edge for some distance, and very near it; and then to turn rather abruptly towards the edge and pass over it. The limb was at this time very well defined; and, when it was most sharp and steady, the bright streak was seen to *project slightly beyond the smooth outline of the limb*, in the manner of a mountain ridge nearly parallel to the sun's equator."

Considerable information respecting the solar disk has been obtained by the organized observations of the total solar eclipses which occurred on July 8, 1842, and July 28, 1851. The former of these phenomena was admirably observed by Mr Baily at Pavia, and by Mr Airy at Turin, and detailed accounts of their observations and impressions are given in vol. xv. of the *Memoirs of the Royal Astronomical Society*, accompanied by drawings of the different phases of the eclipse. The attention of astronomers having been, by these and other accounts, directed to the extreme importance of observing with every possible accuracy the total eclipse of 1851, an organization was formed under the auspices of the British Association, and *Suggestions* were published previously, giving minute directions as to the observation of every possible phenomenon which might occur. The observations were remarkably successful, and the accounts of the British observers alone form the first part of vol. xxi. of the *Memoirs of the Royal Astronomical Society*.

An abstract of the results of the observations with regard to the points of greatest interest, such as "Baily's beads," usually seen on the breaking up of the last narrow annulus of light; the corona or faint ring of light which becomes visible when the moon is quite hidden; and the red or rose-coloured prominences which are then seen outside, and in contact with the black lunar disk, will be found in the *Annual Report of the Council of the Royal Astronomical Society*, for February 1852.

In looking for proximate causes of these phenomena, it would naturally occur to any inquirer to seek for their origin, either in the spots on the surface of the solar disk, or in the faculæ or wave-like ridges of light that are visible near the borders, and to this probable identification the attention of astronomers was directed previously to the eclipse of 1851. In particular, M. Schweizer, director of the Observatory of Moscow, took the precaution of having drawings carefully made of all the faculæ which were visible for several days previous and subsequent to the eclipse; and he has come to some remarkable conclusions, which render it very probable that the red prominences are identical with them, and not with the spots.

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Thus, though we cannot say that very much has been done in establishing a satisfactory theory respecting the constitution of the various layers forming the solar atmosphere, yet every possible advantage has been taken of all the circumstances by which, during the last few years, additional knowledge could be gained. Several circumstances which were matters of speculation have become now well-ascertained matters of fact, and materials are laid up which may at some time not far distant tend to the formation of a satisfactory theory based on observation.

It has been tolerably well confirmed by recent observations, and especially by photographical representations of the sun, that the light at the centre is considerably more intense than that near the borders of the disk; and Professor Secchi has recently been engaged in a series of experiments, which seem to prove very distinctly that the same is true with regard to *heat*.

Secchi's experiments were made with a thermo-electric pile belonging to a Melloni's apparatus, attached to the telescope of the equatorial of the Collegio Romano at Rome, and some of his conclusions are very satisfactory. Amongst these, the most important conclusion is, that the heat of the solar image is at the centre almost twice as great as at the borders, whether estimated in the direction of right ascension or of polar distance. A second conclusion satisfactorily arrived at is, that the point of greatest heat was not exactly at the centre of the disk, but about 3′ above it in declination; and on constructing the curve of intensity, and considering the position of the sun's equator at the different times at which the experiments were made, the maximum line of heat appears to be coincident with the equator. Professor Secchi also thinks it not improbable that the two solar hemispheres possess different temperatures, as seems to be the case with the earth; and if so, he considers that his researches, if continued, will throw some light on the climatology of our planet; since the heat of the sun would be different, accordingly as one or the other of its poles is turned towards the earth. He also had occasion to remark, that the influence of solar spots upon the temperature was very striking; so that sometimes a spot which did not occupy more than one-hundredth part of the aperture of the pile, caused the temperature to fall 3°, or about one-fifteenth of the whole intensity.

CHAP. II.

OF THE MOON.

SECTION I.—*Correction of the Elements of the Lunar Orbit.*

The greatest work of the present century, tending to bring to perfection the theory of the motions of the moon, is the reduction, under the direction of Mr Airy, of the ancient lunar observations made at Greenwich. These observations extend from the time of Bradley to that of Pond, and embrace a period of eighty years, during which the nodes of the orbit in which the cycle of many of the perturbations is completed have made more than four revolutions. The number of observations made in this interval, and thoroughly discussed, amount to about 9000.

It has been fortunate also to the science of astronomy, that the same great astronomer who had courage to undertake the vast amount of labour connected with the reductions, has found leisure to deduce from the results the corrections of the elements of the orbit. The paper containing the investigation connected with the corrections of the elements, is printed in vol. xvii. of the *Memoirs of the Royal Astronomical Society*, from which we extract the following curious and important results.

Correction of the Epoch of Mean Longitude.

The correction of this element proved to be of very great service to the lunar theory, by eliciting from Professor Hansen the discovery of a new inequality, depending upon the action of Venus.

By dividing the observations into groups of about five years,

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it was found that the corrections to Damoiseau's epoch of longitude were neither constant, implying that the mean motion was correct, nor uniformly increasing or diminishing, but that a periodic inequality was very clearly exhibited, showing the result of some unknown cause of disturbance. On the results being shown in MS. to M. Hansen, he very quickly traced the origin of the perturbation, and proved it to be due to the unequal action of Venus at different distances from the earth and moon. On the application of these inequalities for the respective epochs, the periodical inequality disappeared, and the successive corrections to the epochs of longitude for the different epochs showed an evident error of assumed mean motion, the secular correction to which was found to be + 39″·3.

Another important result deduced by Mr Airy, was the correction of Burckhardt's value of the moon's parallax, which he found ought to be increased by $\frac{1}{180}$th part.

Subsequently, however, Mr Adams (the English discoverer of the planet Neptune) has entered into a minute examination of Burckhardt's tables, especially with regard to the parallax; and has found errors of such a magnitude as to enforce the necessity of applying the requisite corrections to all the observed places of the moon in which this tabular parallax has been applied, including all for which the data of the Nautical Almanac have been employed in the reductions. Mr Adams's paper on the lunar parallax is added to the volume of the Nautical Almanac for 1856, and the requisite tables are given for deducing the corrections to be applied to the observed places of the moon which have been reduced with the erroneous parallax.

In Mr Airy's corrections of the elements of the lunar orbit, there is an inequality in the latitude of the form + 2″·17 × cos. moon's true longitude, which had not been detected by theory, but which clearly resulted from the observations. Professor Hansen, soon after the publication of Mr Airy's results, showed this also to be a legitimate deduction from theory, his calculated coefficient of the inequality being + 1″·38. The cause of the inequality he found to be due essentially to the circumstance, indicated by Laplace, of the invariability of the mean inclination of the orbit of the moon to the plane of the earth's orbit, as affected by the action of the planets. The development of the expression for the latitude, according to this law of the inclination, with a slight modification, was found to contain a term of the form required. The same train of investigation has given a new term in the expression for the moon's longitude = − 0″·50 × cos. long. of node, while that deduced from observation and hitherto unexplained = − 0″·97 cos. long. of node.

Again, in a subsequent communication to Mr Airy, M. Hansen announced that he had verified by theory another small term discovered by observation. According to his statement, he found the correction to Damoiseau's secular motion of the node to be + 1″·643, while Mr Airy's investigations had given + 1″·721.

SECTION II.—*Of Selenography, or Observations and Delineations of the Surface and Physical Peculiarities of the Moon.*

The surface of the moon has received that attention which might be looked for from the vast increase of optical power which has been recently brought into action, and from the zeal and talent which have been displayed in every department of physical research.

The most important delineation of the whole surface of the moon, as derived from observation, is that contained in the admirably executed map, accompanying the elaborate work by Beer and Mädler, entitled *Der Mond*. This map is the result of some years' careful study and micrometrical measurement of the surface of the moon, and every point discovered by the telescope is laid down with all attainable precision.

A raised model of the whole surface, deserving especial notice, was executed by Madame Witte, a Hanoverian lady, and exhibited in England in 1845. It is composed of a mixture of mastic and wax, forming a globe of about 12 inches in diameter, on which the positions and general outlines of the craters and other remarkable features were, in the first instance, laid down from their latitudes and longitudes, as given by Beer and Mädler, and the modelling was afterwards performed by the aid of a magnifying-glass from the actual appearance of the objects as presented in the telescope. Another original model, executed by the same lady, is laid up in the Royal Museum of Berlin.

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Of English observers of the lunar surface, the most successful has been Mr James Nasmyth, a gentleman well known to the general, as well as the scientific public by his mechanical inventions. In the year 1844 he exhibited, and subsequently presented to the Royal Astronomical Society, a model and drawing of a portion of the surface, occupying a space of about 190 by 160 miles, the result of four years' careful and continuous labour. The observations were made with two reflecting telescopes, one of $8\frac{3}{4}$ inches aperture and 9 feet focal length, and the other of 12 inches aperture, and 13 feet focal length.

Mr Nasmyth has continued up to the present time to direct his attention to the lunar surface, and in the memorable year 1851 he exhibited, at the Crystal Palace in Hyde Park, some excellent models and charts of various portions of it. He has recently announced that he is still engaged in sketching and modelling the surface, employing for the purpose an excellent reflecting telescope of 20 inches aperture, with a power of 410. For Mr Nasmyth's ingenious speculations on the formation of the moon's craters, and on the apparent identity of the volcanic action with that existing on the surface of our own planet, the reader may consult the *Memoirs* and *Notices of the Royal Astronomical Society*.

Professor Secchi, to whom we are indebted for some valuable contributions to our knowledge of the heating properties of the solar surface, has also, in connection with Professor Ponzi, a distinguished Italian geologist, devoted considerable attention to the study of the surface of the moon, and furnished some remarkable speculations respecting the successive periods of volcanic action. We have not space for any detailed account of these speculations, for which the reader is referred to vol. xiii. of the *Notices of the Royal Astronomical Society*.

CHAP. III.

OF THE PLANETS.

Mercury.

The theory of the motion of Mercury has recently been most thoroughly investigated, and new tables have been constructed by M. Leverrier.

The investigation of the corrected orbit, which is contained in the additions to the *Connaissance des Temps* for 1848, is one of the most profound and laborious, and at the same time original, contributions to planetary astronomy, which have appeared during the last few years, and will well repay the perusal, both of the student and the accomplished astronomer.

We have space only for a brief explanation of the processes employed, and for a recapitulation of the principal results.

His object was to obtain new elliptic elements of the orbit from the Paris Observations made between 1801 and 1828, and between 1836 and 1842, and also totally to revise the whole theory of the perturbations of the planets, using the best modern elements, and taking in every term in the developments of the perturbing function which could possibly exercise the smallest influence on the place of the planet.

Using Lindenau's elements as the basis of his investigations, he first proceeds to prepare the expressions for the equation of the centre and the radius-vector, to the ninth power of the eccentricity. The next and most laborious part of the work is the original redetermination of the perturbations of the elements of the orbit. This process is described most elaborately, and the action of each of the planets is given. Assuming the provisional values for the masses of the disturbing planets, he gives the numerical values of the secular variations of the eccentricity, perihelion, inclination, and node of the orbit, and points out a serious error committed by Laplace in the determination of the secular variation of the equation of the centre. Lastly, after having in a most elaborate way calculated the periodical variations of the elements of the orbit, and of the heliocentric co-ordinates produced by each planet separately, he sums up the provisional expressions of the elliptic elements, and the perturbations, with every detail.

The next part of the work is the reduction of the observa-

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tions, and the comparison of the observed and tabular places. For the reduction of the observations of R.A., his fundamental stars are taken from the *Tabulæ Regiomontanæ*: the right ascensions of the sun are taken from the *Connaissance des Temps*, but are corrected by the *Paris Observations*; the radii-vectores of the Earth's orbit are taken from Bessel's tables; and Bessel's obliquity of the ecliptic is adopted in the reduction to geocentric longitude and latitude. In the reduction of the observations of declination, the planet is compared with stars lying nearly in the same parallel, and observed by the same observer—the zenith point apparently not having been determined independently. The mean parallax of the sun is assumed to be 8″·6.

The observed right ascensions and declinations are then reduced to geocentric longitudes and latitudes; and the tabular heliocentric places are reduced by appropriate formulæ to geocentric longitudes and latitudes; and these, when corrected for aberration, are immediately comparable with the observed geocentric longitudes and latitudes, and the errors of the tabular places are thus found. These errors are then converted into errors of heliocentric longitudes and latitudes by the use of formulæ similar to those given in the *Introductions to the Greenwich Observations*, and involve the error of radius-vector. But the errors of longitude can be immediately expressed in terms of the errors of the epoch, mean motion, eccentricity, and perihelion, by differentiation of the expression for the true longitude, in terms of the mean anomaly and eccentricity; and the errors of latitude can be easily expressed in terms of the errors of inclination and node of the orbit; hence the two sets of equations are formed for the determination of the six elements of the orbit.

The next part of M. Leverrier's process is the collection and discussion of all the observations which had been made of the transits of the planet across the sun's disk, since those alone are capable of giving the exact position of the planet for more remote epochs.

Finally, he solves the equations resulting from the *Paris Observations* by the method of least squares, and obtains the errors of the elements.

One of the most important results is the correction which he finds it necessary to apply to the annual mean motion, namely, +0″·424. "The correction," he observes, "is large; but it is quite impossible without it to represent the ancient and modern observations completely."

M. Leverrier, for the purpose of testing the accuracy of his elements, applies them to the recomputation of the transits across the disk of the sun from the year 1661 to 1832; and the tabulated errors arising from the use of these elements, and those of Lindenau, being placed in adjacent columns, leave no doubt of the superior accuracy of the former.

He finally constructs two distinct sets of tables of the motion of the planets; one according to the old form, and the other according to a form totally original, and of which the chief peculiarity consists in taking the time for the sole argument throughout. The latter he considers to possess very great advantages, and enters into a minute critical investigation of the defects of all planetary tables constructed in the ordinary way.

Venus.

The planet Venus being so close a neighbour to the Earth and her satellite the Moon, it might be expected that she would produce serious disturbances on the orbits of these bodies. It has been seen that this is the case with regard to the Moon; and long before the discovery of this inequality, a very important inequality, of very long period, in the orbits of the Earth and Venus, produced by their mutual action, was detected by Mr Airy.

This investigation (one of the most laborious and remarkable in physical astronomy since the time of Laplace) is contained in Part i. of the volume of the *Philosophical Transactions* for 1832; and we will give a few of the leading features of the investigation, without any explanation of the abstruser parts of the discussion.

In Mr Airy's paper in the *Philosophical Transactions* for 1828, "On the Correction of the Elements of Delambre's Solar Tables," he had stated that the comparison of the corrections in the epochs of the sun, and the place of the perigee given by late observations, with the corrections given by the observations of the last century, appeared to indicate the existence of some inequality not included in the arguments of those tables; and as soon as he had convinced himself of the necessity of seeking for some inequality of long period, he commenced an examination of the mean motions of the planets, with the view of finding one whose ratio to the mean motion of the earth could be expressed very nearly by a proportion whose terms were small.

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Venus is precisely in this predicament with regard to the Earth, since eight times the mean motion of Venus is so nearly equal to thirteen times the mean motion of the Earth, that the difference does not exceed $\frac{1}{272}$th part of the Earth's mean motion. This would imply an inequality whose period is about 240 years—a longer period with regard to the periodic time of the planets disturbed, than any for which a term of perturbation had been calculated.

The coefficient of the term of the expansion of the disturbing function in which this inequality exists, is of the fifth order with regard to the eccentricities and inclinations, and therefore would be exceedingly small; but on the other hand it would be multiplied in integration by a quantity amounting to $3 \times 13 \times (240)^2$ or about 2,200,000, and on this circumstance depended the chance of its becoming sensible.

The orbit of Venus has also received considerable attention during the present century, and the whole series of the Greenwich observations from 1750 to 1840 have been made available, and been employed to obtain the corrections of Lindenau's elements. These investigations, conducted successively by Mr Main, Mr Glaisher, and Mr H. Breen, of the Greenwich Observatory, will be found in various volumes of the *Memoirs of the Royal Astronomical Society*, to which the reader is referred, in connexion with the *Introductions to the Greenwich Observations*, for explanation of the peculiarities of the methods employed.

Mars.

The orbit of Mars has received at the hands of Mr H. Breen a revision similar to that bestowed on the orbit of Venus, by a comparison of the places computed from Lindenau's tables, with the Greenwich observed places from 1750 to 1830. The investigation is precisely similar to that for the orbit of Venus, and will be found in vol. xix. of the *Memoirs of the Royal Astronomical Society*.

Next to the transits of Venus across the sun's disk (which afford absolutely the best means of determining the solar parallax), the observations of Mars at his opposition are the most useful for determining this element. The observatory at the Cape of Good Hope is admirably situated relatively to Greenwich for such determinations, and, ever since the time of Lalande, comparisons of observations between the two observatories have been of great service to astronomy. Notwithstanding the apparently definitive value of the sun's parallax obtained from the transits of Venus in 1761 and 1769, astronomers have been so impressed with the importance of establishing the correctness of this element by all other available means, that, at every opposition of Mars, the places of stars suitable for comparison with the planet are published in the *Nautical Almanac*, and observed at Greenwich and the Cape, and at other places. At the opposition of 1851, a good series of comparative observations of the planet was made at the two observatories, and, as soon as the transit circle now in preparation is established at the Cape, we may hope for some comparative results which will be of still greater service for the determination of the parallax.

The shape of the planet has been well measured, and it appears certain that it has a measurable ellipticity, though there is still some doubt as to its amount. A good set of measures made at Greenwich with a double-image micrometer in 1845, gives $\frac{1}{152}$d for the ellipticity, and another set made in 1852, gives $\frac{1}{190}$th. M. Arago contends for a much larger ellipticity, namely $\frac{1}{103}$th, as the result of the Paris measures, and some observers have not been able, after careful measures, to detect any certain difference between the polar and equatorial diameters.

The physical peculiarities of the planet have been well studied. On this head the reader may consult various papers in the

Nachrichten, and especially one by Mädler in the sixteenth volume. Mr De la Rue devoted a portion of his leisure to the study of the surface of the planet at its last opposition, and has presented to the Royal Astronomical Society some admirably executed drawings of its appearance at various times.

The Small Planets whose orbits lie between Mars and Jupiter.

In no department of astronomy has more activity been displayed than in the discovery of these minute bodies; and the research necessary for discovering them acts very advantageously on the progress of the science, in the formation of charts of small stars lying near the ecliptic, or in regions of the heavens where they are likely to exist. Mr Bishop, at whose observatory in the Regent's Park so many of these bodies have been discovered by Mr Hind, has already published several ecliptic charts, containing all stars as low as the tenth magnitude inclusive, within a zone of 3° on each side of the ecliptic; and Mr Cooper of Markree in Ireland, at whose observatory Metis was discovered, has published in two volumes of observations, catalogues of 30,097 stars. Mr Cooper's telescope, mounted equatorially, has 25 feet focal length, with 14 inches aperture, and he is therefore possessed of peculiar advantages for these researches, and he is still more fortunate in securing the services of his active and talented observer, Mr Graham, the actual discoverer of Metis.

The first planet, Astræa, of the more modern group, was discovered, after an interval of several years, at the end of 1845, by M. Hencke of Driessen; and the next in order of discovery, Hebe, was also discovered by him in 1847. Since that time discoveries of other planets, by Hind, De Gasparis, and others, have followed in rapid succession, till at the present time we are acquainted with twenty-six of these bodies. We subjoin a table exhibiting the whole list, with the names of the discoverers, the dates of discovery, and relative magnitudes of their orbits subjoined. It is only necessary to explain, that they are placed in the order of their mean distances from the sun, as given by the orbits (many of them only provisional) which have been computed.

Name of Planet.	No. in Order of Discovery.	Discoverer.	Date of Discovery.	Mean Distance.	Sidereal Period in Days.
Flora	8	Hind	1847, Oct. 18.	2·202	1193
Melpomene	18	Hind	1852, June 24.	2·297	1275
Victoria	12	Hind	1850, Sept. 13.	2·335	1303
Vesta	4	Olbers	1807, Mar. 29.	2·361	1326
Iris	7	Hind	1847, Aug. 13.	2·381	1342
Metis	9	Graham	1848, April 26.	2·386	1346
Phocea	25	Chacornac	1853, April 7.	2·405	1362
Hebe	6	Hencke	1847, July 1.	2·426	1380
Parthenope	11	De Gasparis	1850, May 11.	2·426	1380
Fortuna	19	Hind	1852, Aug. 22.	2·446	1397
Massilia	20	De Gasparis	1852, Sept. 19.	2·449	1400
Thetis	17	Luther	1852, April 17.	2·491	1436
Astræa	5	Hencke	1845, Dec. 8.	2·577	1513
Egeria	13	De Gasparis	1850, Nov. 2.	2·579	1514
Irene	14	Hind	1851, May 19.	2·584	1517
Proserpine	26	Luther	1853, May 5.	2·588	1521
Lutetia	21	Goldschmidt	1852, Nov. 15.	2·605	1536
Eunomia	15	De Gasparis	1851, July 29.	2·648	1573
Juno	3	Harding	1804, Sept. 1.	2·671	1593
Thalia	23	Hind	1852, Dec. 15.	2·707	1627
Ceres	1	Piazzi	1801, Jan. 1.	2·768	1682
Pallas	2	Olbers	1802, Mar. 28.	2·773	1686
Psyche	16	De Gasparis	1852, Mar. 17.	2·933	1835
Calliope	22	Hind	1852, Nov. 16.	2·941	1842
Hygeia	10	De Gasparis	1849, April 12.	3·122	2015
Themis	24	De Gasparis	1853, April 5.	3·357	2252

The discovery of so many of these small planets has made it necessary to seek for some more convenient method of computing their perturbations than that of mechanical quadratures formerly in use. The difficulty of the calculations consists in the largeness both of the excentricities and inclinations of the orbits, since it is by powers of these quantities or functions of them, that the effects of perturbation are expressed in the ordinary methods.

In a paper published by Professor Hansen in 1843, in the *Transactions of the Royal Academy at Berlin*, and since translated into the French language by Mauvais, and published in the *Connaissance des Temps* for 1847, a method is given by which the variations of these elements can be expressed in general terms by means of series converging with a sufficient degree of rapidity.

Professor Encke has for several years devoted considerable attention to the same subject, and has recently devised a method of remarkable simplicity for effecting the summations of the perturbations. The pamphlet containing the exposition and application of the method has been translated from the German by Mr Airy, with additional notes and illustrations, and is appended to the *Nautical Almanac* for 1856.

A remarkable paper by Mr G. P. Bond, on the same subject, is printed in the fourth volume of the *Memoirs of the American Academy*, entitled, "On some applications of the method of mechanical quadratures."

Jupiter.

On account of the vast size of the planet Jupiter, the determination of his mass is a matter of very great importance, and on account of the brightness of his satellites, this determination is easily effected by means of their observed elongations.

Till the year 1832, however, no observations of the satellites were extant which were sufficiently accurate for the purpose. At this time, Professor Airy made an excellent series of observations of the extreme elongations of the fourth satellite, and obtains for the value of the mass $\frac{1}{1047.7}$. In the years 1833 and 1834 he repeated the observations, and found for the mass the values $\frac{1}{1047.88}$ and $\frac{1}{1047.81}$. He finally caused a similar set of observations to be made with the Shuckburgh equatorial at Greenwich, in 1836, and found for the value, $\frac{1}{1047.92}$. The weights which he assigns to these results are 2, 2·3, and 8, and his definitive value is $\frac{1}{1047.77}$. The separate investigations will be found in vols. vi., viii., ix., and x. of the *Memoirs of the Royal Astronomical Society*.

About the time of the commencement of Mr Airy's observations, Bessel had undertaken the same problem on a more extended plan, including not only the determination of the mass of Jupiter, but a complete revision of the elements of the orbits of the satellites, by means of observations of their elongations. For this purpose he commenced with the Königsberg heliometer a very elaborate series of measures of distance and angle of position of all the satellites relatively to their primary, which was continued from 1832 to 1835, and then again taken up and completed in 1839. His resulting values of the mass are as follow:—

From the observations of the 1st satellite, ... 1048·381
... 2d ... . 1048·153
... 3d ... . 1048·143
... 4th ... . 1047·746

and from these values he deduces for the definitive value of the mass of the Jovial system $\frac{1}{1047.879}$.

Bessel's dissertation on the mass of Jupiter is contained in the second volume of the *Astronomische Untersuchungen*, a work containing several of the most profound researches of this eminent astronomer, published in 1842. The dissertation is accompanied by new tables of the satellites.

An investigation of the value of the mass of Jupiter was also made by Professor Santini at Padua in 1835, by observations of distance of the fourth satellite from the centre of the primary, made with a double-image micrometer furnished by Amici. The definitive result for the mass is $\frac{1}{1047.97}$, and this dissertation also is accompanied by tables of the motion of the fourth satellite. (*Memorie della Societa Italiana delle Scienze*, vol. xxi.)

With regard to the form of the planet Jupiter, the received value of the ellipticity for many years was that deduced by Struve at Dorpat—viz., $\frac{1}{14.7}$. (See *Memoirs of the Royal Astronomical Society*, vol. iii.) This value has, however, been found to be sensibly erroneous, by means of measures taken in several successive years at the Greenwich Observatory, with a double-image micrometer applied to the Sheepshanks equatorial. The value of the ellipticity, deduced from nearly fifty sets of measures averaging ten measures in each set, is $\frac{1}{14.7}$.

We may finally mention a valuable paper by Mr Woolhouse, on the satellites of Jupiter, which will be found in the appendix to the *Nautical Almanac* for 1835. It contains new tables for the calculation of the occultations of the satel-

lites, and of the transits of the satellites and shadows across the disk of the planet.

Saturn.

The additions made to our knowledge of the theory and physical constitution of this important member of the solar system have been very great. In treating of them, we will take in order the orbit, the uranography of the body, the form of the body, the rings, and [illegible] satellites.

The tables representing the motion of Saturn, which have been used to the present time, are those of Bouvard, and in the construction of them a curious error has been detected by Mr Adams, in his course of investigations concerning the orbit.

Mr Adams detected a periodical error of latitude of considerable amount, which, he felt convinced, could not arise from any imperfection in the theory of the perturbations; and on examining the law of the error, of which the period appeared to be nearly twice that of Saturn in his orbit, he traced it to Table xlii. in Bouvard's *Tables*. The formula given in the introduction is correct, but the computation of the whole table is totally erroneous.

Mr Adams gives, in the 14th number of vol. vii. of the *Notices of the Royal Astronomical Society*, a correct table of the values of the inequality in question, to which we would direct the attention of the reader.

In considering the various phenomena which must be constantly occurring before the eyes of a spectator situated on the surface of Saturn, attention is naturally directed to the effects which would be produced by the projection of the rings on the firmament of the spectator, and to the consequences resulting from its interposition for a long period between him and the sun. It has been generally considered, without entering into calculation, that, to the inhabitants below a certain latitude on the planet, the rings, stretching in a circular shape across the heavens, would present a magnificent spectacle for a certain number of years, or as long as the sun should continue on the same side of the ring with the spectator; but that an equally long eclipse, with total absence of light, would be suffered by the inhabitants after the passage of the sun to the other side of the ring.

Dr Lardner has recently shown, in an elaborate paper printed in vol. xxii. of the *Memoirs of the Royal Astronomical Society*, that this view of the subject is to a great extent erroneous; and that even Mädler, who, in his *Populare Astronomie*, has entered more minutely into the consideration of the uranography of Saturn, has made some grave errors in treating the subject. For the details of the investigation by Dr Lardner, we must refer to his paper.

The form of the planet Saturn has been the subject of considerable discussion at various times, but its strictly elliptical figure has been recently established beyond controversy, and the amount of the ellipticity has been very accurately determined.

At the time of the disappearance of the ring in the years 1832 and 1833, Bessel took the opportunity of measuring the planet with the heliometer, with the express view of deciding upon the correctness of Sir William Herschel's opinion, "that at middle latitudes the figure of Saturn deviated considerably from an ellipse," and also of determining accurately the amount of the ellipticity. He measured, therefore, in the directions of the polar and equatorial diameters, and of diameters lying nearly in latitude 45°, and found that the shape was strictly elliptical, and that the ellipticity, deduced from all the measures taken when the ring was either very small or totally invisible, was $\frac{1}{9.7}$th.

Recently, at the last disappearance of the ring in 1848, a series of measures was made with a similar object at Greenwich, by the Rev. R. Main, which give results almost identical with those of Bessel. The shape is proved, by a careful discussion of all the measures, to be strictly elliptical, and the deduced ellipticity is $\frac{1}{9.7}$. Mr Main's paper is printed in vol. xix. of the *Memoirs of the Royal Astronomical Society*.

With regard to the present physical condition of the surface of Saturn as well as of Jupiter, Mr Nasmyth has thrown out some ingenious conjectures based on the knowledge which the rapid advance of geological science has gained for us with regard to the former conditions of the surface of our own planet. Such inquiries are fair subjects of speculation in the present state of the physical sciences, and Mr Nasmyth's paper in No. 2 of vol. xiii. of the *Notices of the Royal Astronomical Society* is well worth perusal.

Amongst the most remarkable discoveries of recent times with regard to the *rings* of Saturn, is that of the *inner dusky or semi-transparent ring*, sufficiently obvious to any observer capable of using well a moderately good telescope, but which, previously to the year 1850, was scarcely suggested by any astronomer. It appears, however, by a paper by Dr Galle of Berlin, published in the *Nachrichten*, No. 756, and discussed with his usual judgment by Mr Dawes in the *Monthly Notices of the Royal Astronomical Society*, vol. xi. p. 184, that this interesting phenomenon was seen by him with the large Berlin refractor in the year 1838, though the observations were not published at the time in the *Nachrichten*, and the attention of the scientific world was not generally drawn to it. The account of Galle's observations, accompanied by drawings exhibiting the trace of the dusky ring as it crosses the body of the planet, was given by Encke in the *Transactions of the Berlin Academy* for 1838.

This was the only intimation of the existence of the inner ring received by the scientific world from that time till the year 1850, when its existence was recognized almost simultaneously by two observers, namely, by Professor Bond of the Cambridge Observatory, U.S., and by the Rev. W. R. Dawes at Wateringbury, near Maidstone. Since that time there has been no difficulty in seeing this curious appendage to Saturn, though it still requires a practised eye and a good telescope.

At the time of the discovery of the dusky ring, Mr Dawes also satisfactorily established the fact of the outer division of the exterior ring near its outer extremity; and subsequently he observed a series of discontinuous gradations of colour or intensity of brightness in a portion of the inner bright ring. He observes, that "the exterior portion of the inner bright ring to about one-fourth of its whole breadth was very bright, but that interior to this, the shading-off did not appear, as under ordinary circumstances, to become deeper towards the inner edge without any distinct or sudden gradations of shade; on the contrary, it was clearly seen to be arranged in a series of narrow concentric bands, each of which was darker than the next exterior one. Four such were distinctly made out; they looked like steps leading down to the black chasm between the ring and the ball. The impression I received was, that they were *separate rings*, but too close together for the divisions to be seen in black lines." This curious phenomenon was confirmed afterwards by Professor Bond.

Many valuable observations of Saturn and his rings have been made recently by Mr Lassell, who, in the autumn of 1852, established himself with his 20-foot reflecting telescope at Malta, for the purpose of observing in a purer atmosphere. Amongst his discoveries may be mentioned the fact of the *semi-transparency* of the dusky ring, which curious fact had been previously recognized by Captain Jacobs at the Madras Observatory.

Mr De la Rue has also devoted considerable attention to the system of Saturn, and has recently published an admirably executed drawing, which embodies the results of his observations.

We would, before concluding our remarks on the rings of Saturn, draw attention to a remarkable paper by M. Otto Struve, printed in vol. v. of the *Petersburg Memoirs*. M. Struve shows with tolerable certainty that the inner or dusky ring is not a modern appendage to the planet, as might almost be suggested by the fact of its remaining so long undiscovered; but that at the beginning of the eighteenth century, the dark line thrown by it across the planet was not confounded with the shadow of the bright rings, but was known by the name of the *equatorial belt*.

But one of the most curious results of M. Struve's researches is, that by a comparison of the micrometrical measures of Huyghens, Cassini, Bradley, Herschel, W. Struve, Encke, Galle, and himself, he finds that the *inner edge of the interior bright ring is gradually approaching the body of the planet, while at the same time the total breadth of the two bright rings is constantly increasing*.

An *eighth* satellite of Saturn was discovered in 1848, independently, and almost simultaneously by two observers, Professor Bond and Mr Lassell. The names of the seven satel-

lites previously known, proposed by Sir J. Herschel, were Mimas, Enceladus, Tethys, Dione, Rhea, Titan, and Iapetus. For the new satellite Mr Lassell proposed the name Hyperion. Its period, as determined by Mr Lassell, from a comparison of observations made in 1850 with those made in 1852 and 1853, is 21·297 days; and, in order of distance from Saturn, it lies between Titan and Iapetus, the latter being the exterior of all.

Uranus.

For many years the orbit of Uranus has been the occasion of great embarrassment to astronomers, from the impossibility of adequately reconciling the ancient and modern observations by any one set of elements, and from the rapid increase of the tables from year to year.

Amongst the astronomers who entered seriously upon the task of tracing the course of the irregularities in the motions of the planet we can only mention those who arrived at a successful solution of the problem; namely, M. Leverrier and Mr Adams, each of whom has attained to a world-wide celebrity by the profound and masterly analysis which led to the discovery of the disturbing planet Neptune.

In France the attention of M. Arago had been particularly directed to the subject; and about the year 1845 he earnestly represented to M. Leverrier the importance of the question, and induced him to lay aside the cometary researches on which he was engaged, and to enter upon the painful and laborious calculations which the problem demanded.

The first part of M. Leverrier's work consists of a complete revision of the theory of the perturbations of Uranus; and his first memoir, which was presented to the Institute in November 1845, is devoted to the exact redetermination of the perturbations produced by Jupiter and Saturn; and this profound investigation is conducted with the same masterly skill which distinguished his researches on the orbit of Mercury.

The second memoir was read before the academy on June 1. 1846, and has for its chief object the comparison of the observed places of Uranus with the tabular places computed by Bouvard's tables, corrected according to the previous investigations for the new inequalities produced by Jupiter and Saturn, and for such other errors as had been discovered in the progress of the work. He arrives at the important conclusion, that though large errors existed in the tables, and through this cause alone they could not correctly represent the observations, yet that the difference existing between theory and observation could not be adequately accounted for by such imperfections, and that the cause of the "discordances" must be sought for elsewhere.

It is but just to Mr Adams to state, that he also, before entering upon the task of accounting for the discrepancies observed, by the hypothesis of an exterior disturbing planet, recomputed all the principal inequalities produced by the action of Jupiter and Saturn, and satisfied himself that errors in the tables would not account for the failure in the agreement between theory and observation.

With regard to the satellites of Uranus some considerable discoveries have been made, though modern research has failed to identify the greater number of those seen by Sir W. Herschel. However, two additional satellites *certainly* (and probably three) were found in 1847 by the exertions of Mr Lassell and M. Otto Struve, each of which is nearer to the planet than any of those discovered by Sir W. Herschel. In the *Notice of the Royal Astronomical Society* for January 1848, will be found the account given by each of these astronomers of the discovery of at least one satellite interior to the second of Sir W. Herschel. Mr Lassell observed the same object for several nights, and on one occasion he observed an additional one, the positions of the object observed being always on the north side of the planet. M. Otto Struve, on the contrary, observed an object always on the south side only of the planet. In the *Notice* for March 1848, will be found a paper by Mr Dawes, in which he discusses very thoroughly the whole of the observations made by both astronomers, and arrives at the conclusion that the objects observed by them are not identical, and consequently that *two* satellites must have been discovered.

Mr Lassell has since that time been able to follow up the observations of both these bodies, and by a comparison of the observations made by him in 1847, 1851, and 1852, he finds for the period of the inner satellite which he calls Ariel, 2·520378 days, and for the period of the exterior one (Umbriel) he deduces 4·144557 days.

By a rigorous scrutiny of all the observations made by the two Herschels, Dr Lamont, and Mr Lassell, of the two bright satellites of Sir W. Herschel, Mr Adams finds for their periods $8^d\ 16^h\ 56^m\ 24^s{\cdot}88$, and $13^d\ 11^h\ 6^m\ 55^s{\cdot}21$.

Neptune.

In whatever light we regard the discovery of the planet Neptune, it must certainly rank amongst the most brilliant of the discoveries of the present century;—the highest achievement in an age abounding with every resource of science and intellectual cultivation.

It has been stated that Leverrier undertook the task of the revision of the theory of Uranus at the instance of M. Arago, that his first memoir on the subject was read before the French Academy in November 1845, and that his second memoir was read in June 1846. These memoirs were printed in the *Comptes Rendus*, vols. xxi. and xxii. In the second memoir Leverrier demonstrates that an account of the motions of Uranus can only be given by the introduction of the disturbing force of a new exterior planet, and he fixes its position for 1847, January 1, at 325° heliocentric longitude.

The third memoir, entitled "*Sur la planète qui produit les anomalies observées dans le mouvement d'Uranus—Détermination de sa masse, de son orbite, et de sa position actuelle,*" was read on August 31. 1846. In it the position of the disturbing planet is fixed more exactly at 326° 32′ heliocentric longitude for 1847, January 1.

The three memoirs mentioned above were read before the discovery of the planet;—the fourth memoir, containing the remaining part of M. Leverrier's investigations, was read after its discovery, on October 5. 1846, and both this and the third are printed in vol. xxiii. of the *Comptes Rendus*. The fourth memoir is entitled "*Sur la planète qui produit les anomalies observées dans le mouvement d'Uranus; cinquième et dernière partie, relative à la détermination de sa position au plan de l'orbite.*"

Finally, the whole investigation was printed as one continuous treatise in the *Additions* to the *Connaissance des Temps* for 1849.

The discovery of the disturbing planet followed almost immediately after the publication of the third memoir of Leverrier. In acknowledging the receipt of a paper from his friend Dr Galle of Berlin, he took the opportunity of requesting him to search for the planet with the large refracting telescope of the Berlin observatory, at the position which he indicated to him. This letter reached Berlin on September 23, and on the same evening Galle had an opportunity of complying with the request contained in it. He observed all the stars in the neighbourhood of the place indicated, and compared their places with those given in Bremicker's Berlin Star-Map (Hora xxi.) This map, it is necessary to say, had not yet reached England, and on this circumstance probably depended the priority of discovery at Berlin. He very quickly found a star of about the eighth magnitude, nearly in the place pointed out, which did not exist in the map. Little doubt was entertained at the time that this was the planet, and the observations of the next two days confirmed the discovery.

It will now be necessary to explain in few words the attempts made in England during the same period of time to secure the discovery of the planet. Mr Adams had, ever since the year 1841, determined on attempting the solution of the problem relating to the unknown disturbances of Uranus, and in 1843 he began his investigations. In September 1845, he communicated to Professor Challis the values of the elements of the orbit of the supposed disturbing planet, and, in the following month, he communicated to the astronomer-royal the same results slightly corrected. Mr Airy entered into correspondence with him, and requested to be informed whether the assumed perturbations would explain the errors of radius-vector as well as of longitude. From some unexplained cause, no answer was received to this letter, and no steps were taken in England to secure by observation the discovery of the planet till the summer of 1846, after the publication of Leverrier's

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second memoir, in which the same position, within one degree, was assigned to the disturbing planet, as that given in Mr Adams's paper.

The resources of the Cambridge Observatory were now brought into use for the discovery of the planet, and a systematic search was begun by Professor Challis with the great Northumberland telescope. With regard to the success of the system devised for conducting the observations, it is sufficient to say that the sweeps of the portion of the heavens in which it was supposed the planet would be found, were begun on July 29, and the planet was actually observed on August 4, but without recognition. After the discovery of the planet at Berlin, it was found that the planet had also been observed on August 12. If, therefore, Bremicker's map had been in the hands of Professor Challis, or if he had found leisure for the mapping of his observations from night to night, Neptune would have been infallibly detected within a very few days of the commencement of the search, and the whole glory of the discovery would have belonged to the English geometer.

The subsequent history of the planet may be summed up in few words. An ancient observation in Lalande's catalogue was discovered almost simultaneously by Mr Walker, of the Washington Observatory, and by Dr Petersen at Altona; two observations, the one in October 1845, and another in September 1846, were also detected by Mr Hind in Lamont's Zones; and these (especially the former) contributed greatly to the construction of an accurate orbit. An excellent orbit was computed by the joint labours of the American astronomers Peirce and Walker, which, up to the present time, continues to represent perfectly the motions of the planet.

Our sketch of the history of Neptune is necessarily so imperfect, through want of space for details, that we feel it necessary to add a list of the principal works to be consulted by those who are desirous of obtaining correct notions on all points relating to this brilliant discovery.—1. Airy's *Account of some circumstances historically connected with the Discovery of the Planet exterior to Uranus.—Notices of the Royal Astronomical Society*, vol. vii., p. 121; 2. Gould's *Report to the Smithsonian Institution on the History of the Discovery of Neptune*; 3. Lindenau's *Beitrag zur Geschichte der Neptun-Entdeckung*, in the *Erganzung-Heft* to the *Astro. Nachr.* published in 1849; 4. Sir J. Herschel's account in his *Outlines of Astronomy*.

Almost immediately after the discovery of Neptune, it was found to be attended by one satellite. This discovery was made by Mr Lassell in October 1846, and the orbit of the satellite is found to be inclined to the elliptic at an angle of about 35°. By observations of this satellite at Cambridge in America, and at Pulkowa, two separate values of the mass, namely, $\frac{1}{19710}$ and $\frac{1}{19380}$, have been deduced; but the object is so difficult to observe that a considerable time must elapse before any very accurate determination will be arrived at.

CHAP. IV.

OF COMETS.

On the chief Discoveries recently made in Cometary Astronomy.

The discoveries in Cometary Astronomy have kept pace with those in the other departments of the science.

With regard to theory, it has become of great importance, on account of the great number of comets which are discovered, to ease as much as possible the practical difficulties of the methods of computing the orbits, and many excellent papers will be found in the *Astronomische Nachrichten*, and in the *Memoirs of the Royal Astronomical Society*.

In particular, we would refer to a paper by Mr Airy, in vol. xi. of the *Memoirs*, the object of which is to render Laplace's method of computing the orbit of a comet easier of application, by enabling the computer to deduce the orbit immediately from the observed right ascensions and declinations, without the conversion of those quantities into longitudes and latitudes. This method evidently requires that the co-ordinates of the sun referred to the equator should also be computed; and these co-ordinates have therefore been given for some years past in the *Nautical Almanac*.

For an excellent method of calculating an ephemeris of a comet from its elements, we would also refer to a paper by Mr Woolhouse, in the appendix to the *Nautical Almanac* for 1835.

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We will now proceed to give brief notices of some of the most remarkable comets which have appeared during the present century. For full information, and for complete catalogues of comets, the following works may be referred to:—1. Jahn's *Verzeichniss aller bis zum jahre* 1847 *berechneten Cometen-bahnen*, Leipzig, 1847; 2. Hind's work, entitled *The Comets*, London, 1852; 3. Cooper's *Cometic Orbits*, Dublin, 1852; 4. Encke's valuable edition of Olbers's *Abhandlung*, Berlin, 1847.

Encke's Comet, or *Comet of Pons*.—This comet was discovered in October 1805, almost simultaneously by Pons and other astronomers, being the third observed appearance. At this apparition it was sufficiently bright to be seen with the naked eye. Its next apparition was in 1818, when it was again discovered by Pons on November 26. By calculations according to Gauss's methods, based upon the great number of observations made at this apparition, Encke proved the orbit to be an ellipse, with a period of about $2\frac{3}{4}$ years, and established its identity with the comets which appeared in 1786, 1795, and 1805. To do this it was necessary to calculate the whole of the perturbations which it had experienced from the large planets, from the time of its apparition backwards to the dates of the other apparitions. This enormous labour Encke satisfactorily accomplished in a very short space of time; and the comet has ever since been called most commonly after his name. Since that time it has been observed at most of its apparitions, of which one of the most favourable for observation was in 1838. It was in the discussion of the elements of the orbit from the observations made at this apparition, compared with the previous ones, that Encke was induced to enter seriously upon the celebrated problem of the retardation probably experienced by the comet by a highly-attenuated resisting medium. The value of the *constant of resistance* was afterwards definitely determined by him, and the disturbance produced by this singular cause has been introduced into every subsequent discussion of the orbit.

In the year 1805 appeared the comet now known as *Biela's Comet*, also of short period. It was discovered by Pons on November 10. It was afterwards observed at the apparitions of 1826, 1832, and 1846, and at the last appearance presented the remarkable phenomenon of a double comet, both components being together in the field of the same telescope. Its period is rather less than seven years.

In 1807 appeared a *great comet*, surpassing in splendour any which had appeared since 1769. One of the most remarkable phenomena attending it was a double tail.

In 1811 appeared a *very splendid comet*, whose appearance is still remembered by many persons yet living. Its orbit was so situated that for many months it was circumpolar, and this added to the lustre of its appearance. In October the tail extended over an arc of 25° in length.

In 1812 appeared a *fine comet*, at one time visible to the naked eye. It was discovered by Pons on July 20. Encke calculated elements, giving a period of about 71 years.

In 1819 a *great comet* suddenly made its appearance at the beginning of July. The tail was about 7° in length, and at one time it must have transited the sun's disk.

In 1823 appeared a *comet* worthy of notice, from the fact of its exhibiting two tails, of which one was turned towards the sun, and the other in the opposite direction.

In 1825 appeared a *great comet*, which was discovered independently by Pons and Biela in July, and continued visible till the same season of the following year. The tail, which was double, extended over an arc of 15°.

In 1830 appeared *two comets*, visible to the naked eye, the first of which was discovered by Gambart in April. Each was attended by a tail, and the nucleus of each was bright.

In 1835 appeared, according to prediction, the famous *comet of Halley*. It was first detected at Rome by Dumouchal, on the 5th of August 1835, and was observed till May 1836; and excellent series of observations of it were made at the greater number of the observatories both of the northern and southern hemisphere. For particulars of its appearance, the reader

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may consult Sir J. Herschel's *Results of Observations made at the Cape of Good Hope;* the *Memoirs of the Royal Astronomical Society;* and Struve's *Beobachtungen des Halley-schen Cometen*, where admirable drawings will be found of its appearance at various phases. To these may be added Bessel's drawings in the *Astronomische Nachrichten*, No. 302.

Westphalen's elliptic orbit corresponds to a period of about 76 years.

In 1843 appeared the most remarkable comet of the present century, familiarly known as the *great comet of* 1843. This comet came suddenly upon astronomers in all its brightness. the immense tail being first seen in England in the month of March, like a long band of light cirrous cloud, not very high above the south-west horizon soon after sunset.

For accounts of its physical appearance, we are indebted chiefly to accounts given by officers of ships on their passage to England from the southern seas, and a great number of such accounts will be found in vols. v. and vi. of the *Notices of the Royal Astronomical Society*. As seen by southern observers, the spectacle presented by it must have been very grand. The tail extended over an arc varying from 30° to 45°, and its breadth was so great that it produced the effect of two distinct streams of light united at the head of the comet, but separated throughout nearly the whole length by a dark interval.

But the most remarkable observations of this comet were made in America at the time of its nearest approach to the sun's disk, in broad daylight, by Mr J. G. Clarke, at Portland, in the State of Maine. He measured the distance of the nucleus from the sun (about 3½°) in strong sunshine, and states that it and the tail were as well defined as the moon in a clear day, and resembled a perfectly pure white cloud.

In 1843 was also discovered a *comet of short period*, by M. Faye, which has been the subject of some remarkable papers by Leverrier, in vols. xx., xxv., and xxvi. of the *Comptes Rendus*. The period of this comet is about 7½ years, and it was observed on its return in 1850.

In 1844 another *periodical comet* was discovered by De Vico at Rome. The period is about 1993 days, but it was not observed at its return in 1850, owing to its unfavourable position.

In 1845 a *bright comet* was discovered by Colla at Parma, on June 2. It was at one period visible to the naked eye, and exhibited a tail.

In 1846, on February 26, an interesting *periodical comet* was discovered by Brorsen. The period is about 5½ years. It was not seen at its return in 1851, being very near the sun at the time of its perihelion passage.

In 1847, a *remarkable comet* was discovered by Mr Hind on February 6. Before its perihelion passage, it became bright enough to be seen in the morning twilight, and it was observed close to the sun on March 30, at noonday.

In 1850, on May 1, a *comet* was discovered by Petersen, which became bright enough to be visible to the naked eye, with a tail several degrees in length.

In 1851, Brorsen discovered a *bright comet* on October 22, which exhibited a double tail.

In the present year 1853, a *comet* was discovered by Klinkerfues at Gottingen, on June 10, which in August became very bright, and for several evenings was a splendid object in the west, seen after the setting of the sun. It exhibited a tail perfectly straight, of several degrees in length.

CHAP. V.

OF THE FIXED STARS.

SECT. I.—*Star Catalogues.*

Within the last few years very many valuable *Star Catalogues* have been added to the list, through the combined labours of public and private observers. We can give only the names of a few of the most important, with such notices of their construction as seem necessary.

1. The Catalogues of Ptolemy, Ulugh Beigh, Tycho Brahé, Halley, and Hevelius, have been admirably edited by Mr Baily, and form vol. xiii. of the *Memoirs of the Royal Astronomical Society*.

2. Flamsteed's Catalogue in the *Historia Cœlestis* has been also edited by Mr Baily, and was published in 1835, together with his life of Flamsteed.

3. A Catalogue of the Stars in Lalande's *Histoire Céleste* (about 40,000 in number), edited and compiled by Mr Baily. at the expense of the British Association, and printed at the expense of the Government in 1847.

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4. The Catalogue of Stars of the *British Association*, containing 8377 stars, edited by Mr Baily. 1845.

5. Lacaille's Catalogue of 9766 Stars, reduced at the expense of the British Association, under the superintendence of Professor Henderson, and printed at the expense of the Government, under the direction of Mr Baily, with Preface by Sir J. Herschel. 1847.

6. Sir Thomas Brisbane's Catalogue of 7385 Stars, chiefly in the Southern Hemisphere, observed at Paramatta. 1835.

7. Groombridge's Catalogue of Circumpolar Stars, edited by Mr Airy. 1838.

8. Johnson's Catalogue of 606 Principal Stars in the Southern Hemisphere. 1835.

9. Argelander's Catalogue of 560 Stars exhibiting Proper Motions observed at Abo. 1835.

10. The Greenwich Twelve-Year Catalogue of 2156 Stars. 1849.

11. Taylor's Madras Catalogue of 11,015 Stars. 1844.

12. Weisse's Catalogue of those Stars in Bessel's Zones, situated in a Zone extending 15° North and South of the Equator. 1846.

13. Oeltzen's Catalogue of the Stars in Argelander's Zones, situated between 45° and 80° North Declination. 2 vols. 1851 and 1852. (This valuable Catalogue forms vols. i. and ii. of the Third Series of the *Annalen des k. k. Sternwarte in Wien.*)

14. Rümker's Catalogue of 12,000 Stars. 1843–1851.

15. Cooper's two Catalogues of 30,097 Stars near the Ecliptic, observed at Markree. 1851 and 1853.

Several other Catalogues will be found in the *Memoirs of the Royal Astronomical Society*, but we have not space for separate accounts of them.

The following Catalogues of Double Stars must be mentioned:—

1. Struve's Great Catalogue of Double and Multiple Stars, observed at Dorpat. 1837.

2. Struve's Catalogue of 514 Double and Multiple Stars observed at Pulkowa. 1843.

3. Herschel and South's Catalogue of 380 Double and Triple Stars. (*Phil. Trans.* for 1825.)

4. Dawes's Catalogue of 121 Double Stars, observed at Ormskirk in the years 1831–1833. (*Memoirs of the Royal Astronomical Society*, vol. viii.)

5. Smyth's Cycle of Celestial Objects. 2 vols. 1844.

6. Struve's Catalogue of the Mean Places of the Stars observed at Dorpat from 1822 to 1843. 1852.

SECTION II.—*Of the Apparent Magnitudes, Number, and Distribution of the Stars.*

In any scheme for the re-arrangement of the stars in new constellations or *asterisms*, according to the views of Sir John Herschel (*Memoirs of the Royal Astronomical Society*, vol. xii.), or for thoroughly correcting the old arrangement of the constellations, a knowledge of their relative brightness or apparent magnitudes is absolutely necessary; yet this department of the science remains, even at present, in a very unsatisfactory state; and the estimated magnitudes set down in our best catalogues are always vague, and frequently inaccurate.

Notwithstanding this, however, several successful attempts have been made by eminent astronomers to put this branch of science on a better footing; and, under this head, its progress is mainly due to Argelander, Herschel, Johnson, and Dawes.

Argelander's remarkable work, the *Uranometria Nova*, published in 1843, gives for the northern heavens the most accurate scale of magnitudes for all stars visible to the naked eye, though the estimations do not profess greater accuracy than the descending scale of thirds of magnitudes employed by him will furnish.

Sir J. Herschel, while at the Cape, made the estimation of the magnitudes of the stars on a better system than any formerly employed—one of his most important subjects; and by naked-eye observations alone has assigned magnitudes to nearly 500 stars on a systematic plan, and with a degree of demon-

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strable accuracy far exceeding anything which had been previously attempted. For a detail of his methods we must refer to his *Observations at the Cape of Good Hope.*

Mr Dawes has also been successful in devising a method for observing the magnitudes of telescopic stars, which is very easily applicable, and requires only ordinary perseverance and laborious observing, to establish, on a perfectly satisfactory basis, a scale of magnitudes for all telescopic stars in the heavens. (See *Monthly Notices of the Royal Astronomical Society*, vol. xii.)

Mr Johnson has also, in the course of his re-observation of the stars of Groombridge's Catalogue, paid great attention to the correct estimation of their magnitudes, and has lately devised a method, by the use of the heliometer, for comparing directly the magnitudes of such stars as lie within its range, so as to be brought into the same field. The results of his researches are published in a pamphlet appended to his last published volume of observations.

On the subject of the *number and distribution of the stars*, a most valuable work was published by the elder Struve in the year 1847, entitled *Etudes d'Astronomie Stellaire ; sur la Voie Lactée et sur le distance des Etoiles Fixés;* which gives a most lucid account of his own elaborate researches on this subject distributed throughout his other works, and especially of his preface to Weisse's Catalogue. Of this treatise an excellent abstract was given by Mr Airy, and is included in the *Report of the Council of the Royal Astronomical Society* of February 11, 1848, printed in the *Monthly Notices*. To this extract we must refer the reader for further information.

The almost-despaired-of problem of finding the *distances* of some of the fixed stars, has been successfully solved during the present half-century ; and in no branch of astronomy has the perfection, both of the theoretical and practical methods adopted by modern astronomers, been more severely tested, or more triumphantly successful.

The star 61 Cygni, a binary system of two stars of very nearly equal magnitudes, connected by gravity, and having a large proper motion, is that of which the parallax was first detected and measured by Bessel, by means of comparative measures of distance made with the heliometer, extending from the year 1837 to 1840, of which the whole series will be found in vols. xvi. and xvii. of the *Astr. Nachr.* The definitive value of the parallax arrived at is 0″·3483, which corresponds to a distance of about 600,000 radii of the earth's orbit.

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The bright southern star α Centauri, has also had its parallax determined with great care by several series of meridian observations of zenith distance made by Professor Henderson and Mr Maclear. The resulting parallax amounts to very nearly 1″.

The parallax of α Lyræ was determined by micrometrical measurements, made by M. Struve, of its distance from a neighbouring faint star. The series of observations extended from November 1835 to August 1838, and the resulting value of the parallax is 0″·2619.

But the most remarkable paper on annual parallax is that by M. Peters of the Pulkowa Observatory. He gives in this paper the results of the meridian observations made with Ertal's circle, to determine the parallaxes of the stars Polaris, Capella, ι Ursæ Majoris, Groombridge 1830 (having large proper motion), Arcturus, α Lyræ, α Cygni, and 61 Cygni. The results he arrives at are as follow :—

	Parallax.	With prob. error.
For Polaris	+ 0″·067	0″·012
... Capella	+ 0·046	0·200
... ι Ursæ Majoris	+ 0·133	0·106
... Groombridge 1830	+ 0·226	0·141
... Arcturus	+ 0·127	0·073
... α Lyræ	+ 0·103	0·053
... α Cygni	− 0·082	0·043
... 61 Cygni	+ 0·349	0·080

We have endeavoured in the preceding pages to give a few of the most prominent of the researches and discoveries which have enriched astronomical science in the present century; but the very small space which could be allotted for this extension renders of necessity the accounts very imperfect, and forbids any details. It is hoped, however, that the references given will enable the reader to obtain for himself the full details of investigations of which we have only indicated the outlines, and to study fully the methods by which the results given in the preceding pages have been arrived at. (R. M—N.)

PART III.[1]

PHYSICAL ASTRONOMY.

The whole science of astronomy may be reduced to two general problems. The first is to express the position of all the heavenly bodies in terms of the time reckoned from a given instant, either in the past or the future duration of the world. The same may be otherwise stated by saying, that the thing required is, to express the position of any one of the heavenly bodies in a function of the time, the time being considered as the only variable quantity, though combined with other known quantities, which enter into the function as the co-efficients of the different terms. This is the most general view of that which is usually called descriptive, or sometimes geometrical astronomy. The solution of this problem enables us to determine for any time the places of the heavenly bodies, relatively to one another, and relatively to any point on the earth's surface. It contains under it an endless variety of subordinate problems, embracing a long series of successive generalizations, from the first observations to the determination of the orbits of the heavenly bodies, and the final reduction of all that concerns their motions into the form of astronomical tables. The second problem is, to compare the laws of motion in the heavens, as discovered from the preceding investigations, with the laws of motion as already known on the surface of the earth, in order to find out whether or not they are the same; and, if not, in what their difference consists. The solution of this problem constitutes what is called Physical Astronomy: it is the same with inquiring into the causes of the celestial motions; for by *causes* we mean the general facts concerning the motion of bodies which are observed to take place on the surface of the earth.

Though the first of these two problems goes necessarily before the second, for the solution of which it affords the *data*, yet, after this solution is obtained, it affords great assistance to many of the researches involved in the first, and exemplifies, in a most remarkable manner, the use of theory in the investigation of facts, and the re-action, as it were, of the second problem on the first.

Taking for granted the solution of the first problem, as given under the other Parts of this article, we are now to

[1] This portion of the present treatise is reprinted from the article on Physical Astronomy contributed by the late Professor Playfair to the *Supplement* to the fourth, fifth, and sixth editions of this work. The chief alteration made in this, the eighth edition, is the substitution of the differential for the exploded fluxional notation.

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consider the second, and to explain the manner in which it has been resolved by Newton and the philosophers who have come after him.

The history of the first of these two problems is long and interesting, beginning from the remotest period to which the records or the traditions of mankind have ventured to ascend, and coming down to the present time; and, in the ages to come, it is never likely to know any limit but the movable instant which separates the past from the future,—as long, at least, as science and civilization are inhabitants of the earth.

The history of the second comes within small compass; because, between the first rude effort and the last refined investigation there is hardly any intermediate step but one.

The concentric orbs of the ancient philosophers were an attempt at an explanation of the physical causes of the celestial motions, or at an assimilation of those motions to such as we are accustomed to see on the surface of the earth. The great phenomenon to be explained was the diurnal motion of the heavens, by which so many bodies, very distant from one another, all describe circles round the earth, keeping time so precisely with one another, that the revolutions, whether great or small, are accomplished in the same interval. This could not be, unless a connection subsisted between those bodies; and the most simple idea of that connection was, that the bodies were fixed in the surface of a sphere which revolved on an axis, and carried them along with it.

If the whole of astronomy had been confined to the single fact of the diurnal revolution of the fixed stars, the hypothesis just mentioned would have been quite satisfactory. But as some of the heavenly bodies, such as the sun and planets, did not revolve precisely in the same time with the rest, it was necessary to assign to them particular spheres of their own. Those spheres, therefore, must be transparent: light must find an easy passage through them, and hence they must be crystalline. By degrees, as more accurate knowledge was obtained of the motion of the planets, it was found necessary so to increase the number of the spheres, that the complication of the structure was burdensome to the imagination; the hypothesis did not answer the very first object of a theory, that of connecting the facts together; and it was so unlike any process of nature with which we are acquainted, that it was highly improbable. The hypothesis of the homocentric orbs therefore fell into discredit, and, after the discovery of the earth's motion, was entirely abandoned.

The next attempt to explain the whole system of the celestial motions was that of Descartes, by means of vortices of subtile matter, and the pressure which, by the centrifugal force of those vortices, was produced on the grosser bodies of the stars. But as a taste for accurate knowledge increased, and as men reflected more on the true objects of philosophic theory, the system of vortices appeared more and more defective, and at length ceased to have any followers.

Newton succeeded, who, rejecting all the cumbersome machinery, both solid and fluid, of his predecessors, adopted a plan far more philosophical in the design, and far more difficult in the execution, than any thing yet known in the physical or mathematical sciences. Assuming as true the three general facts concerning the planetary system known by the name of the laws of Kepler, he proceeded to inquire by what sort of action on one another the planets could be made to describe orbits having the properties indicated by these three general facts. The general facts to which we now refer, are,

I. *That every planet moves so, that the line drawn from it to the sun describes about the sun areas proportional to the times.*

II. *That the planets describe ellipses, each of which has one of its foci in the same point, viz. the centre of the sun.* Physical Astronomy.

III. *That the squares of the times of the revolutions of the planets are as the cubes of their mean distances from the sun.*

Sect. I.—*Of the Forces which retain the Planets in their Orbits.*

1. *If a body gravitating to a fixed centre have a motion communicated to it in a direction not passing through that centre, it will move in a curve, and the straight line drawn from the body to the centre will describe areas proportional to the times.*

Let S (fig. 109) be the centre to which the body A gravitates, at the same time that a motion is communicated to it in the direction AB. And first, let the gravitating or centripetal force be supposed to act, not continually, but at intervals, producing instantaneously, at the beginning of each interval, the same velocity that it would have produced by acting continually during the whole of that time: let AC be the space which the body would describe by the action of this force alone; also let AB be the space which it would describe in the same time by the projectile force acting on it alone. It will therefore describe the line AD, the diagonal of the parallelogram contained by AB and AC, and at the end of the first interval will be in D. If, then, no new impulse of gravity were to act on it, it would in the second interval of time go on in the direction AD, and describe DF equal to AD. But if, at the beginning of the second interval, an impulse of the centripetal force be instantaneously impressed, sufficient to carry the body in that time from D to E in the line DS, it will describe the line DG, the diagonal of the parallelogram contained by DE and DF. The same is true of the third interval, in which the body will go from G to L, and of every subsequent interval. Join SB, SF, SK, &c. The areas of the triangles ABS, ADS are equal, the triangles being on the same base AS, and between the same parallels AS and BD. For the same reason, the triangles DGS, DFS are equal, and DFS is equal to ADS, because they have equal bases and the same altitude. For the same reason, the triangle SGL is equal to SDG, or to ADS; and the same is true of all the other triangles that are described in the equal intervals of time by the line drawn from the body to the centre S. This holds, however short the intervals may be, and however great their number; and therefore it is true when the intervals are indefinitely small, and their number infinitely great, that is, when the action of the centripetal force is continued. Plate LXXXIX.

But when the intervals of time become indefinitely small, the rectilineal figure ADGL passes into a curve. For when these intervals diminish, the lines AB, DF, &c. the lengths of the parallelograms, diminish in the same proportion; but the lines AC, DE, &c. the breadths, diminish in a greater proportion, viz. in that of the squares of these intervals. Hence, the angles which AD, DG, GL, the diagonals, make with the sides AB, DF, GK, continually diminish; and therefore the angles ADG, DGL, or the angle which each diagonal makes with that which is contiguous, increases without limit, so that, as the diagonals diminish in length, the angles they make with one another become greater than any finite rectilineal angles, and therefore the figure becomes a curve line.

That the lines AC, &c. or the supposed effect of the centrifugal force, diminish as the squares of the times, is evident from the laws of the descent of heavy bodies, as explained under the head of Dynamics.

2. Hence, conversely, if a body move in a curve, so that the line drawn from it to a fixed point describe areas proportional to the times, the body gravitates to that point, or tends continually to descend to it.

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For, since it does not move in a straight line, it must be continually acted on by a deflecting force; and the direction of the deflecting force must always pass through the same point, otherwise the areas described about that point would not be proportional to the time.

3. *Corollary.* The velocities of a body in different points of the curve which it describes about a centre of force, are inversely as the perpendiculars drawn from the centre to the tangents of the curve at these points. Let ACA′, fig. 110, be the curve which a body describes about the centre S. Let A*a* and A′*a*′ be two arches of the curve, described in the same indefinitely small portion of time. Join S*a*, S*a*′, then the areas of the triangles AS*a*, A′S*a*′ are equal by this proposition. At A and A′, draw the tangents AB′ A′B′, and from S let fall on them the perpendiculars SB and SB′. Because the areas of the triangles AS*a*, A′S*a*′, are equal, $Aa \times SB = A'a' \times SB'$, or $Aa : A'a' :: SB' : SB$; but A*a* is to A′*a*′ as the velocity of the body describing the curve at A to its velocity at A, therefore these velocities are inversely as the perpendiculars SB, SB′.

The straight line AB (fig. 109), according to which the projectile motion was impressed on the body, is a tangent to the curve at the point A.

4. On comparing the first and second of these propositions with the first of Kepler's laws, as just enumerated, it is evident that the primary planets all gravitate to the sun, and that the secondary planets gravitate every one to its primary. The next thing, therefore, is to discover the law observed by this force, or the function of the distance to which it is proportional; and also, whether, in that function, other variable quantities are not involved beside the distance. The general fact that the orbits, or curves described by the planets round the sun, are ellipses, may assist in this investigation, and in expressing the velocity of a planet, in terms of the radius vector, or its distance from the sun

5. Let ADBE (fig. 111) be the orbit of a planet, S the focus in which the sun is placed, AB the axis major, and DE the axis minor, C the centre, and F the superior focus. Let the planet be anywhere at P; draw a tangent to the orbit in P, on which from the foci let fall the perpendiculars SG, FH. Draw also DK touching the orbit in D, and let SK be perpendicular to it. Let the velocity of the planet, when at the mean distance, or at D, be $= c$, and when at P $= v$. Join SP, FP. Then, by the corollary to the last proposition, the velocity at D is to the velocity at P as SG to SK, that is, $c : v :: SG : DC$, or $v = c \cdot \frac{DC}{SG}$.

But because the triangles SGP, FHP, are equiangular, having right angles at G and H, and also the angles SPG, FPH equal, from the nature of the ellipse, $SP : PF :: SG : FH$, and therefore also $SP : PF : SG^2 : SG \times FH$. But $SG \times FH = CD^2$, therefore $SP : PF :: SG^2 : CD^2$, and $\frac{CD^2}{SG^2} = \frac{PF}{SP}$. Now $v = c \cdot \frac{CD}{SG}$, or $v^2 = c^2 \cdot \frac{CD^2}{SG^2}$, and therefore $v^2 = c^2 \cdot \frac{PF}{SP}$.

Hence, as the distance of a planet from the sun, at any point in its orbit to its distance from the superior focus, so the square of its velocity at its mean distance from the sun to the square of its velocity at the point just mentioned.

6. If SL be taken in the greater axis equal to SP, and FN $=$ PF, so that SN $=$ the transverse axis AB, $v^2 = c^2 \cdot \frac{NL}{LS} = c^2 \cdot \frac{SN - SP}{SP}$. Then as SN is a given line, v is expressed in terms where SP, the distance from the sun, is the only variable quantity.

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If, from the velocity of the revolving body thus expressed in terms of the distance, a transition can be made to that of a body descending in a straight line, the law of the centripetal force will be easily investigated. This will be facilitated by the following proposition:

An equal approach to the centre of force produces an equal increase of the square of the velocity, whether the body revolve in a curve about the centre, or descend to it in a straight line. In like manner, equal recesses from the centre of force produce equal diminutions of the square of the velocities, in whatever lines the bodies move.

Let ABC (fig. 112) be a curve which a body describes about a centre, S, to which it gravitates, while another body descends in a straight line AS, to that centre. Let BC be any arch of the curve ABC, and let BD, CH, be arches of circles described from the centre S, intersecting the line AS in D and H; the square of the velocity of the body, which describes the arch BC, will be as much increased as the square of the velocity of that which falls through DH.

From the centre S describe the arch *bd*, indefinitely near to BD, and draw E*f* perpendicular to the arch B*b*. Also let the centripetal force at B or D be called G. Now, the part of this force which is in the direction B*b*, and which is employed in accelerating the body moving in that line, is $G \times \frac{Bf}{BE}$; and the increment of the space being B*b*, therefore $2G \times \frac{Bf \times Bb}{BE}$ is the momentary increment of the square of the velocity of the body at B. But $Bf \times Bb = BE^2$, because BE*b* is a right-angled triangle, and E*f* the perpendicular on the hypothenuse. Therefore $2\,G \times \frac{Bf \times Bb}{BE} = 2G \times \frac{BE^2}{BE} = 2G \times BE =$ $2G \times Dd$. But $2G \times Dd$ is the momentary increment of the square of the velocity of the body at D, or the increment of that square while the body falls from D to *d*. These momentary increments therefore are equal; and as the same may be shown for the next and every subsequent instant, the whole increase of the square of the velocities of the bodies in moving over BC and DH are equal.

If the bodies moved in the opposite directions, the one from C to B, and the other from H to D, it would be proved, in the same manner, that the squares of their velocities would be equally diminished.

7. Hence it is evident, that, if the velocities of the revolving and of the falling body are equal in any one instance when they are equally distant from the centre, their velocities will always be equal when they are equally distant from that point; for equal quantities receiving equal increments continue equal.

8. Suppose now that a planet revolves in the elliptical orbit APB (fig. 111), it will have at A, the higher apsis, a velocity $= c \times \sqrt{\frac{AF}{AS}}$, or (if AN in the axis produced be taken equal to AF) $= c \times \sqrt{\frac{AN}{AS}}$. Let a body at A begin to descend towards S with the same velocity; then if SL $=$ SP, the velocity of the planet at P will be the same with that of the falling body at L. But the velocity of the planet at P is $c \times \sqrt{\frac{PF}{PS}} = c \times \sqrt{\frac{NL}{SL}}$, therefore, a body descending from A, and falling directly to the sun under the action of the same centripetal force which urges the planet, would at any point L in its fall have its velocity $= c \times \sqrt{\frac{LN}{LS}}$. Hence, at the point N

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its velocity would be equal to 0, or the body must begin to fall from N, in order that its velocity may be everywhere equal to that which the planet has in its orbit, when at the same distance from the sun.

The law, therefore, according to which the planets gravitate is such, *that any body under the influence of the same force, and falling direct to the sun, will have its velocity at any point equal to a certain velocity, multiplied into the square root of the distance it has fallen through, divided by the square root of the distance between it and the sun's centre.*

This is a fact with respect to the law of gravity in the solar system, of which, though there be no direct example, yet is it no less certain than the ellipticity of the planetary orbits, of which it is a necessary consequence.

9. From the law thus found to regulate the velocity of bodies falling in straight lines to the sun, the law of the force by which that velocity is produced may be derived by help of reasoning which is quite elementary.

Let C (fig. 113) be the centre to which the falling body gravitates, A the point from which it begins to fall, and let its velocity at any point B, be to its velocity in the point G, which bisects AC, as $\sqrt{\frac{AB}{BC}}$ to 1; it is required to find the law of the force with which the body gravitates to C.

Let DEF be a curve, such, that if AD be an ordinate or a perpendicular to AC, meeting the curve in D, and BE any other ordinate, AD is to BE as the force at A to the force at B, then will twice the area ABED be equal to the square of the velocity which the body has acquired in B. If, therefore, the velocity at B be v, that at the middle point G being c, $v = c\sqrt{\frac{AB}{BC}}$, by hypothesis, and therefore $2ABED = c^2 \cdot \frac{AB}{BC}$; and since $AB = AC - BC$, $2ABED = c^2 \cdot \frac{AC - BC}{BC} = c^2\left(\frac{AC}{BC} - 1\right)$. For the same reason $2AbED = c^2\left(\frac{AC}{bC} - 1\right)$, and therefore the difference of these areas, or $2BbeE$, that is, $2EB \times Bb = c^2\left(\frac{AC}{bC} - \frac{AC}{BC}\right) = c^2 \cdot \frac{AC \cdot Bb}{BC^2}$. Wherefore, dividing by Bb, $2EB = c^2 \cdot \frac{AC}{BC^2}$; or $EB = c^2 \cdot \frac{AG}{BC^2}$; now c^2 and AG are given, therefore EB is inversely as BC^2, that is, the centripetal force at B is inversely as the square of BC, the distance from the centre of force. *In the planetary system, therefore, the force with which any planet gravitates to the sun varies in the inverse ratio of the square of the distance of the planet from the sun's centre.*

10. The line CG is the same with the mean distance of the planet, in an orbit of which AC is the length of the major axis, and if the gravitation at that distance $= F$, and the mean distance itself $= a$, $F = c^2 \times \frac{a}{a^2} = \frac{c^2}{a}$, or $aF = c^2$.

Let it next be required, the elliptic orbit of a planet being given, to find the time in which the planet will revolve round the sun.

If a be the mean distance, or the semimajor axis, b the semiminor, then πab = the area of the orbit. But as c is the velocity at the mean distance, or the elliptic arch which the planet moves over in a second when it is at D, the vertex of the minor axis, therefore $\frac{1}{2}bc$ is the area described in that second by the radius vector; and since this area is the same for every second of the planet's revolution, therefore the area of the orbit divided by $\frac{1}{2}bc$ will give the number of seconds in which the revolution is completed, which is therefore $= \frac{\pi ab}{\frac{1}{2}bc} = \frac{2\pi a}{c}$, or since $c^2 = aF$, the time of a revolution $= \frac{2\pi a}{\sqrt{aF}} = 2\pi\sqrt{\frac{a}{F}}$.

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11. Hence it is easy to compare the times of the revolutions of any two planets of which the mean distances are known. Let t and t' be the times of revolution for two different planets, of which the mean distances are a and a', and the gravitation at those distances F and F', and, by what has just been shown, $t : t' :: \frac{a^{\frac{1}{2}}}{F^{\frac{1}{2}}} : \frac{a'^{\frac{1}{2}}}{F'^{\frac{1}{2}}}$, or $t^2 : t'^2 :: \frac{a}{F} : \frac{a'}{F'}$. But $F : F' :: a'^2 : a^2$, by what is already shown (Art. 9), therefore $t^2 : t'^2 :: \frac{a}{a^2} : \frac{a'}{a^2}$, or $t^2 : t'^2 :: a^3 : a'^3$, *that is, the squares of the times of revolution of any two planets are as the cubes of their mean distances from the sun.* Thus the third law of Kepler is explained by the conclusions deduced from the other two.

12. The share which this third law has in establishing the principle of universal gravitation does not seem to have been always clearly apprehended. From the elliptical orbit of a planet, it is fairly inferred that, over all the circumference of that orbit, gravitation is inversely as the square of the distance from the centre of the sun. That force is shown to be $\frac{c^2a}{x^2}$ (x being the distance from the centre of force), and the same is true of every individual planet; but whether c^2a was a constant quantity, or one which retained the same value through the whole planetary system, could not be known without comparing the periods of different planets with their distances from the sun. It was indeed highly probable that c^2a was a given quantity, or the same for every part of our system; but it could not be considered as a thing demonstrated till the evidence of the third law was introduced.

13. These laws hold of the secondary planets relatively to their primary, just as with the primary planets relatively to the sun. Each system of secondary planets, however, has a different numerator to the fraction which expresses gravity; that is, the quantity c^2a is the same for all the satellites of Jupiter, but it is a different quantity from that which belongs to the satellites of Saturn, and different from that which belongs to the primary planets. The quantity c^2a seems therefore to depend on the central body of each system of planets, and the precise nature of this connection requires to be farther examined into.

14. Let the centripetal force tending to a given centre S be inversely as the squares of the distances, and let the intensity of that force at any given distance from the centre be also given; then, if a body be projected from a given point, with a given velocity, and in a given direction, it is required to determine the conic section which it will describe.

Let the semimajor axis, or the mean distance to be found, $= a$, the semiminor $= b$, the velocity at the distance $a = c$, and at the given distance d let the centripetal force $= f$; and first let the direction of the initial motion be at right angles to the radius vector, so that the point of projection is either the higher or the lower apsis. Let the velocity of the projection $= v$, and the radius vector at the point of projection $= r$.

Because the areas described in equal times are equal,

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$bc = rv$; and if F denote the centripetal force at the distance a, $c^2 = a\,\mathrm{F}$, and $\mathrm{F} = \frac{c^2}{a}$. But $\mathrm{F} = \frac{d^2f}{a^2}$, therefore $\frac{c^2}{a} = \frac{d^2f}{a^2}$, and $c = d\sqrt{\frac{f}{a}}$. Hence, by substituting for c, $bd\sqrt{\frac{f}{a}} = rv$, and $b^2d^2f = ar^2v^2$. But $b^2 = \mathrm{AS} \times \mathrm{SB} = r\,(2a - r)$, wherefore $r\,(2a - r)\,d^2f = ar^2v^2$, and $a = \frac{rd^2f}{2d^2f - rv^2}$. Thus a, the semitransverse axis, and therefore the transverse axis itself, is found; and thence with the focus S and the apsis A, the conic section may be described.

15. The conic section will be a circle, when $a = r$, that is, when $2\,d^2f - v^2r = d^2f$, or when $d^2f = v^2r$, and $v^2 = \frac{d^2f}{r}$.

16. But if $2d^2f = rv^2$, or $v^2 = \frac{2d^2f}{r}$, the denominator vanishes, and a becomes infinite, so that the trajectory is a parabola, of which the focus is S, the vertex A, and the parameter $4r$. *The square of the velocity which determines the trajectory to be a parabola is, therefore, double of the square of the velocity which determines it to be a circle.*

17. When $2d^2f > v^2r$, the value of a is affirmative and the conic section is an ellipsis, and this ellipsis has its higher apsis at A, if $v^2 < \frac{d^2f}{r}$; but when $v^2 > \frac{d^2f}{r}$, and less $\frac{2d^2f}{r}$, A *is the lower apsis.*

18. When v^2 goes beyond this last limit, or when $v^2 > \frac{2d^2f}{r}$, the value of a is negative, and the trajectory becomes an hyperbola.

19. Next, let the body be projected from B (fig. 114) with the velocity v, in the direction BD, oblique to BS. Find the distance from which a body must fall to acquire at B the velocity v, and let OB, taken in SB produced, be equal to this distance; then is SO equal to the major axis. Let BE be drawn, making with BD the same angle that SB makes with BG, and let BE = BO, then is E the higher focus. Produce SE to N, so that SN = SO, and bisect EN in A, then is A the higher apsis; and if SP be made equal to EA, P is the lower apsis, and AP the major axis; and therefore the foci and the major axis being given, the elliptic orbit may be described.

20. From what has been shown at Art. 9, it is evident that the primary planets gravitate to the sun with forces that are inversely as the squares of the distances, and that the secondary gravitate toward the primary, according to the same law. This inference, however, does not apply exactly to the moon, which, being a single satellite, does not by comparison with any other afford a proof that, in bodies revolving round the earth, the squares of the periodic times are as the cubes of the mean distances. The centripetal force at the moon, however, from our knowledge of her periodic time, may be compared with the force of gravity at the earth's surface, and will determine whether that force decreases as we recede from the earth in the inverse ratio of the squares of the distances.

Let a be the distance of the moon from the centre of the earth, r the radius of the earth, g the velocity acquired by a heavy body at the earth's surface by falling during one second; let t be the period of the moon's revolution in seconds, and c the velocity of her motion. Then, by Art. 14, $ac^2 = r^2g$, and therefore $c = r\sqrt{\frac{g}{a}}$.

Now, the circumference of the circle described by the moon is $2\pi a$, and this, divided by c, gives the periodic time of the moon in seconds, or $\frac{2\pi a}{r} \times \sqrt{\frac{a}{g}} = t$, so that $t^2 = \frac{4\pi^2a^3}{r^2g}$, and $a^3 = \frac{r^2gt^2}{4\pi^2}$. Hence $\frac{a^3}{r^3} = \frac{gt^2}{4\pi^2r}$, and $\frac{a}{r} = \left(\frac{gt^2}{4\pi^2r}\right)^{\frac{1}{3}}$. Hence, as g, r, and t are known, we may find $\frac{a}{r}$, or the ratio of the moon's distance to the radius of the earth, which, if it come out the same that it is known to be from observations of the moon's parallax, will prove that the force which retains the moon in her orbit is the same that causes bodies to fall at the surface of the earth, but diminished in the same ratio that the square of the moon's distance is greater than the square of the radius of the earth.

Now $g = 32{\cdot}166$ feet, $r = 3481279{\cdot}4$ fathoms or $20887676{\cdot}4$ feet, and $t = 2360591{\cdot}5$ seconds. Hence $\frac{a}{r} = 60{\cdot}218$.

Now the mean equatorial parallax of the moon is found by observation = 57′ 0″·9, from which the mean distance, in semidiameters of the equator, is found = 59·964.

But it is in mean semidiameters of the earth that the moon's distance is given in the former computation; therefore, to reduce the last measure to the same scale, it must be increased by a 600th part, as the mean radius of the globe is about that much less than the radius of the equator; the distance 59·964 then becomes 60·063, which agrees with the former number to the small fraction ·003 of the earth's radius.

Thus, from the theory of gravity, combined with the time of the moon's sidereal revolution, her distance from the earth is found to within a very small fraction of the whole.

21. *It is therefore a general proposition, derived from the most rigorous induction, that the primary planets gravitate to the sun, and the secondary planets to the primary, with forces which are inversely as the squares of the distances.* But since, in all communication of motion, the re-action is equal to the action, when a planet gravitates to the sun, analogy forces us to conclude that the sun gravitates to the planet, in such a manner, that if the momentary approach of the planet to the sun, and of the sun to the planet, were respectively multiplied by the quantity of matter in those bodies, the products, or the *quantities of motion*, would be equal. Such a mutual tendency, therefore, of the great bodies of our system to the sun, and of the sun to them, doubtless takes place; but whether this be in consequence of an attractive force residing in their centres, as the magnetic force does in certain parts of the loadstone, or if it arise from the mutual attraction of all the particles of the one for all the particles of the other, does not appear from the phenomena hitherto examined. We may, however, observe that the bodies between which this attraction in the inverse ratio of the squares of the distances takes place, are all of a round form, and are either accurately spherical, or nearly approaching to that shape. It will therefore be of use for resolving this question, to inquire whether, if the particles of matter did attract one another with forces inversely as the squares of their distances, the spherical bodies, compounded of such particles, would attract one another according to the same law. If this is found to be the case, it will be reasonable to conclude that the gravitation of large bodies to one another arises from the mutual attraction of their particles to one another.

22. In order to determine the relation between the attraction of a sphere and that of the particles of which it consists, we may consider the sphere as made up of plates

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or *laminæ* infinitely great in number, and infinitely small in thickness. The attraction of each of these is to be estimated, and from thence the attraction of the whole may be computed. Let AFBG (fig. 115), therefore, be a circular plate, of which the centre is C; CE a straight line passing through C, and perpendicular to the plane AFBG; E any particle in that line attracted by each particle of the circular plate, as D, with a force inversely as the square of DE, the distance between the particles; it is required to find the whole force with which E is attracted in the direction EC.

If DC be drawn, the force with which D attracts E in the direction ED is inversely as DE^2 or as $\frac{1}{DE^2}$, and that same force, reduced to the direction EC, is as $\frac{1}{DE^2} \times \frac{EC}{DE} = \frac{EC}{DE^3}$. From the centre C, with the radius DC, let a circle DKH be described, and indefinitely near it the circle *d k h*; then, since every particle in the *ring* of matter contained between these circles has its attraction proportional to $\frac{EC}{ED^3}$, the attraction of the whole ring will be as $\frac{EC}{ED^3}$ multiplied into the number of particles, or into the solidity of the ring. But if EC $= a$, ED $= x$, and AC $= r$, $CD^2 = x^2 - a^2$, and the surface of the ring $= 2\pi x dx$. If then the thickness of the plate AFBG $= m$, the solidity of the ring $= 2\pi m x dx$, and its attraction in the direction EC is $= \frac{2\pi m x dx \times a}{x^3} = \frac{2\pi a m dx}{x^2}$, the integral of which taken so as to vanish when DC $= 0$, or when $x = a$, is $2\pi m - \frac{2\pi m a}{x} = 2\pi m\left(1 - \frac{a}{x}\right)$ = the attraction of the circle DKH. Therefore, when $x =$ AE, the whole attraction of the plate, or the whole force which it exerts on the particle E, is $2\pi m\left(1 - \frac{EC}{EA}\right)$.

23. Next, let ABD (fig. 116) be a circle of which the centre is C, and E a particle of matter anywhere in the diameter AB produced. Draw ED to any point D in the circumference; draw also DC, and let DF be at right angles to AB. Then, when the whole figure revolves about EB, the semicircle ADB will generate a sphere, and DF a circle perpendicular to the plane ABD, and having its centre in F. If all the particles of the sphere attract the particle E with forces inversely as the squares of their distances from it, then, by the last proposition, the attraction of the circular plate, of which the centre is F, will be $2\pi m\left(1 - \frac{EF}{ED}\right)$.

Let CE$=a$, AC$=r$, ED$=x$, EF$=y$, and the attraction above will be $2\pi m\left(1 - \frac{y}{x}\right)$; and if x and y be variable, the quantity m in this formula, or the thickness of the circular plate will be $= dy$, and therefore the attraction of the plate $= 2\pi dy\left(1 - \frac{y}{x}\right)$. In order to integrate this quantity, y must be expressed in terms of x, or x in terms of y.

Now, because AE $= a - r$, and AF $= y - a + r$, FB $= 2r - y + a - r = a + r - y$, and AF $\times$ FB $= (r - a - y)(r + a - y) = r^2 - a^2 + 2ay - y^2 = DF^2 = x^2 - y^2$. Hence $r^2 - a^2 + 2ay = x^2$, or $y = \frac{a^2 - r^2 + x^2}{2a}$, and therefore $dy = \frac{x dx}{a}$. By substituting these values of y and dy in the expresssion for the attraction of the circular plate, that

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attraction $= \frac{2\pi x dx}{a}\left(1 - \frac{a^2 - r^2 + x^2}{2ax}\right)$

$= \pi\left(\frac{2axdx - a^2dx + r^2dx - x^2dx}{a^2}\right)$.

But the attraction of this circular plate may be considered as the differential of the attraction of the spherical segment, generated by the revolution of the arch AD, and therefore the integral of the above differential quantity will give the attraction of that segment. Now, this integral $= \pi\left(\frac{ax^2 - a^2x + r^2x - \frac{1}{3}x^3}{a^2}\right) + C$. Here C must be so determined that the integral may be equal to 0, when the arch AD $= 0$, or when $x = y = a - r$. Therefore C $= \pi\left(\frac{\frac{1}{3}a^3 - ar^2 + \frac{2}{3}r^3}{a^2}\right)$; and the attraction

$= \frac{\pi}{a^2}(ax^2 - a^2x + r^2x - \frac{1}{3}x^3 + \frac{1}{3}a^3 - ar^2 + \frac{2}{3}r^3)$.

This is the attraction of the spherical segment generated by the arch AD, and will become equal to that of the whole sphere when AD $=$ the semicircle ADB, or when $x = a + r$. This substitution being made, and the terms reduced, the attraction is found $= \frac{4\pi r^3}{3a^2}$. But $\frac{4\pi r^3}{3}$ is the solid content of the sphere; *therefore the attraction of the sphere, on any particle* E, *is as the quantity of matter in the sphere, divided by the square of the distance of its centre from* E. *Hence also the sphere attracts any particle without it, as if all its matter were united in its centre.* The sphere, it is also obvious, would attract another sphere just in the ratio of its quantity of matter, divided by the distance of the centres of the spheres.

24. Thus, supposing that the particles of matter attract one another with forces which are inversely as the squares of the distances, it is certain that the spherical bodies composed of these particles would do so likewise, or would attract one another with forces directly as their quantities of matter, and inversely as the squares of the distances of their centres. Since, therefore, it has been found that round or spherical bodies, such as the sun and the planets, do attract other bodies with forces that are inversely as the squares of the distances, it is reasonable to suppose that these bodies are composed of particles gravitating towards one another, or attracting one another with forces inversely as the squares of the distances. *Gravitation, therefore, is not to be considered as a force residing in the centres of the planets, but as a force belonging to all the particles of matter, and as universally diffused throughout the universe.*

And as it has been shown that between spherical bodies constituted of such particles, the force of attraction is as the quantity of matter in the attracting body, divided by the square of the distance between its centre and that of the attracted body; if m be the mass or quantity of matter in the former body, and x the distance of the centres, $\frac{m}{x^2}$ is the value of f, the accelerating force with which it attracts the other body.

25. Hence the masses of any two planets which have bodies revolving round them may be compared with one another. Let a and a' be the mean distances at which satellites revolve about any two planets, m and m' the quantities of matter in those planets, t and t' their periods

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of revolution; it has been shown that $t=\frac{2\pi a^{\frac{3}{2}}}{df^{\frac{1}{2}}}=\frac{2\pi a^{\frac{3}{2}}}{m^{\frac{1}{2}}}$,

and consequently $t:t'::\frac{a^{\frac{3}{2}}}{m^{\frac{1}{2}}}:\frac{a'^{\frac{3}{2}}}{m'^{\frac{1}{2}}}$, and $m:m'::\frac{a^3}{t^2}:\frac{a'^3}{t'^2}$.

The masses, therefore, of any two planets are as the cubes of the mean distances at which their satellites revolve, divided by the squares of the periodic times of those satellites.

26. In this way the masses of the four planets which have satellites may be compared with one another, and with the mass of the sun.

When this calculation is undertaken with the requisite data, it is found that, making

Mass of the Sun.....1

that of the Earth..... $=\frac{1}{354936}$

of Jupiter..... $=\frac{1}{1070{\cdot}5}$

of Saturn... ..... $=\frac{1}{3512}$

of Uranus..... $=\frac{1}{17918}$.

Or if we make the mass of the Earth 1, that of the Sun = 329630, of Jupiter 330·6, of Saturn 101·06, and of Uranus 20·3. From this also may be derived the densities of the sun and of the four planets just mentioned. Seen from a distance equal to the mean radius of the earth's orbit, the diameter of the sun subtends an angle of 1923″, that of the earth would subtend 17″·4, of Jupiter 186″·8, of Saturn 177″·7, and of Uranus 74″. The real diameters, therefore, are in the proportion of these numbers, and the bulk in the proportion of their cubes. By dividing the quantities of matter by the bulks, we have the densities; and if that of the earth be 4·713, which is its mean density, that of water being = 1, then

Density of the Sun..... =1·1775
of the Earth..... =4·713
of Jupiter..... =1·1678
of Saturn..... =0·4055
of Uranus..... =1·0348.

The mean density of the earth, in respect of water, is here taken from the experiments made at Schehallien. (*Phil. Trans.* 1811, p. 376.)

27. It has been already observed, that because action is always accompanied by an equal re-action, when the sun attracts a planet, the planet also attracts the sun, and that the velocities impressed on the bodies by their mutual attraction are in the inverse ratio of their masses.

In consequence of this mutual action the sun and the planet must both move, and must describe orbits about their common centre of gravity, the only point which the mutual action of those bodies has no tendency to put in motion.

In the solar system, therefore, the centre of gravity of the whole is the focus about which all the orbits are described. Thus, if C be that centre (fig. 117), S the sun, and P a planet; while P describes the elliptic arch PP′ about C, S describes the arch SS′ similar to PP′, and having to it the ratio that SC has to CP, or the ratio which the mass of the planet has to the mass of the sun.

The true orbits, therefore, are all described about the same immovable point; but the orbit of any of the planets may be referred to the sun as a centre, by supposing a body placed in that centre equal to the sum of the masses of the sun and of the planet. This is true, because the bodies appear to approach one another, or to recede from one another, with a force that is equal to the sum of the forces with which they tend towards their centre of gravity. Thus, if S denote the mass of the sun, and E that of the earth, the distances from the centre being CP and CS, the orbit which each of the two bodies will appear to describe round the other, is that which would be described about an immovable centre C, with a centripetal force $=\frac{S+E}{SP^2}$.

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Thus we have arrived at the knowledge of the principle of UNIVERSAL GRAVITATION, a power which pervades all nature, extending to an unlimited distance, and determining the condition of every body in the universe at any instant, from its state in the former instant, and from the relations in which it stands to all other bodies. Whether this force can be explained upon any principle more general than itself, is yet undecided, though, from the bad success which has hitherto attended all attempts towards that object, it seems probable that such explanation is not within the reach of the human understanding. Thus much, however, we know with certainty, that the law of gravity, as just announced, may be considered as a very accurate expression of all the phenomena of the planetary motions.

SECT. II.—*Of the Forces which disturb the Elliptic Motion of the Planets.*

1. *Of the force by which the Sun disturbs the motion of the Moon round the Earth.*

28. The motion of the moon in an elliptic orbit round the earth is disturbed by the action of the sun: the gravity of the moon to the earth is increased at the quadratures, and diminished at the syzygies; and the areas described by the radius vector, except near these four points, are never exactly proportional to the times.

Let ADBC (fig. 118) be the orbit, nearly circular, in which the moon M revolves, in the direction CADB, round the earth E. Let S be the sun, and let SE, the radius of the earth's orbit, be taken to represent the force with which the earth gravitates to the sun.

Then $\frac{1}{SE^2}:\frac{1}{SM^2}::SE:\frac{SE^3}{SM^2}=$ the force by which the sun draws the moon in the direction MS. Take $MG=\frac{SE^3}{SM^2}$, and let the parallelogram KF be described, having MG for its diagonal, and having its sides parallel to EM and ES. The force MG may be resolved into the two, MF and MK, of which MF, directed towards E, the centre of the earth, increases the gravity of the moon to the earth, and does not hinder the areas described by the radius vector from being proportional to the times.

The other force MK draws the moon in the direction of the line joining the centres of the sun and earth. It is, however, only the excess of this force above the force represented by SE, or that which draws the earth to the sun, which disturbs the relative position of the moon and earth. This is evident, for if KM were just equal to ES, no disturbance of the moon relatively to the sun could arise from it. If, then, ES be taken from MK, the difference HK is the whole force in the direction parallel to SE, by which the sun disturbs the relative position of the moon and earth. Now, if in MK, MN be taken equal to HK, and if NO be drawn perpendicular to the radius vector EM produced, the force MN may be resolved into two, MO and ON, the first lessening the gravity of the moon to the earth; and the second, being parallel to the tangent of the moon's orbit in M, accelerates the moon's motion from C to A, retards it from A to D, and so alternately in the other two quadrants.

Thus the whole solar force directed to the centre of

the earth is composed of the two parts MF and MO, which are sometimes opposed to one another, but which never affect the uniform description of the areas about E. Near the quadratures the force MO vanishes, and the force MF, which increases the gravity of the moon to the earth, coincides with CE or DE. As the moon approaches the conjunction at A, the force MO prevails over MF, and lessens the gravity of the moon to the sun. In the opposite point of the orbit, when the moon is in opposition at B, the force with which the sun draws the moon is less than that with which the sun draws the earth, so that the effect of the solar force is to separate the moon and earth, or to increase their distance; that is, it is the same as if, conceiving the earth not to be acted on, the sun's force drew the moon in the direction from E to B. This force is negative, therefore, in respect of the force at A, and the effect in both cases is to draw the moon from the sun, in a direction perpendicular to the line of the quadratures.

29. The analytical values of these forces must be found if a more exact estimate is to be made of their effects. Let SE, considered as constant, $= a$; EM, the radius vector of the moon's orbit, $= r$; the angle CEM $= \varphi$; the mass of the sun $= m$. The force SE, then, which retains the earth in its orbit, is $\frac{m}{a^2}$, and the sun's force in the direction SM, if ML be drawn perpendicular to ES, is $\frac{m}{SM^2}$ $= \frac{m}{SL^2+LM^2} = \frac{m}{(a-r\sin.\varphi)^2+r^2\cos.\varphi} = \frac{m}{a^2-2ar\sin.\varphi+r^2}$. The part of this force, which is in the direction ES or MK, is therefore $\frac{ma}{(a^2-2ar\sin.\varphi+r^2)^{\frac{3}{2}}}$. By raising the denominator to the power $-\frac{3}{2}$, rejecting the terms which involve the higher powers of r, and multiplying ma by those that are left, the force MK comes out $= \frac{m}{a^2}\left(1+\frac{3r}{a}\sin.\varphi\right)$ nearly. Taking away from this ES or MH $= \frac{m}{a^2}$, there remains the force MN $= \frac{m}{a^3} \times 3r\sin.\varphi$.

Hence the force MO $= \frac{m}{a^3} \cdot 3r\sin.^2\varphi$; and the force NO at right angles to the radius vector $= \frac{m}{a^3} \cdot 3r\sin.\varphi \times \cos.\varphi = \frac{m}{a^3} \cdot \frac{3r}{2}\sin.2\varphi$; also the force MF $= \frac{mr}{a^3}$, rejecting such terms as involve the square and higher powers of r. Therefore MF—MO, or the whole solar force increasing or diminishing at any point, the moon's tendency to the earth is $\frac{mr}{a^3}(1-3\sin.^2\varphi)$.

30. At the quadratures where φ vanishes, this force is $\frac{mr}{a^3}$, and is affirmative, increasing the moon's gravity to the earth. At a certain point, between the quadratures and the syzygies, when $3\sin.^2\varphi = 1$, or $\sin.\varphi = \frac{1}{\sqrt{3}}$, that is, when $\varphi = 35° 15' 5''$, the same force becomes equal to 0, and at this point in each quadrant the moon's gravity to the earth is neither increased nor diminished. From these points to the conjunction and opposition, as $\sin.\varphi$ increases, the quantity $1-3\sin.^2\varphi$ is negative, and the moon's gravity to the earth suffers a diminution. At the opposition and conjunction $\sin.\varphi = 1$, and therefore the disturbing force is $-\frac{2mr}{a^3}$, and by this quantity the moon's gravitation is diminished.

The mean quantity of the force which is thus continually directed to or from the centre of the earth may also be easily computed. Since for any point in the moon's orbit, where the radius vector makes the angle φ with the line of the quadratures, this force $= \frac{mr}{a^3}(1-3\sin.^2\varphi)$; multiplying by $d\varphi$, we have $\frac{mr}{a^3}(d\varphi - 3d\varphi\sin.^2\varphi)$, the integral of which $= \frac{mr}{a^3}(-\frac{1}{2}\varphi + \frac{3}{2}\sin.\varphi\cos.\varphi)$, and this, when φ is an entire circumference or four right angles, is $\frac{mr}{a^3} \times \pi$. This is the sum of the forces for an entire revolution, and when divided by 2π, gives the mean force $-\frac{mr}{2a^3}$ which being negative, shows that the solar force, on the whole, diminishes the gravitation of the moon to the earth.

Thus it appears, that at the quadratures the gravity of the moon to the earth is increased by a quantity equal to the mass of the sun, multiplied into the radius of the moon's orbit, and divided by the cube of the sun's distance from the earth: at the syzygies it is diminished by twice this quantity; and the effect on the whole is a diminution by one half of the same quantity.

If $\frac{mr}{a^3}$ be reduced to its numerical value, supposing the moon's gravitation to the earth to be 1, it is found $= \frac{1}{174}$ nearly. Hence the mean disturbing force of the sun is nearly $= \frac{1}{348}$ of the moon's gravity to the earth.

31. From the disturbing force of the sun arise two kinds of inequalities which affect the lunar motions; the one kind affects the form and position of the orbit of that planet, the other immediately affects the motion of the planet in the orbit. When any of these inequalities is expressed numerically, the measure of it so obtained is, in the language of astronomy, called *an Equation.*

32. The line in which the plane of the moon's orbit cuts the ecliptic is called the line of the nodes; and this line is subject to change its position continually, in such a manner as to go back annually 19° 19′ 42″·3. The way in which this effect is produced may be thus conceived. That part of the solar force which is parallel to the line joining the centres of the sun and earth, is not in the plane of the moon's orbit, except when the sun itself is in that plane, or when the line of the nodes, being produced, passes through the sun. In all other cases it is oblique to the plane of the orbit, and may be resolved into two forces, one of which is at right angles to that plane, and is directed towards the ecliptic. This force of course draws the moon continually towards the ecliptic, or produces a continual deflection of the moon from the plane of her own orbit towards that of the earth Hence the moon meets the plane of the ecliptic sooner than it would have done if that force had not acted. At every half-revolution, therefore, the point in which the earth meets the ecliptic advances in a direction contrary to that of the moon's motion, or contrary to the order of the signs. This retrograde motion is such that, in its mean quantity, it amounts to 19° 19′ 42″·3 in a year. The manner of de-

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ducing it from the theory of gravity is explained by Newton, *Princip.* lib. iii. prop. 31. This motion is subject to many inequalities, depending on the changes in the quantity and direction of the solar force.

If the earth and the sun were at rest, the effect of the deflecting force just described would be to produce a retrograde motion of the line of the nodes till that line was brought to pass through the sun, and of consequence the plane of the moon's orbit to do the same, after which they would both remain in their position, there being no longer any force tending to produce a change in either. The motion of the earth carries the lines of the nodes out of this position, and produces, by that means, its continual retrogradation.

33. The same force produces a small variation in the inclination of the moon's orbit, giving it an alternate increase and decrease within very narrow limits.

34. The line of the moon's apsides, that is, the longer axis of her orbit, has also a slow angular motion round the centre of the earth, which is progressive, or in the same direction with the motions of the moon itself. To conceive the cause of this phenomenon, we may begin with supposing the moon at the lower apsis, or perigee; and it is plain, if that planet were urged by no other force than its gravitation to the earth, that after the *radius vector* had moved over 180°, the moon would be at the higher apsis, where its motion would be at right angles to the said radius. But as the mean disturbing force in the direction of the radius vector tends, on the whole, to diminish the gravitation of the moon to the earth, the portion of her path, described in any instant, will be less bent or deflected from the tangent, than if this disturbing force did not exist. The actual path of the moon, therefore, will be less incurvated than the elliptic orbit that would be described under the influence of gravity alone, and will not be brought to intersect the radius vector at right angles, till this last have moved over an arch of more than 180°.

Hence the solar force, by lessening the moon's gravity to the earth, produces a progressive motion in the apsides of the lunar orbit. If the disturbing force had increased the moon's gravity to the earth, the motion of the apsides would have been *in antecedentia.*

The precise quantity of the motion of the apsides is not however easily determined. Newton left this part of the lunar theory almost untouched; and the only investigation he has entered into having any reference to it, assigned a measure only the half of that which is known from observation to belong to it. Several years afterwards, when Clairaut attempted a more accurate investigation of the lunar inequalities than was to be obtained by the method which Newton had followed, he at first encountered the same difficulty, and found that his calculus gave the motion of the apogee only half of the real quantity. He began, therefore, to suspect that gravity does not follow so simple a law as the inverse of the squares of the distances, but one which is more complex, and such as cannot be expressed but by a formula of two terms. The second of these terms he supposed to be inversely as the fourth power of the distance, and proceeded to inquire what must be the co-efficient of that term, in order to make this new supposition represent the true motion of the apsides. In order to this, he found it necessary to carry his approximation farther than he had yet done, and to include terms which he had before neglected. When these terms were included, he found that the co-efficient he was seeking for came out equal to 0; the necessary inference from which was, that there was no such term; and that the Newtonian law of gravity, when the approximation was carried far enough, was quite sufficient to explain the motion of the apsides. This doubt concerning the law of gravity terminated, therefore, in the confirmation of it. Physical Astronomy

35. When the doubts excited by Clairaut's first attempt were made known, and before his final solution of the difficulty was fully understood, there were several mathematicians who, still following the method of Newton, endeavoured to deduce the true motion of the moon's apsides from the theory of gravity. Among those who were most successful in this attempt were Dom. Walmesley, and afterwards Dr Matthew Stewart, professor of mathematics in the university of Edinburgh. In his *Mathematical and Physical Tracts* he has demonstrated this remarkable theorem:

Let r be the radius of the moon's orbit, supposing it to be a circle, and the moon to be acted on only by F, her gravity to the earth. If the mean disturbing force by which the sun diminishes the moon's gravity be f, then will the greatest distance to which the moon will recede from the earth be $r \times \frac{F-3f}{F-5f}$; and the cube of this distance will be to the cube of r, in the duplicate ratio of the angle described by the moon from one apsis to the same apsis again, to four right angles.

Hence the angle described by the radius vector from one apsis to the same apsis, is $360° \times \left(\frac{F-3f}{F-5f}\right)^{\frac{3}{2}}$.

This proposition, which is demonstrated by Dr Stewart in the fourth of his Tracts, in a manner somewhat prolix, on account of his rigorous adherence to the methods of the ancient geometry, but in a way perfectly clear and elementary, is employed by him to deduce the mean disturbing force from the motion of the apsides as ascertained by observation. But when the mean disturbing force is known from other phenomena, the same proposition may be employed to deduce the motion of the apsides from that force. Accordingly, if the disturbing force be taken $= \frac{1}{357{\cdot}7}$, the motion of the apsides will come out $= 3°\ 1'\ 20''$ for a sidereal revolution of the moon, very near the quantity actually observed.

36. Having determined the sun's mean disturbing force from the motion of the apsides, Dr Stewart proceeded to determine from the former of these the sun's distance from the earth. The result of a very nice investigation gave the sun's parallax $6''{\cdot}9$, a quantity that is no doubt too small, and makes of course the sun's distance too great. It is indeed but an inconsiderable part of the sun's disturbing force into which the parallax enters as an element, and therefore any deduction founded on it must be liable to this inaccuracy, that a small error in the data will produce a great one in the result.

37. After the inequalities which are conceived as belonging to the moon's orbit, come those which directly affect the place of the moon in that orbit. The most considerable of these, after what is called the equation of the centre, arising from the elliptic figure of the lunar orbit, and independent of all disturbance, is the equation or inequality called the evection, which was discovered by the Greek astronomers. This depends on the position of the transverse axis of the moon's orbit in respect of the line of the syzygies. When that axis is in the line just mentioned, because the quantity by which the solar force diminishes the gravitation of the moon in the syzygies is, *cæteris paribus*, proportional to her distance from the earth, it is greatest when the moon is in the apogee, and least when in the perigee. In this situation of the orbit, therefore, the greatest diminution is made from the quantity of the moon's gravitation which is already the least, and

the least from that which is already the greatest; the gravitation at the perigee, and therefore the difference, is augmented, and the orbit appears to have its eccentricity increased. When the line of the apsides is in the quadratures, the contrary happens; the gravitation at the apogee is most augmented, and at the perigee least; the difference is therefore diminished, and the eccentricity of the lunar orbit seems also to be diminished. This is conformable to observation; and when the evection is accurately deduced from the theory of gravitation, it appears $= (1^\circ\ 20'\ 29''{\cdot}9)\ \sin.\left(2\left(\mathrm{☾}-\odot\right)-a\right)$ where ☾ is the mean longitude of the moon, ⊙ that of the sun, and a the mean anomaly of the moon counted from the perigee.

38. The moon's variation is an inequality which was discovered by Tycho, and found to depend on the angular distance of that planet from the sun. It is derived from that part of the sun's disturbing force which is at right angles to the radius vector, and which accelerates the motion of the moon from the quadratures to the syzygies, and retards it from the syzygies to the quadratures. The effect of this force is found, from the theory of gravity, to be represented by three terms, which, if $\triangle$ be the angular distance of the moon from the sun, are,

$$+\ (35'\ 41''{\cdot}9)\ \sin.\ 2\triangle$$
$$+\ (\ 0'\ \ 2''\ \ )\ \sin.\ 3\triangle$$
$$+\ (\ 0'\ 14''\ )\ \sin.\ 4\triangle.$$

39. The lunar inequality, called the annual equation, arises from the variation of the sun's disturbing force according to the place which the earth occupies in its orbit. It is shown above that the sun's disturbing force is, *cæteris paribus*, inversely as the cube of his distance; so that when the earth is in its perihelion this force is the greatest, and at the aphelion the least, its effect varying at the same rate with the equation of the sun's centre, or having everywhere the same ratio to that equation. Hence this equation is nearly $(11'\ 12'') \times$ sin. sun's mean anomaly, with a contrary sign to the equation of the sun's centre.

40. These inequalities are all phenomena which were observed before the explanation of them was known. To them may be added a fourth inequality, known by the name of the moon's acceleration. It appeared to astronomers as a continual increase in the velocity of the moon, or in the rate of her mean motion, amounting to about 10″ in a century, and its effect, like that of all other constant accelerations, accumulating as the squares of the times. It did not seem to be periodical, like the other lunar inequalities, but to be a constant increase of the velocity, and a corresponding diminution of the periodical time of the moon, which must in the end change entirely the relation of that body to the earth.

It is but a short time since Laplace discovered it to be a periodic inequality, though requiring, in order to accomplish the series of its changes, a length of time which science has not yet ventured to calculate. For many centuries to come it may be expressed by this formula, taking n to denote the number of centuries reckoned from the year 1700, viz.,

$$10''{\cdot}7232 \times n^2 + 0''{\cdot}019361 \times n^3.$$

The first term includes all that was known from observation previously to the discovery of Laplace. This, however, must be considered not as the true form of the equation, which must include the sines or cosines of certain angles, but merely a provisional formula, to serve till the true one can be rigorously assigned.

This inequality has in its cause a great affinity to the annual equation.

Whatever changes the form of the earth's orbit, has an effect on the disturbing force of that body on the moon, which is in the inverse ratio of the cube of the distance between the sun and earth. But it is found that though the mean distance remains invariable, the eccentricity of the earth's orbit changes, on account of the action of the other planets, and in fact has been diminishing, from a more remote antiquity than that to which the history of astronomy extends. From this cause Laplace has deduced the supposed acceleration of the moon's mean motion.

41. All these inequalities have been pointed out by observations, and have been explained in the most satisfactory manner by the principle of universal gravitation. But when all these were reduced into equations and arranged in tables, yet the places of the moon calculated from them were never quite exact; and there seemed a cause of error or a mass of small inequalities unknown in their magnitude and form, to which this inaccuracy was to be ascribed, and which operated, as it may be said, like a mist which concealed the true place of the moon from the calculator, and prevented his results from agreeing completely with those of the observer. The most likely way to discover these inequalities, if they arose from gravity, was to push the approximation to the moon's place still farther, and to try if the terms hitherto neglected in the approximation would not, when taken into account, afford a complete analysis of the circle of confusion which might be said to surround the moon on all occasions.

The problem on which mathematicians now entered, and which Clairaut, already mentioned, Euler, and D'Alembert, all three resolved nearly about the same time, has been called the *Problem of Three Bodies*. The thing proposed is, three bodies which attract one another with forces directly as their quantities of matter, and inversely as the squares of their distances, being given, and any motions whatever being impressed on them, to find the orbits which they will describe round their common centre of gravity. It is, however, only in certain cases that this general problem admits of solution, and one of these is, when one of the bodies is at a vast distance from the other two. This is exactly the case with the moon and earth in respect of the sun, the orbit of the earth being nearly the same as if there only existed the sun and earth, and the orbit of the moon relative to the earth being nearly the same if there were only the moon and earth. This solution of the problem, however, in this direct way, leads to far more exact conclusions than can be obtained from the more simple but more indirect method which Newton followed. The general view which leads to the most exact estimate of the merit of the two solutions is, that the motions of the moon, when analytically and fully expressed, necessarily form a number of different series, each of which converges with more or less rapidity. The prosecution of the direct method allows the terms of these series to be computed to an indefinite extent, or till the quantities omitted are too small to affect observation. The method of Newton can go no farther than to compute the first, or at most a few of the leading terms of each of the series. Its accuracy is therefore limited; that of the other knows no limits. Though this be a true estimate of the value of the methods, yet that of the original inventor possesses infinite merit, as having first led the way to this arduous investigation, and as still serving to carry the imagination better along with it than the other, and to keep the mechanical principles more directly in view.

The complete solution of the problem of the *three bodies* has accordingly discovered a great number of new equations, each individually small, which would sometimes nearly destroy one another, and, at other times, having many of them the same sign, would accumulate to a considerable amount. This was the triumph of the theory, and the strongest evidence of its truth. The effect

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of these irregularities varied so much, and depended on so many elements, that it may be doubted whether the most accurate and most constant observation would ever have enabled astronomers to discover their precise quantities, and to separate them from one another.

The tables of the moon, in the state to which they are now brought, contain twenty-eight equations for the longitude, twelve for the latitude, and thirteen for the horizontal parallax of the moon. Of the first of these, twenty-three have been deduced from theory alone; of the second, nine; and of the third, eleven. This applies to the tables of Burg: those since published by Burckhardt contain more equations, and are still more accurate.

2. *Of the Disturbance in the Motion of the Primary Planets, produced by their action on one another.*

42. It is evidently necessary, in this inquiry, to know the quantities of matter in the different planets, or, which comes to the same, the intensity of the attraction of each at a given distance from its centre. With respect to those planets which have satellites, the Earth, Jupiter, Saturn, and Uranus, their masses or quantities of matter have been already determined. The masses of Venus and Mars have been estimated by Laplace, from the effects which they appear to produce on the earth's motion. The mass of Mercury has been estimated on the supposition that the densities of that planet and of the earth are inversely as their mean distances from the sun. This law holds with respect to the Earth, Jupiter, and Saturn, and analogy renders it probable that the same law includes the other planets. Thus, the mass of the Sun being 1, that of Mercury is $\frac{1}{2025810}$, of Venus $\frac{1}{405871}$, and of Mars $\frac{1}{2546320}$; the masses of the other planets being as already stated.

43. The effects of the action of the planets on one another is more difficult to be investigated than the effects of the sun's action on the moon, because the disturbing forces are not only more numerous, but because the distance of the disturbing from the disturbed body is not so great that the quantities divided by higher powers of that distance can be so safely rejected. The general principle, however, according to which the solar action on the moon was resolved into forces either in the direction of the radius vector or at right angles to it, is applicable to both questions.

Thus, supposing P and P′ (fig. 119) to be two planets revolving in orbits, nearly circular, about the sun at S; in order to find how the motion of P′ is affected by the action of P, let PP′, PS, and P′S be drawn, and let the line A denote the force with which P attracts a particle of matter at the distance PS, then the force with which it attracts a particle at the distance PP′, will be $A \times \frac{PS^2}{P'P^2}$. Let $P'R = A \times \frac{PS^2}{P'P^2}$; and if P′R be resolved into two forces, P′M and P′N, the one in the direction of the radius vector P′S, and the other parallel to PS, take NO = A; then the remaining forces OP′ and P′M are those which disturb the motion of P′, as was proved in the case of the moon. The former of these, OP′, may be resolved into OQ and P′Q, of which P′Q diminishes the gravity of the planet to the sun, and OQ accelerates its motion in a direction perpendicular to the radius vector. Therefore, as the force P′M always increases the planet's gravity to the sun, P′M—P′Q is the whole force increasing or diminishing the gravity of P′ to S; and the force directly employed in increasing or diminishing the angular motion of P about S, is OQ or P′T. The analytical values of these quantities may be found, as in the theory of the moon, though not with equal simplicity, because SP cannot always be supposed great in respect of SP′.

44. In consequence of these actions, the orbit of every planet may be considered as an ellipsis, which is undergoing slowly certain changes in its form, magnitude, and position, or in what are called its elements. By the elements of the orbit of any heavenly body, are meant the quantities that determine the position and magnitude of that orbit, viz. the position of the line of the nodes, the inclination of the plane of the orbit to the plane of the ecliptic, the position of the line of the apsides, the eccentricity, and the mean distance. These are all quantities independent of one another, and from them may be deduced all other circumstances with respect to the elliptic orbit. Of these five elements, which would be invariable if the planet only gravitated to the sun, all except the mean distance are subject to slow but perpetual changes.

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45. The line of the nodes, in every one of the planets, has a retrograde angular motion, which goes on continually, and of which the amount, when calculated as due to each planet, agrees very well with observation. The plane of the orbit also varies its inclination, by certain small periodical changes, which alternately increase and diminish it, as in the case of the moon. The line of the apsides, from the same cause as in the planet just mentioned, has a continued motion forward, or according to the order of the signs. Thus, in Mercury the node goes back about 7″·82 annually. The aphelion goes forward about 5″·84 in a year, and the inclination of the orbit in the course of a century increases about 18″·18, which, in the course of succeeding ages, will be compensated by an equal diminution, so as to preserve it always nearly of the same quantity. In the same planet the equation of the centre, which depends on the eccentricity, increases about 1″·6 in a century, indicating a small increase of eccentricity. These variations in the orbit of Mercury arise from the action of Venus, the Earth, Mars, Jupiter, and Saturn; the effects of the first of these planets, on account of its vicinity, being by much the most considerable. The mean distance, however, of Mercury from the Sun, does not, any more than that of the other planets, undergo any change whatever.

46. Similar conclusions apply also to the orbit of Venus. The orbit of the earth also is subject to similar changes, the line of the apsides moving forward annually at the rate of 11″·8, in respect to the fixed stars. The earth's eccentricity is also diminishing, and the secular variation of the greatest equation of the centre is — 17″·66.

The motion of the earth is subject to another inequality on account of the action of the moon; for, to speak strictly, it is not the centre of the earth, but the centre of gravity of the moon and earth, which describes equal areas in equal times about the centre of the sun. It is evident that, on this account, the earth will be sometimes advanced before, and sometimes will fall behind, the point which describes the circumference of the ellipsis, in conformity with the general law of the planetary motions. From the same cause also, as the moon does not move in the plane of the ecliptic, the earth will be forced out of that plane, in order to preserve a position diametrically opposite to the moon. These irregularities, however, are inconsiderable. By observers on the earth's surface, they are transferred to the sun, but in an opposite direction. The sun, therefore, has a motion in longitude, by which he alternately advances before the point which describes the elliptic orbit in the heavens, and falls behind it; and also a motion in latitude, by which he alternately ascends above and descends below the plane of the ecliptic. As the mass of the moon, however, is not more than $\frac{1}{79}$ part of that of the earth, the distance of the centre of gravity of the moon and earth from the centre of the latter must be

less than a semidiameter, and therefore the inequality thus produced in the sun's longitude must be less than his horizontal parallax. The alteration in latitude can hardly amount to a second. This inequality in the sun's motion is called the menstrual parallax, and was first mentioned by Smeaton, *Phil. Trans.* 1768.

47. In the orbit of Mars the node moves backward 23″·3 annually, and the line of the apsides moves forward 15″·8, both in respect of the fixed stars. The eccentricity of the orbit is increasing, and the secular variation of the greatest equation of the centre is + 37″.

In the case of this planet, however, the elliptic orbit is not only changed by these quantities, but the place of the planet in that orbit is sensibly affected by the action of Venus, Jupiter, and the Earth. The effect of the action of Venus is expressed by this formula, 5″·7 sin. (long. ♀ — 3 long. ♁); of the earth, 7″·2 sin. (long. ☉ — long. ♀). Several inequalities are produced in Jupiter.

48. The inequalities of the small planets *Vesta, Juno, Ceres,* and *Pallas*, have also been computed. The disturbances which they must suffer from Venus, Mars, and Jupiter are considerable, and, on account of their vicinity, though their masses are small, they may somewhat disturb the motions of one another. Their action on the other bodies in the system is probably insensible.

As Pallas and Ceres have nearly the same periodic time, they must preserve nearly the same distance and the same aspect with regard to one another. This offers a new case in the computation of disturbing forces, and may produce equations of longer periods than are yet known in our system.

The motion of the apsides and the change of eccentricity in the orbits of Jupiter and Saturn are chiefly produced by their action on one another, but a part also depends on the action of the other planets. The node of Jupiter moves backward annually 15″·8, and his aphelion forward 6″·96. The secular change in the inclination of the orbit is 22″·6, and in the first and last of these inequalities the action of Venus has the principal share. The equation of the centre increases 56″·25 in a century, of which nearly the whole arises from the action of Saturn. In Saturn again the node goes back at the rate of 19″·4 annually, and the aphelion forward at the rate of 19″·4; the secular change of the inclination is — 15″·5, and the secular diminution of the equation of the centre 2′·1.

There is, besides these variations in the orbits, an inequality in the motion of each of these planets, which for a long time was difficult to explain, and was ultimately fully accounted for, according to the theory of gravity, by the profound investigations of Laplace. These inequalities are both of a long period, viz. 918·76 years, which is the time that they take to run through all their changes. If n express a number of years reckoned from the beginning of 1750, S the mean longitude of Saturn, and I that of Jupiter, reckoned from the same time, then the equation which must be applied to the mean longitude of Jupiter, or the amount of this inequality, is

$$+ (20' 49''{\cdot}5 - n \times 0''{\cdot}042733) \times \sin.(5\,S - 2\,I + 5^\circ\ 34'\ 8'' - n \times 58''{\cdot}88);$$

and that which must be applied to S is

$$-(48'\ 44'' - n \times 0''{\cdot}1) \times \sin.(5\,S - 2\,I + 5^\circ\ 34'\ 8'' - n \times 58''{\cdot}88).$$

These two equations are to one another nearly in the ratio of 3 to 7. The reason of the long period above mentioned is, that the argument $5\,S - 2\,I - n \times 58''{\cdot}88$ requires all that time to increase from 0 to 360°.

Uranus, on account of his great distance, suffers hardly any disturbance in his motion, but from Saturn and Jupiter. The node moves backward at the rate of 36″ annually, and the aphelion forward at that of 2″·55. The eccentricity is diminishing, and the secular variation of the greatest equation of the centre is 11″·03.

There is also an inequality in the longitude of this planet, depending on the action of Saturn. If S be the longitude of this last planet, U the longitude of Uranus, and A the longitude of the aphelion of Saturn, the inequality in question amounts to 2′ 30″ × sin. (S — 2 U + A).

49. *Of all these inequalities, and of many other smaller ones which theory has discovered, it must be observed that they are periodical, each returning after a certain time to run through the same series of changes which it had formerly exhibited.*

Another remark is, that one element in every orbit, viz. the mean distance, is exempted from all excepting periodical changes; and since on the mean distance depends the time of revolution, that time remains also unchanged. From the invariability of the mean distance, and the periodical revolution of all the inequalities, it follows that the actual condition of the planetary system can never deviate far from the mean, about which we may, therefore, conceive it to be continually making small oscillations, which in the course of ages compensate one another, and therefore produce nothing like disorder or permanent change. It is in this manner that the stability of the planetary system is provided for by the wisdom of its Author.

50. *Comets*, in describing their elliptic orbits round the sun, have been found to be disturbed by the action of the larger planets, Jupiter and Saturn; but the great eccentricity of their orbits makes it impossible, in the present state of mathematical science, to assign the quantity of that disturbance for an indefinite number of revolutions, though it may be done for a limited portion of time, by considering the orbit as an ellipsis, the elements of which are continually changing. This is the method of Lagrange, and is followed in the *Mécanique Céleste*, Part ii. chap. ix. Dr Halley, when he predicted the return of the comet of 1682, took into consideration the action of Jupiter, and concluded that it would increase the periodic time of the comet a little more than a year; he therefore fixed the time of the re-appearance to the end of the year 1758, or the beginning of 1759. He professed, however, to have made this calculation hastily, or, as he expresses it, *levi calamo*. (*Synopsis of the Astronomy of Comets.*)

The effects both of Jupiter and Saturn on the return of the same comet were afterwards calculated more accurately by Clairaut, who found that it would be retarded 511 days by the action of the former planet, and 100 by the action of the latter; in consequence of which, the return of the comet to its perihelion would be on the 15th of April 1759. He admitted at the same time that he might be out a month in his calculation. The comet actually reached its perihelion on the 13th of March, just 33 days earlier than was predicted; affording, in this way, a very striking verification of the theory of gravity, and the calculation of disturbing forces. The same comet appeared again, according to prediction, in 1835.

In some instances, the effect which the planets produce on the motion of comets are far more considerable than in this example. A comet which was observed in 1770 had a motion which could not be reconciled to a parabolic orbit, but which could be represented by an elliptic orbit of no great eccentricity, in which it revolved in the space of five years and eight months. This comet, however, which had never been seen in any former revolution, has never been seen in any subsequent one. On tracing the path of this comet, Mr Burckhardt found that between the year 1767 and 1770 it had come very near to Jupiter, and had done so again in 1779. He therefore conjectured, that the action of Jupiter may

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have so altered the original orbit as to render the comet for a time visible from the earth; and that the same cause may have so changed it, after one revolution, as to restore the comet to the same region in which it had formerly moved. This is the greatest instance of disturbance which has yet been discovered among the bodies of our system, and furnishes a very happy, as well as an unexpected, confirmation of the theory of gravity.

Though the comets are so much disturbed by the action of the planets, yet it does not appear that their reaction produces any sensible effect. The comet of 1770 came so near to the earth as to have its periodic time increased by 2·246 days, according to Laplace's computation; and if it had been equal in mass to the earth it would have augmented the length of the year by not less than two hours and forty-eight minutes. It is certain that no such augmentation took place, and therefore that the disturbing force by which the comet diminished the gravity of the earth is insensible, and the mass of the comet, therefore, less than $\frac{1}{500}$th of the mass of the earth. The same comet also passed through the system of the satellites of Jupiter without causing any derangement of their motions. Hence it is reasonable to conclude, that no material or even sensible alteration has ever been produced in our system by the action of a comet.

3. *Of the disturbances which the satellites of Jupiter suffer from their action on one another.*

51. The same resolution of the forces by which one satellite acts upon another, into two, one directed to the centre of the primary, and the other at right angles to it, serves to explain the irregularities which had been observed in their motions, and to reduce under known laws several other inequalities, of which the existence only is indicated by observation.

An instance of this we have in the very remarkable relation which takes place between the mean motions of the first three satellites; the mean motion of the first satellite, together with twice the mean motion of the third, being equal to three times the mean motion of the second. Laplace has shown that, if the primitive mean motions of these satellites were nearly in this proportion, the mutual action of these bodies on one another must in time have brought about an accurate conformity to it.

The first moves nearly in the plane of Jupiter's equator, and the orbit has no eccentricity, except what is communicated from the third and fourth, the irregularities of one of these small bodies producing similar irregularities in those that are contiguous to it. The first satellite has, beside, an inequality, chiefly produced by the action of the second, and circumscribed by a period of 437·659 days.

52. The plane of the orbit of the second satellite is inclined to a determinate fixed plane at an angle of 27′ 13″, and on which its nodes have a retrograde motion, so that they complete a revolution in 29·914 years. The motion of the nodes of this satellite is one of the principal data used for determining the masses of the satellites themselves, which are so necessary to be known for computing their disturbances. This satellite has no eccentricity but that which it derives from the action of the third and fourth. The plane of the orbit of the third satellite is inclined to a determinate fixed plane at an angle of 12′ 20″, and its nodes make a tropical revolution backwards in 141·739 years. The equator of Jupiter is inclined to the plane of his orbit at an angle of 3° 5′ 30″. The fixed planes on which the planes of the orbits move are determined by theory, and could not have been discovered by observation alone.

The orbit of the third satellite is eccentric, but appears to have two distinct equations of the centre; one which really arises from its own eccentricity, and another which theory shows to be an *emanation* from the equation of the centre of the fourth satellite. The first equation is referable to an apsis which has an annual motion of 2° 36′ 39″ forward in respect of the fixed stars; the second equation is referable to the apsides of the fourth satellite.

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These two equations may be considered as forming one equation of the centre, referable to an apsis that has an irregular motion. The two equations coincided in 1682, and the sum of their *maxima* was 13′ 16″. In 1777 the equations were opposed, and their difference was 5′ 6″.

The two last inequalities were perceived by Mr Wargentin, by observation alone; but their exact amount, and the law which they observe in their changes, he could not discover. The plane of the orbit of the fourth satellite is inclined to a determinate fixed plane at an angle of 14′ 58″; and its nodes complete a sidereal revolution backward in 531 years. The fixed plane on which the orbit moves is inclined at an angle of 24′ 33″ to the equator of Jupiter; the orbit is sensibly elliptical, and its greater axis has an annual motion of 42′ 58″·7. The motion of this axis is one of the principal data from which the quantities of matter of the different satellites have been determined.

If the mass of Jupiter be supposed unity, the mass of

the 1st satellite = ·0000173281
of the 2d = ·0000232355
of the 3d = ·0000884972
of the 4th = ·0000426591

If the mass of the earth be supposed unity, that of the third satellite will be found = ·027337; and as the mass of the moon is $\frac{1}{79·89}$ = ·012517, the quantity of matter in the third satellite is about twice as great as that in the moon. The fourth satellite is therefore nearly equal to the moon, the second about one half, and the first somewhat more than one third.

53. The general result of this investigation concerning the inequalities in the motion of the planets, both primary and secondary, is, that in every one of these orbits two things remain secure against all disturbance, the mean distance and the mean motion, or, which is the same, the transverse axis of the orbit, and the time of the planet's revolution. Another result is, that all the inequalities in the planetary motions are periodical, and observe such laws that each of them, after a certain time, runs through the same series of changes. This last conclusion follows from the fact, that every inequality is expressed by terms of the form A sin. *nt* or A cos. *nt*, where A is a constant co-efficient, and *n* a certain multiplier of *t* the time, so that *nt* is an arch of a circle, which increases proportionally to the time. Now, in this expression, though *nt* is capable of indefinite increase, yet, since *nt* never can exceed the radius, or 1, the maximum of the inequality is A. Accordingly, the value of the term A sin. *nt* first increases from 0 to A, and then decreases from A to 0; after which it becomes negative, extends to — A, and passes from thence to 0 again. If, when the inequality was affirmative, it was an addition to the mean motion, when negative it will become a diminution of it; and the sum of all these increments and decrements, after *nt* has passed over an entire circumference, or 360°, is equal to 0; so that at the end of that period the planet is in the same position as if it had moved on regularly all the while at the rate of the mean motion. As this happens to every one of the inequalities, the deviation of the system from its mean state can never go beyond certain limits, each inequality in a certain course of time destroying its own effect.

It would be far otherwise if into the value of any inequalities a term entered of the form A × *nt*, A tan. *nt*.

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$\frac{A}{\sin. nt}$. The inequalities so expressed would continually increase with the time, so as to go beyond any assignable limit, and of consequence to destroy entirely the order of any system to which they belonged.

Lagrange and Laplace, who discovered and demonstrated that no such terms as these last can enter into the expression of the disturbances which the planets produce by their action on one another, made known one of the most important truths in physical science. They proved that the planetary system is stable, and that it does not involve any principle of destruction in itself, but is calculated to endure for ever, or till the action of an external power shall put a period to its existence. After the knowledge of the principle of gravitation, this may be fairly considered as the greatest discovery to which men have been led by the study of the heavens.

The accurate compensation, just remarked, depends on three conditions, belonging to the primitive or original constitution of our system, but not necessarily determined, as far as we know, by any physical principle. The first of these conditions is, that the eccentricities of the orbits are all inconsiderable, or contained within very narrow limits, not exceeding in any instance one tenth or one eighth part of the mean distance. The second condition is, that the planets all move in the same direction, or from west to east. This is true both of the primary and secondary planets, with the exception only of the satellites of Uranus, which may be accounted retrograde; but their planes being nearly at right angles to the orbit of their primary, the direction of their motion, whether retrograde or otherwise, can have little effect. Lastly, the planes of the orbits of the planets are not much inclined to one another. This is true of all the larger planets, though it does not hold of some of the new and smaller ones; of which, however, the action on the whole system must be altogether insensible. Practical Astronomy

Unless these three conditions were united in the constitution of the solar system, terms of the kind just mentioned, admitting of indefinite increase, might enter into the expression of the inequalities, which would indicate a gradual and unlimited departure from the original order and constitution of the universe. Now, the three conditions just enumerated do not necessarily arise out of the nature of motion, or of gravitation, or from the action of any physical cause with which we are acquainted. Neither can they be considered as arising from chance; for the probability is almost infinity to one, that, without a cause particularly directed to that object, such a conformity could not have arisen in the motions of so large a number of bodies, scattered over the whole extent of the solar system. *The only explanation, therefore, which remains is, that all this is the work of intelligence and design, directing the original constitution of our system, and impressing such motions on the parts as are calculated to give stability to the whole.* (J. P.)

For some further discussions connected with *Physical Astronomy*, see the articles COMETS; EARTH, *Figure of*; PRECESSION of the EQUINOXES; and TIDES.

PART IV.

PRACTICAL ASTRONOMY.

INTRODUCTION.

PRACTICAL ASTRONOMY may be considered as comprehending the observations which must originally have been made to determine the facts which have now been embodied in a system, as well as those which are constantly being made for its further extension and improvement; the observations which are required to make the science useful in the affairs of life; and the rules and calculations which must be applied to the observations, to obtain from them the required results.

Of the first class of observations mentioned above, the most important are those which relate to general surveys of the heavens, and the extension of cosmical research amongst those bodies that lie beyond the solar system. The sweeps of the stars, and the observations of the nebulæ begun by Sir W. Herschel in the last century, have been carried forward with additional vigour in this. Star maps and star catalogues for almost every portion of the heavens have been accumulating during the present century, till the places and magnitudes of very nearly one hundred thousand stars have been accurately laid down; speculation has closely followed practice; and not only has our own position with respect to the star cluster of which our solar system forms a part, been pretty accurately defined, but clearer views have been obtained of the probable distances and even of the constitution of some others of those systems which, though seen by us under the aspect of a feeble nebulous light, scarcely larger than the apparent disk of a planet of our system, yet probably occupy individually a space equivalent to that of our galaxy, and fill the firmaments of other worlds like our own, with their light and their glory.

Even with regard to observations connected with the solar system merely, observation and theory combined have achieved conquests, since the last edition of this work was published, not inferior in interest or importance. Since the beginning of the present century, the telescope, aided by the improved methods of modern research, has discovered twenty-two of those small fragmentary bodies moving in planetary orbits between Mars and Jupiter; and theory alone, without the aid of the telescope, using only the laws of mechanical action and the results of previous observation, has extended the bounds of the known solar system, by predicting the place of a new body, and calling in the aid of the observer only to verify the fact, and to assist in the inquiry. The assumed well-marked distinction between the planetary and cometary orbits has been disproved by the discovery of several comets moving in ellipses with a periodical term shorter than that of Jupiter; curious physical facts have been elicited by the motions of some of them, while several new members of this class of bodies are yearly added to the list, and their orbits eagerly computed by new aspirants for astronomical fame.

Yet while the science has been thus followed up in its more speculative departments with all the success that the united zeal, talent, and energy of a highly intellectual age would give us reason to expect, and with an accuracy of detail in the observations which brings into play all the resources of mere *practical* astronomy, it has been cultivated with equal ability in those departments to which the term practical more peculiarly belongs, and has lent its aid to the kindred and dependent science of navigation in a way which will soon render the art of guiding a ship through the trackless ocean as perfect both in theory and practice as anything depending upon human casualties can possibly be. The problem of determining the position of a ship at sea depends upon three things mainly, namely, 1*st*, an accurate knowledge of the lunar orbit, and the consequent motions of the moon; 2*dly*, upon the indisputable accuracy of the places of certain fundamental stars and bright planets with which her place is compared; and, 3*dly*, upon the accuracy of performance of chronometers and nautical observing instruments. Now, in all these departments, the progress towards perfection during the last twenty years has been immense. The lunar orbit has been nearly cleared of all its theoretical irregularities, or those depending

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upon unknown causes of perturbation, and, very recently, important errors in the tables ordinarily in use have been detected, and corrected; ephemerides of the motions of the moon are computed with all attainable accuracy both in England and America; and finally, by the extra-meridional observations begun at Greenwich in 1847, and continued without intermission to the present time, the errors due to want of observations in certain parts of the orbit (those near conjunction namely) will be altogether got rid of. Again, the Greenwich Catalogues alone furnish the places of large numbers of stars with an accuracy indispensable for lunar purposes only in the case of a few, and every fundamental result of observations connected with the theory of the moon is supplied from the Greenwich Observatory with an accuracy and a steadiness even now unrivalled. Finally, the construction of chronometers and of nautical instruments has been brought to almost as much perfection as the case will admit of. Our government has encouraged the artists to place in competition every year a certain number of chronometers; and the ingenuity of this whole class of persons, brought to bear upon this branch of art, has been the means of eliciting some important improvements in the methods of compensating for temperature and in general construction, at the same time that their rivalry has been the means of reducing the price of the article, and bringing it more within the reach of the ordinary merchant captains of vessels. Various improvements have been at the same time made in surveying instruments and hydrographical methods. The sextant has been simplified and improved; charts have been made of almost every shore in our dominions; the tides have been studied with that attention to the union of high analytical investigations, and the practical results of observations, which have put astronomy on so sound a basis; the laws of the currents of various seas have recently been made the subject of special investigation on a scale equal to its importance; and, in fact, there is not a single branch of nautical astronomy which has not been benefited in an equal degree with the more theoretical or elevated branches of the science.

The science of electricity, in its application to the electric telegraph, has been already of considerable service to astronomy, by affording the opportunity of making simultaneous signals at any two observatories situated on a line of railway, however distant they may be from each other. By this means the differences of longitude of three principal British observatories—namely, Greenwich, Cambridge, and Edinburgh—have already been obtained with an accuracy unattainable by any other method, and the difference of longitudes of Greenwich and Oxford will shortly be determined. The galvanic connexion between Greenwich and Paris is also complete, by means of the submarine communication between Dover and Calais; and experiments will shortly be tried for the determination of the difference of longitudes of these two observatories; and, after this has been accomplished, there will be no difficulty whatever in determining the longitudes of all the continental observatories situated near the grand lines of railroad or telegraph wires. Hopes are beginning to be entertained also of carrying a wire across the Atlantic, and thus bringing the American observatories into connexion with Europe; and the project is not in reality very chimerical.

We need not dwell specifically upon the means by which these great results have been attained. Our two supplements historical and theoretical will have given ample information concerning every available source of improvement in the methods of making observations, and of the chief improvements which have been devised by the eminent men conducting the establishments which have been described. There is scarcely a discovery of importance, or a new method deserving of explanation, in any one of the branches of pure astronomy, concerning which the reader will not find information, and guidance for future research; many of the books which the accomplished astronomer, as well as the student, will require for his pursuit of the science are indicated, and some account of the contents of some of them, where it is necessary to elucidate the subject, has been given.

Such information, indeed, as relates exclusively to the allied sciences of surveying and navigation, must of course be sought for under their respective titles, since the space allotted us would not allow of the extension which such subjects would have required; but, in everything that relates to the observations made in fixed observatories, and to the results deduced from them as applied to the use of these sciences, it is hoped that some instruction has been given. Practical Astronomy

There is one subject which we hoped to have entered into with more minuteness, but which we are prevented from doing through want of space, namely the method of reducing as well as making the observations necessary for the determination of the position of a body in the heavens; and we were the more reluctant to relinquish our design because it is a subject on which most elementary books are either deficient or silent. It has been stated again and again, that the two elements which determine the position in question, are the right ascension and declination of the body, and the instruments which ordinarily determine these elements are the transit instruments (assisted by an astronomical clock) and the mural circle, if two instruments be used, or the transit circle, if only one instrument be employed. Under this head it has been deemed sufficient to retain the accounts of the transit instrument constructed by Troughton for Sir James South, which is still mounted and in excellent condition; and of Troughton's mural circle, erected at the Royal Observatory of Greenwich, in 1812, which was used with excellent effect till the end of the year 1850, when it was replaced by the great transit circle now in use. Each of these instruments is probably one of the best existing specimens of its class, and neither has been excelled in perfection of workmanship even to the present time. In addition to the instruments which determine the place of a body by observations made on the meridian, a third instrument, namely the equatorial, is necessary for various purposes, but especially for comparing planets and comets, of which a sufficient number of observations cannot be obtained on the meridian, with neighbouring stars; of this class of instruments we have retained the accounts of the celebrated Dorpat telescope already mentioned in the account of that observatory, and of the three-foot equatorial in the possession of Sir James South, which was used with such effect by him and Sir John Herschel in the measurement of double stars.

With regard to the tables printed in this department, we have retained those relating to the calculation of eclipses, as interesting to the student, though it must be borne in mind that much better elements exist at present for such calculations than those which were used in these tables.

The catalogue of stars has been replaced by a more modern catalogue accurately compiled, by the use of the best elements, from the Greenwich Twelve-Year Catalogue of 2156 stars. This list includes all the stars down to the fifth magnitude inclusive, which are found in that catalogue, and the places are reduced to the epoch 1850, by the use of the geometrical precessions given in the *British Association Catalogue*, and by the proper motions given in Mr Main's paper on Proper Motions, (*Memoirs of the Royal Astronomical Society*, vol. xix.) Where no proper motion is given by Mr Main,—that is for stars not observed by Bradley or not given in the *Fundamenta*,—the annual variation is taken altogether from the *British Association Catalogue*, except in a few cases specified in the notes.

Finally, we have retained, as useful to the student, the small table of refractions given in the former edition, not as insisting upon its accuracy (since the whole subject has been since revised by Bessel), but as enabling the student to see by compendious tables and examples how this element of correction is taken account of in the reduction of observations.

A few problems given in the former edition have been retained, as being good exercises for the students, and amongst the most interesting and important that belong to the science of plane astronomy, though it is evident that in the systematic study of the science they should be read in their proper order in works treating of the details of the science.

CHAP. I.

PROBLEMS IN PRACTICAL ASTRONOMY.

PROBLEM I.—*Given the right ascension and declination of a star or planet, together with the obliquity of the ecliptic, to find the star's longitude and latitude.*

Let P (fig. 120, Plate XC.) be the pole of the equator O ♈ Q, E the pole of the ecliptic I ♈ L, and S the place of the star. Let PR, the circle of latitude passing through

S, meet the equator in R; and EM, the circle of declination, meet the ecliptic in M; also let ♈E, ♈P, be arcs of great circles passing through the equinoctial point ♈ and the poles of the ecliptic and equator respectively. Let us now make

L = ♈M the longitude of S,
l = SM the latitude,
$\mathcal{A}$R = ♈R the right ascension,
D = SR the declination,
ω = L♈Q the obliquity of the ecliptic.

Since ♈M = ♈L − ML = 90° − ML, and ML is the measure of the angle SEP, we have ♈M = L = 90° − SEP, and, consequently, sin. L = cos. SEP. Again, since ♈R = ♈Q − RQ = 90° − RQ, and RQ is the measure of the angle RPQ, we have ♈R = $\mathcal{A}$R = 90° − RPQ; whence sin. $\mathcal{A}$R = cos. RPQ = − cos. EPS. In like manner we have l = SM = 90° − ES, whence sin. l = cos. ES; and also D = SR = 90° − PS, whence sin. D = cos. PS. Thus the problem depends on the solution of the oblique angled spherical triangle PES.

From the known properties of spherical triangles, we have

cot. PS sin. EP = cot. PES sin. EPS + cos. EP. cos. EPS;

therefore, by substituting the values just found, and observing that EP = ω, we have

tan. D sin. ω = tan. L cos. $\mathcal{A}$R − cos. ω sin. $\mathcal{A}$R;

whence

$$\text{tan. L} = \frac{\text{tan. D sin. } \omega + \text{sin. } \mathcal{A}\text{R cos. } \omega}{\text{cos. } \mathcal{A}\text{R}}.$$

Assume an angle φ such that tan. φ = sin. $\mathcal{A}$R cot. D, then

$$\text{sin. D tan. } \varphi = \text{sin. } \mathcal{A}\text{R cos. D},$$

$$\text{or tan. D} = \frac{\text{sin. } \mathcal{A}\text{R}}{\text{tan. } \varphi} = \frac{\text{sin. } \mathcal{A}\text{R cos. } \varphi}{\text{sin. } \varphi};$$

whence, by substituting,

$$\text{tan. L} = \text{tan. } \mathcal{A}\text{R} \left(\frac{\text{sin. } \omega}{\text{tan. } \varphi} + \text{cos. } \omega\right),$$

and by reducing,

$$\text{tan. L} = \frac{\text{sin. } (\omega + \varphi)}{\text{sin. } \varphi} \text{tan. } \mathcal{A}\text{R} \quad \text{.....(1.)}$$

a formula from which the longitude L is easily computed by means of the logarithmic tables.

To find the latitude l, we have

cos. ES = cos. EP cos. PS + sin. EP sin. PS cos. EPS,

which gives

sin. l = cos. ω sin. D − sin. ω cos. D sin. $\mathcal{A}$R.

Assume as before, tan. φ = cot. D sin. $\mathcal{A}$R, then, by substituting,

sin. l = sin. D (cos. ω − sin. ω tan. φ),

that is,

$$\text{sin. } l = \text{sin. D} \left(\frac{\text{cos. } \omega \text{ cos. } \varphi - \text{sin. } \omega \text{ sin. } \varphi}{\text{cos. } \varphi}\right),$$

whence

$$\text{sin. } l = \frac{\text{sin. D cos. } (\omega + \varphi)}{\text{cos. } \varphi} \quad \text{.....(2.)}$$

PROBLEM II.—*Given the longitude and latitude of a star or planet, together with the obliquity of the ecliptic, to determine its right ascension and declination.*

The spherical triangle EPS gives the relation

cot. ES sin. EP = cot. EPS sin. PES + cos. EP cos. PES,

that is,

tan. l sin. ω = − tan. $\mathcal{A}$R cos. L + cos. ω sin. L,

whence

$$\text{tan. } \mathcal{A}\text{R} = \frac{\text{cos. } \omega \text{ sin. L} - \text{tan. } l \text{ sin. } \omega}{\text{cos. L}}.$$

Assume tan. ψ = sin. L cot. l; then

$$\text{tan. } l = \frac{\text{sin. L}}{\text{tan. } \psi} = \frac{\text{sin. L cos. } \psi}{\text{sin. } \psi};$$

and by substituting this value of tan. l in the above equation, it becomes

$$\text{tan. } \mathcal{A}\text{R} = \text{tan. L} \left(\text{cos. } \omega - \text{sin. } \omega \frac{\text{cos. } \psi}{\text{sin. } \psi}\right),$$

that is,

$$\text{tan. } \mathcal{A}\text{R} = \text{tan. L} \frac{(\text{cos. } \omega \text{ sin. } \psi - \text{sin. } \omega \text{ cos. } \psi)}{\text{sin. } \psi}$$

whence

$$\text{tan. } \mathcal{A}\text{R} = \frac{\text{tan. L sin. } (\psi - \omega)}{\text{sin. } \psi} \quad \text{..... .....(1.)}$$

To find the declination, we have

cos. PS = cos. EP cos. ES + sin. EP sin. ES cos. PES;

that is,

sin. D. = cos. ω sin. l + sin. ω cos. l sin. L,
= (cos. ω + sin. ω cot. l sin. L) sin. l,

and by substituting $\frac{\text{tan. } \psi}{\text{sin. L}}$ for cot. l,

sin. D = (cos. ω + sin. ω tan. ψ) sin l,

$$= \frac{(\text{cos. } \omega \text{ cos. } \psi + \text{sin. } \omega \text{ sin. } \psi) \text{ sin. } l}{\text{cos. } \psi},$$

therefore

$$\text{sin. D} = \frac{\text{cos. } (\psi - \omega)}{\text{cos. } \psi} \text{ sin. } l \quad \text{.....(2.)}$$

Corollary.—In the case of the sun, the latitude l becomes zero, and the formulæ are considerably simplified. Thus, let T be the sun's place in the ecliptic; the relations subsisting between the longitude, right ascension, declination, and obliquity, are given by means of the right-angled spherical triangle ♈TR. The following are the formulæ:

$$\left.\begin{aligned} \text{sin. L} &= \frac{\text{sin. D}}{\text{sin. } \omega}, \\ \text{tan. L} &= \frac{\text{tan. } \mathcal{A}\text{R}}{\text{cos. } \omega}, \end{aligned}\right\} \quad \text{.....(1.)}$$

$$\left.\begin{aligned} \text{sin. } \mathcal{A}\text{R} &= \text{cot. } \omega \text{ tan. D}, \\ \text{tan. } \mathcal{A}\text{R} &= \text{cos. } \omega \text{ tan. L}, \end{aligned}\right\} \quad \text{.....(2.)}$$

$$\left.\begin{aligned} \text{sin. D} &= \text{sin. } \omega \text{ sin. L} \\ \text{tan. D} &= \text{tan. } \omega \text{ sin. } \mathcal{A}\text{R}, \end{aligned}\right\} \quad \text{.....(3.)}$$

PROBLEM III.—*Given the latitude of the observatory, the polar distance of a star, and its hour-angle at the pole, to find its zenith distance, azimuth, and angle of variation.*

Let P (fig. 121) be the pole of the equator, A the zenith of the place, and V the position of the star: we have then given the two sides, AP and PV, of an oblique angled spherical triangle, together with the included angle APV, to determine the third side and the remaining angles.

Make λ = AP the complement of the latitude,
Δ = PV the polar distance of the star, which is here supposed to be north,
P = APV the hour-angle at the pole,
Z = AV the zenith distance,
A = VAP the azimuth,
V = AVP the angle of variation.

1. To find Z we have

cos. Z = cos. λ cos. Δ + sin. λ sin. Δ cos. P.

Assume tan. φ = tan. Δ cos. P; then by substituting,

cos. Z = cos. Δ (cos. λ + sin. λ tan. φ);

whence, by reducing,

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$$\cos. Z = \cos. \Delta \frac{\cos.(\lambda - \varphi)}{\cos. \varphi} \quad \ldots\ldots\ldots (1.)$$

2. To find A, we have from spherical trigonometry the formula

$$\cot. A = \frac{\cot. \Delta \sin. \lambda}{\sin. P} - \cot. P \cos. \lambda.$$

Assume $\cot. \psi = \frac{\cot. \Delta}{\cos. P}$, whence $\cot. \Delta = \cot. \psi \cos. P$, and, by substituting,

$$\cot. A = \cot. P (\cot. \psi \sin. \lambda - \cos. \lambda)$$
$$= \cot. P \left(\frac{\cos. \psi \sin. \lambda - \sin. \psi \cos. \lambda}{\sin. \psi}\right),$$

whence

$$\cot. A = \frac{\cot. P \sin.(\lambda - \psi)}{\sin. \psi} \quad \ldots\ldots\ldots (2.)$$

3. To find V we have

$$\cot. V = \frac{\cot. \lambda \sin. \Delta}{\sin. P} - \cos. \Delta \cot. P.$$

Assume $\cot. \chi = \frac{\cot. \lambda}{\cos. P}$, or $\cot. \lambda = \cot. \chi \cos. P$, then, by substituting and reducing as above, we have

$$\cot. V = \frac{\cot. P \sin.(\Delta - \chi)}{\sin. \chi} \quad \ldots\ldots\ldots (3.)$$

PROBLEM IV.—*Given the declination and zenith distance of a star, and the latitude of the observatory, to determine the hour-angle.*

This is the case in the solution of spherical triangles, in which the three sides are given to find one of the angles. The formula, therefore, from which P is computed (see SPHERICAL TRIGONOMETRY) is

$$\tan.^2 \tfrac{1}{2} P = \frac{\sin. \frac{1}{2}(Z + \lambda - \Delta) \sin. \frac{1}{2}(Z - \lambda + \Delta)}{\sin. \frac{1}{2}(Z + \lambda + \Delta) \sin. \frac{1}{2}(\lambda + \Delta - Z)}$$

PROBLEM V.—*Given the latitude of a place, and the sun's declination, to find, 1st, the time of sunrise; 2d, the sun's amplitude at rising; 3d, the time when the sun is due east; 4th, the sun's altitude when in that position.*

In fig. 122 let AZP be the meridian, in which Z is the zenith, and P the pole; let ZO be the prime vertical, and AOB the horizon, A being the south, O the east, and B the north points; let SS′ be the part of the parallel described by the sun between his rising and passing the prime vertical, and PS PS′ hour circles.

Let L = the latitude of the place = PB,
D = the sun's declination = 90° — PS,
v = the time from midnight to sunrise = hour angle SPB,
x = the sun's amplitude at rising = OS,
y = the time from midnight to the sun's coming on the prime vertical = hour-angle S′PB,
z = the sun's altitude when in the prime vertical = OS′.

In the spherical triangle PBS, right angled at B,

$$\cos. SPB = \frac{\tan. PB}{\tan. PS}, \quad \cos. BS = \frac{\cos. PS}{\cos. PB};$$

and in the spherical triangle PZS′, right angled at Z,

$$\cos. ZPS = \frac{\tan. PZ}{\tan. PS'}, \quad \cos. ZS' = \frac{\cos. PS'}{\cos. PZ}.$$

Now PB = L, PZ = 90° — L, PS = PS′ = 90° — D, BS = 90° — x, ZS′ = 90° — z; hence we have these four formulæ:

$$\cos. v = \tan. L, \tan. D \quad \ldots\ldots\ldots (1.)$$
$$\sin. x = \frac{\sin. D}{\cos. L} \quad \ldots\ldots\ldots (2.)$$
$$\cos. y = \cot. L, \tan. D \quad \ldots\ldots\ldots (3.)$$
$$\sin. z = \frac{\sin. D}{\sin. L} \quad \ldots\ldots\ldots (4.)$$

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The hour-angles v and y must be converted into time by allowing 15° to one hour.

PROBLEM VI.—*To find how much the rising of the sun or a star is advanced by refraction.*

Let ZPB be the meridian (fig. 123), Z the zenith, P the pole, and OB the horizon. Let SS′, the parallel described by the sun, meet the horizon in S. Were it not for the effect of refraction, the sun or star would appear to rise at S, and at rising the hour-angle from midnight would be SPB; but it is elevated by refraction (which takes place in a vertical circle), and appears to rise at D, while in fact it is below the horizon at S′ somewhere in the vertical circle ZD produced downward, and the time of rising is accelerated by the small angle SPS′.

Let L denote the latitude of the place = 90 — PZ; D the declination of the star = 90 — PS; H the hour-angle BPS, reckoned from midnight; r the arc DS of the vertical ZS, the effect of refraction; and x the angle SPS, the acceleration of time of rising.

In the spherical triangle ZPS′,

$$\cos. ZS' = \cos. ZP \cos. PS' + \sin. ZP \sin. PS' \cos. ZPS',$$

Now, $\cos. ZS' = \cos.(90 + r) = -\sin. r$,
and $\cos. ZPS' = -\cos. BPS' = -\cos.(H - x)$;

therefore

$$-\sin. r = \sin. L \sin. D - \cos. L. \cos. D \cos.(H - x).$$

In like manner, in the triangle ZPS, in which $\cos. ZS = \cos. 90° = 0$,

$$0 = \sin. L \sin. D - \cos. L \cos. D \cos. H;$$

hence, by subtraction,

$$\sin. r = \cos. L \cos. D\,[\cos.(H - x) - \cos. H],$$

and $$\cos.(H - x) - \cos. H = \frac{\sin. r}{\cos. L \cos. D};$$

but $\cos.(H - x) - \cos. H = 2 \sin. \frac{1}{2} x \sin.\left(H - \frac{x}{2}\right)$ (ALGEBRA, § 240, D);

therefore, $2 \sin. \frac{1}{2} x \sin.\left(H - \frac{x}{2}\right) = \frac{\sin. r}{\cos. L \cos. D}$.

Now, x and r being small angles, we may consider $2 \sin. \frac{1}{2} x = x$, $\sin. r = r$, and $\sin.\left(H - \frac{x}{2}\right) = \sin. H$.

We have then $$x = \frac{r}{\sin. H \cos. L \cos. D};$$

and here H is determined by the formula

$$\cos. H = \tan. L \tan. D.$$

The value of x just found is only a near approximation; let it be denoted by x', and let $H' = H + x'$, and we shall have more nearly

$$x = \frac{r}{\sin. H' \cos. L \cos. D}$$

Since $\cos. H = \tan. L \tan. D = \frac{\sin. L \sin. D}{\cos. L \cos. D}$,

therefore, $$\sin.^2 H = \frac{\cos.^2 L \cos.^2 D - \sin.^2 L \sin.^2 D}{\cos.^2 L \cos.^2 D}.$$

Again, $\cos.^2 L \cos.^2 D - \sin.^2 L \sin.^2 D$
$= (\cos. L \cos. D - \sin. L \sin. D)(\cos. L \cos. D + \sin. L \sin. D)$
$= \cos.(L + D) \cos.(L - D)$.

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Therefore, $\sin.^2 H = \frac{\cos.(L+D)\cos.(L-D)}{\cos.^2 L \cos.^2 D}$,

and $x = \frac{r}{\sqrt{[\cos.(L+D)\cos.(L-D)]}}$.

The value of r is variable; but in general it is about 33 minutes of a degree, or 132 seconds of time. Therefore the acceleration by refraction is nearly, in time,

$$\frac{132^s}{\sqrt{[\cos.(L+D)\cos.(L-D)]}}.$$

PROBLEM VII.—*To find the length of the twilight.*

Let ZPB (fig. 123) be the meridian, Z the zenith, P the pole, and SDB the horizon. Let S'S be the arc of the parallel described by the sun between the beginning of the twilight, when he is at S', and its end at sunrise, when he reaches the horizon at S.

The twilight begins when DS', the sun's depression below the horizon, is about 18°.

Let a denote the arc, DS the depression, L the latitude of the place = 90° — ZP, D the sun's declination = 90° — PS, H the hour angle SPB (from midnight), x the angle SPS'.

Then, cos. ZS' = cos. ZP cos. PS' + sin. ZP sin. PS' cos. ZPS';

that is, because cos. ZS' = — sin. a, and cos. ZPS = — cos. SPB,

— sin. a = — sin. L sin. D — cos. L cos. D cos. (H — x);

hence we obtain

$$\cos.(H-x) = \tan. L \tan. D + \frac{\sin. a}{\cos. L \cos. D}.$$

Now, by Problem V. cos. H = tan. L tan. D.....(1)

Let φ be such an angle, that

$$\cos.\varphi = \frac{\sin. a}{\cos. L \cos. D};$$

Then cos. (H — x) = cos. H + cos. φ

= 2 cos. $\frac{1}{2}$ (H + φ) cos. $\frac{1}{2}$ (H — φ)..... ..(2)

Now H is determined by formula (1); therefore x, the angle described about the pole while the twilight lasts, is determined by formula (2).

PROBLEM VIII.—*Given the right ascensions and declinations of two celestial bodies, to compute their angular distance.*

Let S and M (fig. 124) be the two stars (for example the sun and moon), and let Z be the zenith, and P the pole of the equator. In the triangle SPM, the side SM represents the angular distance of the two stars; PS and PM are respectively their polar distances, or the complements of their declinations, and therefore given; and the angle SPM is also given, being the difference of ZPS and ZPM, the right ascensions of the given stars. Let PS = Δ, PM = Δ', the angle SPM = P, and SM, the distance sought, = d. We have then

cos. d = cos. Δ cos. Δ' + sin. Δ sin. Δ' cos. P.

Assume tan. φ = tan. Δ cos. P; then, by substituting and reducing, as in Problem II., we obtain

$$\cos. d = \frac{\cos.\Delta \cos.(\Delta' - \varphi)}{\cos.\varphi}.$$

PROBLEM IX.—*To determine the latitude of a place.*

1. Of the various methods which are employed for determining the latitude, that which depends on the observation of the double transits, or upper and lower culmination of a circumpolar star, is perhaps the best, being independent of the star's declination, and of the effects of aberration and nutation. The accuracy of the result depends, indeed, on the allowance made for refraction; but unless the observed star at the lower culmination passes within 15° or 20° of the horizon, the errors of the tables will be very inconsiderable. Practical Astronomy.

Let Z be the observed zenith distance, and R the refraction of the star at its lower culmination; Z' and R' the same quantities at its upper culmination, and λ the correct zenith distance of the pole, or the co-latitude; then

$$\lambda = \tfrac{1}{2}(Z + Z') + \tfrac{1}{2}(R + R').$$

The quantities R and R' must be taken from the tables, regard being had to the state of the barometer and thermometer.

2. Another method of determining the latitude, which, by reason of the facility of observation and computation, is extremely commodious, and therefore much employed, especially by voyagers, depends on observations of the meridional zenith distances of the sun or a star. Let P (fig. 125) be the pole, Z the zenith, C the intersection of the meridian and equator, and S the sun or star; then, l being the required latitude,

$$l = ZC = ZS \pm SC = Z \pm D,$$

according as the star is situated S or S', that is, above or below the equator.

If the star is to the north of the zenith, and above the pole, as at a, then

$$l = ZC = Ca - Za = D - Z,$$

and if below the pole, at a', then $Ca' = 180° - D$, and

$$l = ZC = Ca' - Za' = 180° - (Z + D).$$

PROBLEM X.—*To determine the difference of longitude between two points on the earth's surface.*

The different methods which have been proposed for the solution of this problem, one of the most difficult in practical astronomy, are the following: 1*st*, The eclipses of Jupiter's satellites; 2*d*, the eclipses of the moon; 3*d*, the eclipses of the sun; 4*th*, the occultations of fixed stars by the moon; and, 5*th*, the comparison of the moon's transits over the meridian with those of certain fixed stars selected for the purpose. Of these five methods, the two first give results affected by many causes of uncertainty; and the third can seldom be practised, because solar eclipses occur very rarely for any given point on the earth's surface. Of the remaining two, the last (which is recommended by Mr Baily) seems entitled to the preference, on account of its being independent of great accuracy in the rate of the clock or the position of the transit instrument.

The difference of the longitudes of the two stations is supposed to be *nearly* known from the chronometer, or by other means; and the object is to correct or determine the error of the first approximation.

Let A and B be the two stations, of which A is supposed to be the most *westerly*, and put

r = the difference (in sidereal time) of the transit of the moon's limb and the star previously agreed on at A;

r' = the same difference at B;

t = the *apparent* Greenwich time of the culmination of the moon at A;

t' = the *apparent* Greenwich time of the culmination of the moon at B;

d = ☽'s true declination, r = ☽'s true radius } computed for the time t;

d', r' = the same quantities computed for the time t';

s = the length of the true solar day in seconds;

m = ☽'s motion in ☌R in half that interval, expressed in seconds of space;

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χ = the assumed difference of longitude, in time;
$(\chi + e)$ = the correct difference of longitude.

The angle comprised between the two horary circles which pass respectively through the centre and limb of the moon, at the station A, is $\frac{r}{\cos. d}$, which being reduced to time, becomes $\frac{r}{15 \cos. d}$, and expresses the sidereal time in which the moon's semi-diameter passes the meridian. Hence $r \mp \frac{r}{15 \cos. d}$ is the observed difference of the $\mathcal{A}$R of the star and moon's centre at A, the upper sign being taken when the first or western limb of the moon is observed, and the under when it is the eastern limb, the star being supposed to precede the moon. In the same manner $\frac{r'}{15 \cos. d'}$ is the sidereal time in which the semi-diameter of the moon passes the meridian at B, and $r \mp \frac{r'}{15 \cos. d'}$ the observed difference of the $\mathcal{A}$R of the star and moon's centre. We have, therefore, by subtracting these two expressions,

$$(r - r') \mp \frac{r}{15 \cos. d} \mp \frac{r'}{15 \cos. d'}$$

for the observed difference of the $\mathcal{A}$R of the moon's centre, during the time elapsed between the two observations. Put this difference equal to Δ, then $\chi + \Delta$ is the difference between t and t' in sidereal time, which becomes $(\chi + \Delta) \frac{8640}{s}$ when expressed in mean solar time. Hence we have

$$t = t' + (\chi + \Delta) \frac{8640}{s};$$

consequently, when the apparent Greenwich time at one of the observatories is known, it is also known at the other observatory. Now, let a and a' be the moon's $\mathcal{A}$R in *space*, computed for the times t and t' respectively (taken from the ephemeris); then the formula for the correction of the assumed difference of longitudes will evidently be

$$e = \left\{15 \Delta - (a - a')\right\} \frac{s}{2m};$$

and this added to χ gives $\chi + e$, the corrected difference of longitudes.

PROBLEM XI.—*To find the meridional zenith distance of the sun (or a star), from observations made near the meridian.*

Let P (fig. 124) be the pole, Z the zenith, and S the sun. Make

l = 90° — PZ = the latitude of the place;
D = 90° — PS = the declination;
P = ZPS the hour angle;
Z = l — D = the true zenith distance;
Z' = ZS the observed zenith distance;
x = Z' — Z the correction.

The triangle PZS gives

cos. ZS = cos. ZP cos. PS + sin. ZP sin. PS cos. ZPS,
or cos. Z' = sin. l sin. D + cos. l cos. D cos. P;
but cos. (l — D) = cos. l cos. D + sin. l sin. D,
and cos. P = 1 — 2 sin.^{2} $\frac{1}{2}$ P,

therefore,

cos. Z' = cos. (l — D) — 2 cos. l cos. D sin.^{2} $\frac{1}{2}$ P,
or cos. Z' = cos. Z — 2 cos. l cos. D sin.^{2} $\frac{1}{2}$ P.

Now, by the trigonometrical formula (ALGEBRA, § 240),

cos. Z — cos. Z' = 2 sin. $\frac{1}{2}$ (Z' — Z) sin. $\frac{1}{2}$ (Z' + Z),

therefore,

2 sin. $\frac{1}{2}$ (Z' — Z) sin. $\frac{1}{2}$ (Z' + Z) = 2 l cos. D sin.^{2} $\frac{1}{2}$ P.

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But Z' — Z = x, and Z' + Z = 2 Z + x,

therefore,

2 sin. $\frac{1}{2}$ x sin. (Z + $\frac{1}{2}$ x) = 2 cos. l cos. D sin.^{2} $\frac{1}{2}$ P,

that is,

2 sin. $\frac{1}{2}$ x cos. $\frac{1}{2}$ x sin. Z + 2 sin.^{2} $\frac{1}{2}$ x cos Z
= 2 cos. l cos. D sin.^{2} $\frac{1}{2}$ P,
or 2 sin. $\frac{1}{2}$ x cos. $\frac{1}{2}$ x + 2 sin.^{2} $\frac{1}{2}$ x cot. Z
$= \frac{2 \cos. l \cos. D}{\sin. Z}$ sin.^{2} $\frac{1}{2}$ P.

In order to resolve this equation, make cot. Z = a. $\frac{\cos. l \cos. D}{\sin. Z}$ sin.^{2} $\frac{1}{2}$ P = b, and divide both sides by 2 cos.^{2} $\frac{1}{2}$ x; it then becomes

$$\tan. \tfrac{1}{2} x + a \tan.^2 \tfrac{1}{2} x = \frac{b}{\cos.^2 \frac{1}{2} x} = b (1 + \tan.^2 \tfrac{1}{2} x).$$

Whence

$$\tan.^2 \tfrac{1}{2} x + \frac{1}{a - b} \tan. \tfrac{1}{2} x = \frac{b}{a - b};$$

and, consequently,

$$\tan. \tfrac{1}{2} x = -\frac{1}{2(a - b)} \mp \frac{1}{2(a - b)} \sqrt{1 + 4 b(a - b)}.$$

Developing this expression, and rejecting all the powers of b higher than the cube, we have

$$\tan. \tfrac{1}{2} x = b - ab^2 + (1 + 2a^2) b^3 —, \&c.$$

Now the series which expresses the arc in terms of its tangent (see art. ALGEBRA, § 270), gives

$$\tfrac{1}{2} x = \tan. \tfrac{1}{2} x - \tfrac{1}{3} \tan.^3 \tfrac{1}{2} x + \tfrac{1}{5} \tan.^5 \tfrac{1}{2} x —, \&c.$$

Therefore, by substituting, and rejecting the terms containing higher powers of b than the cube,

$$\tfrac{1}{2} x = b - ab^2 + (\tfrac{2}{3} + 2a^2) b^3 —, \&c.$$

that is,

$$x = 2b - 2ab^2 + (\tfrac{4}{3} + 4a^2) b^3 —, \&c.$$

and therefore, on restoring the values of a and b, and dividing by sin. 1″,

$$x = 2\left(\frac{\cos. l \cos. D}{\sin. Z}\right) \cdot \frac{\sin.^2 \frac{1}{2} P}{\sin. 1''} - 2 \cot. Z \left(\frac{\cos. l \cos. D}{\sin. Z}\right)^2 \frac{\sin.^4 \frac{1}{2} P}{\sin. 1''} + 4(\tfrac{1}{3} + \cot.^2 Z) \left(\frac{\cos. l \cos. D}{\sin. Z}\right)^3 \frac{\sin.^6 \frac{1}{2} P}{\sin. 1''} —, \&c.$$

The last term of this series is scarcely sensible in any case; it is therefore only necessary to compute the first two.

If, instead of eliminating Z' by means of the equation Z' — Z = x, we had eliminated Z, the resulting expression would have been

$$x = -2\left(\frac{\cos. l \cos. D}{\sin. Z'}\right) \cdot \frac{\sin.^2 \frac{1}{2} P}{\sin. 1''} + 2 \cot. Z' \left(\frac{\cos. l \cos. D}{\sin. Z'}\right)^2 \frac{\sin.^4 \frac{1}{2} P}{\sin. 1''} —, \&c.$$

PROBLEM XII.—*Given the times of two observed equal altitudes of the sun, to find the true time of his meridional passage.*

Let P (fig. 126) be the pole, Z the zenith, ZPM the meridian, and A and C the places of the sun, before and after his meridional passage, when his zenith distances ZA and ZC are observed to be equal. In consequence of the variation of the sun's declination while he passes from A to C, the hour angles APM and MPC are unequal. Make BPM = APM = P, and let BPC be denoted by φ. Now, APC = 2P + φ; half of which is P + $\frac{1}{2}\varphi$; therefore the true time of the meridional passage will be found by subtracting $\frac{1}{2}\varphi$ from the mean of the times of observed equal altitudes.

To find the value of φ, we have the equation

cos. ZA = cos. ZP cos. PA + sin. ZP sin. PA cos. APM,

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that is (employing the denominations of last problem),

$$\cos. Z = \sin. l \sin. D + \cos. l \cos. D \cos. P \ldots\ldots (1)$$

Now, let $\Delta = B\delta$ be the small change of declination corresponding to the variation of the hour-angle from P to $P + \varphi$, and let $D + \Delta$ be substituted for D, and $P + \varphi$ for P in this equation. It then becomes

$$\cos. Z = \sin. l \sin. (D + \Delta) + \cos. l \cos. (D + \Delta) \cos. (P + \varphi).$$

But as Δ and φ are very small arcs, their cosines may be made equal to the radius, and their sines equal to the arcs themselves; therefore, on expanding the above equation, it becomes

$$\cos. Z = \sin. l \sin. D + \cos. l \cos. D \cos. P + (\sin. l \cos. D - \cos. l \sin. D \cos. P)\,\Delta - \cos. l \cos. D \sin. P. \varphi. + \cos. l \sin. D \sin. P. \Delta. \varphi;$$

whence, in consequence of equation (1), and rejecting the term multiplied by $\Delta . \varphi$,

$$(\sin. l \cos. D - \cos. l \sin. D \cos. P)\,\Delta = \cos. l \cos. D. \sin. P. \varphi;$$

therefore,

$$\varphi = \Delta\left(\frac{\tan. l}{\sin. P} - \tan. D \cot. P\right).$$

Let t be the sidereal time of the first observation, t' that of the second, and $t' - t = 2\theta$. Also let the diurnal variation of D be denoted by v, expressed like the arcs φ and Δ in seconds; we have then $24^h : 2\theta :: v : \Delta$, whence $\Delta = \frac{1}{12}\theta v$, and consequently

$$\varphi = \tfrac{1}{12}\theta v\left(\frac{\tan. l}{\sin. P} - \tan. D \cot. P\right).$$

Now, to convert φ into seconds of time, it is only necessary to divide the number to which it is equal by 15; therefore, expressed in *time*, φ becomes

$$\varphi = \tfrac{1}{180}\theta v\left(\frac{\tan. l}{\sin. P} - \tan. D \cot. P\right).$$

For the angle P we may substitute θ (half the time elapsed between the two observations) converted into degrees, and suppose D to be the value of the declination at the instant of the meridional passage; the value of φ being so small as not to be affected by these substitutions. Therefore, ultimately,

$$\tfrac{1}{2}\varphi = \tfrac{1}{360}\theta v\left(\frac{\tan. l}{\sin. \theta} - \tan. D \cot. \theta\right),$$

which, subtracted from θ, gives the true time of the meridional passage.

PROBLEM XIII.—*To compute the angle of the vertical, or the difference between the* apparent *and* geocentric *latitude arising from the spheroidal figure of the earth* (fig. 127).

Let AMP be a quadrant of the elliptic meridian, C being the centre, and P the pole. The straight line VME, perpendicular to the ecliptic in M, determines the apparent zenith V of the place M, while ZMC drawn through C determines the true zenith Z. Hence the angle ADM is the apparent latitude of M, and ACM its geocentric latitude; and the angle ZMV between the true and apparent zenith is the angle of the vertical.

Let x and y be the rectangular co-ordinates of the point M, the origin being at C, and make $AC = m$, $CP = n$, $ADM = l$, and $ZMV = v$.

The equation of the ellipse gives

$$y^2 = n^2 - \frac{n^2}{m^2} x^2,$$

whence

$$y dy = -\frac{n^2}{m^2} x dx;$$

therefore,

$$\frac{y}{x} = -\frac{n^2}{m^2} \cdot \frac{dx}{dy}.$$

But $\frac{y}{x} = \tan. ACM$, and $-\frac{dx}{dy} = \tan. ADM = \tan. l$; Practical Astronomy

therefore $\tan. ACM = \frac{n^2}{m^2} \tan. l$. Now $ZMV = DMC = ADM - ACM$, therefore $\tan. ZMV = \tan. (ADM - ACM) = \frac{\tan. ADM - \tan. ACM}{1 + \tan. ADM \tan. ACM}$; that is,

$$\tan. v = \frac{\left(1 - \frac{n^2}{m^2}\right)\tan. l}{1 + \frac{n^2}{m^2} \tan.^2 l} = \frac{(m^2 - n^2) \tan. l}{m^2 + n^2 \tan.^2 l}$$

$$= \frac{(m^2 - n^2) \sin. l \cos. l}{m^2 \cos.^2 l + n^2 \sin.^2 l} = \frac{(m^2 - n^2) \sin. l \cos. l}{m^2 - (m^2 - n^2) \sin.^2 l}$$

Now, let $m - n = 1$, or $n = m - 1$; then, by substituting,

$$\tan. v = \frac{(2m - 1) \sin. l \cos. l}{m^2 - (2m - 1) \sin.^2 l}$$

or, neglecting the terms multiplied by $\frac{1}{m^2}$, and recollecting that $\sin. l \cos. l = \frac{1}{2} \sin. 2l$,

$$\tan. v = \frac{\sin. 2l}{2m}\left(2 - \frac{1}{m}\right)\frac{1}{1 - \frac{2}{m} \sin.^2 l},$$

whence

$$\tan. v = \frac{\sin. 2l}{2m}\left(2 - \frac{1}{m}\right)\left(1 + \frac{2}{m} \sin.^2 l\right);$$

that is,

$$\tan. v = \frac{\sin. 2l}{m}\left(1 - \frac{1}{2m} + \frac{2}{m} \sin.^2 l\right)$$

$$= \frac{\sin. 2l}{m}\left(1 - \frac{1}{2m} + \frac{1}{m} - \frac{1}{m} \cos.^2 l + \frac{1}{m} \sin.^2 l\right).$$

but $\cos.^2 l - \sin.^2 l = \cos. 2l$; therefore,

$$\tan. v = \frac{\sin. 2l}{m}\left(1 + \frac{1 - 2 \cos. 2l}{2m}\right);$$

and $2 \sin. 2l \cos. 2l = 4 \sin. 4l$, therefore,

$$\tan. v = \frac{\sin. 2l}{m} + \frac{\sin. 2l - \sin. 4l}{2m^2}.$$

The last term of this expression cannot in any case amount to 2″, so that the angle of the vertical is very nearly proportional to the sine of twice the latitude.

PROBLEM XIV.—*To compute the parallax of the moon, or a planet, in altitude.*

Let P = the horizontal parallax,
p = the parallax of altitude,
Z = the apparent zenith distance.

It was shown in Chap. I. Sect. 2 of THEORETICAL ASTRONOMY that $\sin. p = \sin. P \sin. Z$; now let Z' = the true zenith distance, then $Z = Z' + p$, and consequently

$$\sin. p = \sin. P \sin. (Z' + p)$$
$$= \sin. P (\sin. Z' \cos. p + \cos. Z' \sin. p),$$

therefore

$$\tan. p = \sin. P (\sin. Z' + \cos. Z' \tan. p)$$
$$\tan. p (1 - \sin. P \cos. Z') = \sin. P \sin. Z',$$

whence

$$\tan. p = \frac{\sin. P \sin. Z'}{1 - \sin. P \cos. Z'}.$$

But by a well-known series,

$$p = \tan. p - \tfrac{1}{3} \tan.^3 p + \tfrac{1}{5} \tan.^5 p -, \text{ \&c.}$$

Substituting therefore the above expression for tan. p, and reducing the powers to series, we find

$$p = \frac{\sin. P \sin. Z'}{\sin. 1''} + \frac{\sin.^2 P \sin. 2Z'}{\sin. 2''} + \frac{\sin.^3 P \sin. 3Z'}{\sin. 3''}, \text{ \&c.}$$

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The first two terms of this series are in every case sufficient for the computation of p.

PROBLEM XV.—*To compute the parallax in right ascension.*

In fig. 128 let P be the pole, Z the zenith, A the true place of the moon or a planet, depressed on the vertical circle through the effects of parallax to B. Having joined PA and PB by arcs of great circles, the corresponding variation in right ascension will be represented by the angle APB. Make

P = the horizontal parallax;
p = AB, the parallax of altitude;
Π = APB, the parallax in right ascension;
l = 90° — ZP, latitude of place;
Δ = PA, the polar distance;
N = ZA, the true zenith distance;
N + p = ZB, the apparent zenith distance;
H = ZPA the hour angle.

In the parallactic triangle APB we have

sin. PA : sin. AB : : sin. ABP : sin. APB;

that is,

sin. Δ : sin. p : : sin. ABP : sin. Π,

but sin. p = sin. P sin. (N + p). See THEORETICAL ASTRONOMY, Chap. I. Sect. 2.

Therefore,

$$\sin.\,\Pi = \frac{\sin.\,P\,\sin.\,(N+p)\,\sin.\,ABP}{\sin.\,\Delta}$$

Now, in the triangle ZBP, we have

sin. ZB : sin. ZP : : sin. ZPB : sin. ZBP (ABP);

that is,

sin. (N + p) : cos. l : : sin. (H + Π) : sin. ABP.

Therefore,

$$\sin.\,ABP = \frac{\cos.\,l\,\sin.\,(H+\Pi)}{\sin.\,(N+p)},$$

whence

$$\sin.\,\Pi = \frac{\sin.\,P\,\cos.\,l}{\sin.\,\Delta}\,\sin.\,(H+\Pi).$$

Make $\frac{\sin.\,P\,\cos.\,l}{\sin.\,\Delta} = A$; then

sin. Π = A sin. (H + Π) = A (sin. H cos. Π + cos. H sin. Π);

whence

tan. Π = A (sin. H + cos. H. tan. Π),

and

tan. Π (1 — A cos. H) = A sin. H;

that is,

$$\tan.\,\Pi = \frac{A\,\sin.\,H}{1 - A\,\cos.\,H},$$

whence we have the following series,

$$\Pi = A\,\frac{\sin.\,H}{\sin.\,1''} + A^2\,\frac{\sin.\,2H}{\sin.\,2''} +, \&c.$$

PROBLEM XVI.—*To compute the parallax in declination.*

Make π = PB — PA (fig. 129) = the parallax in declination.

From the triangle ZPA we get

$$\cos.\,PZA = \frac{\cos.\,AP - \cos.\,PZ\,\cos.\,AZ}{\sin.\,PZ\,\sin.\,AZ},$$

and from ZPB

$$\cos.\,PZB = \frac{\cos.\,BP - \cos.\,PZ\,\cos.\,BZ}{\sin.\,PZ\,\sin.\,BZ};$$

therefore

$$\frac{\cos.\,AP - \cos.\,PZ\,\cos.\,AZ}{\sin.\,AZ} = \frac{\cos.\,BP - \cos.\,PZ\,\cos.\,BZ}{\sin.\,BZ},$$

that is (retaining the notation of last problem),

$$\frac{\cos.\,\Delta - \sin.\,l\,\cos.\,N}{\sin.\,N} = \frac{\cos.\,(\Delta+\pi) - \sin.\,l\,\cos.\,(N+p)}{\sin.\,(N+p)};$$

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whence

$$\cos.\,(\Delta+\pi) = \frac{\cos.\,\Delta\,\sin.\,(N+p)}{\sin.\,N} - \frac{\sin.\,l\,[\cos.\,N\,\sin.\,(N+p) - \sin.\,N\,\cos.\,(N+p)]}{\sin.\,N}$$

$$= \frac{\cos.\,\Delta\,\sin.\,(N+p)}{\sin.\,N} - \frac{\sin.\,l\,\sin.\,p}{\sin.\,N},$$

$$= \frac{\cos.\,\Delta\,\sin.\,(N+p)}{\sin.\,N} - \frac{\sin.\,l\,\sin.\,P\,\sin.\,(N+p)}{\sin.\,N};$$

therefore

$$\cos.\,(\Delta+\pi) = \frac{\sin.\,(N+p)}{\sin.\,N}\,[\cos.\,\Delta - \sin.\,l\,\sin.\,P] \ldots (1)$$

Now, from the property of spherical triangles,

Sin. ZA : sin. PA : : sin. ZPA : sin. AZP,

therefore

$$\sin.\,AZP = \frac{\sin.\,PA\,\sin.\,ZPA}{\sin.\,ZA}.$$

For the same reason

$$\sin.\,BZP = \frac{\sin.\,PB\,\sin.\,ZPB}{\sin.\,ZB};$$

therefore

$$\frac{\sin.\,PA\,\sin.\,ZPA}{\sin.\,ZA} = \frac{\sin.\,PB\,\sin.\,ZPB}{\sin.\,ZB},$$

that is,

$$\frac{\sin.\,\Delta\,\sin.\,H}{\sin.\,N} = \frac{\sin.\,(\Delta+\pi)\,\sin.\,(H+\Pi)}{\sin.\,(N+p)},$$

whence

$$\frac{\sin.\,(N+p)}{\sin.\,N} = \frac{\sin.\,(\Delta+\pi)}{\sin.\,\Delta}\cdot\frac{\sin.\,(H+\Pi)}{\sin.\,H}.$$

By substituting this in equation (1) there results

$$\cos.\,(\Delta+\pi) = \frac{\sin.\,(\Delta+\pi)}{\sin.\,\Delta}\cdot\frac{\sin.\,(H+\Pi)}{\sin.\,H}\,[\cos.\,\Delta - \sin.\,l\,\sin.\,P],$$

whence

$$\cot.\,(\Delta+\pi) = \frac{\sin.\,(H+\Pi)}{\sin.\,H}\left\{\cot.\,\Delta - \frac{\sin.\,l\,\sin.\,P}{\sin.\,\Delta}\right\}.$$

Make $\frac{\sin.\,l\,\sin.\,P}{\sin.\,\Delta} = \cot.\,\alpha$, then

$$\cot.\,(\Delta+\pi) = \frac{\sin.\,(H+\Pi)}{\sin.\,H}\,(\cot.\,\Delta - \cot.\,\alpha),$$

that is,

$$\cot.\,(\Delta+\pi) = \frac{\sin.\,(H+\Pi)\,\sin.\,(\alpha-\Delta)}{\sin.\,H\,\sin.\,\alpha\,\sin.\,\Delta},$$

from which, as Δ is known, cot. (Δ + π) may be computed, and thence π. A more convenient formula, however, may be obtained by proceeding as follows. (See Delambre, *Abrégé d'Astronomie*, p. 154).

From the equation

$$\cot.\,(\Delta+\pi) = \frac{\sin.\,(H+\Pi)}{\sin.\,H}\left(\cot.\,\Delta - \frac{\sin.\,l\,\sin.\,P}{\sin.\,\Delta}\right)$$

we have

$$\cot.\,\Delta = \frac{\sin.\,H\,\cot.\,(\Delta+\pi)}{\sin.\,(H+\Pi)} + \frac{\sin.\,l\,\sin.\,P}{\sin.\,\Delta};$$

whence

$$\cot.\,\Delta - \cot.\,(\Delta+\pi) = \frac{\sin.\,H\,\cot.\,(\Delta+\pi)}{\sin.\,(H+\Pi)} - \cot.\,(\Delta+\pi) + \frac{\sin.\,l\,\sin.\,P}{\sin.\,\Delta};$$

but cot. Δ — cot. (Δ + π) =

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$$\frac{\sin.(\Delta+\pi)\cos.\Delta-\cos.(\Delta+\pi)\sin.\Delta}{\sin.(\Delta+\pi)\sin.\Delta}=\frac{\sin.\pi}{\sin.(\Delta+\pi)\sin.\Delta};$$

therefore

$$\frac{\sin.\pi}{\sin.(\Delta+\pi)\sin.\Delta}=\frac{\sin.l\sin.P}{\sin.\Delta.}$$
$$-\frac{\cot.(\Delta+\pi)[\sin.(H+\Pi)-\sin.H]}{\sin.(H+\Pi)}.$$

Now, by the trigonometrical formulæ, the difference of the sines of two arcs is equal to twice the sine of half their difference multiplied by the cosine of half their sum, therefore

$$\sin.(H+\Pi)-\sin.H=2\sin.\tfrac{1}{2}\Pi\cos.(H+\tfrac{1}{2}\Pi),$$

whence

$$\frac{\sin.\pi}{\sin.(\Delta+\pi)\sin.\Delta}=\frac{\sin.l\sin.P}{\sin.\Delta}$$
$$-\frac{2\sin.\tfrac{1}{2}\Pi\cos.(H+\tfrac{1}{2}\Pi)\cot.(\Delta+\pi)}{\sin.(H+\Pi)};$$

and $\sin.\pi=\sin.l\sin.P\sin.(\Delta+\pi)$

$$-\frac{2\sin.\tfrac{1}{2}\Pi\sin.\Delta\cos.(H+\tfrac{1}{2}\Pi)\cos.(\Delta+\pi)}{\sin.(H+\Pi)},$$

or, since $2\sin.\tfrac{1}{2}\Pi=\frac{\sin.\Pi}{\cos.\frac{1}{2}\Pi}$,

$$\sin.\pi=\sin.l\sin.P\sin.(\Delta+\pi)$$
$$-\frac{\sin.\Pi\sin.\Delta\cos.(H+\frac{1}{2}\Pi)\cos.(\Delta+\pi)}{\cos.\frac{1}{2}\Pi\sin.(H+\Pi)}.$$

But it was shown in the last problem that

$$\sin.\Pi=\frac{\sin.P\cos.l}{\sin\Delta.}\sin.(H+\Pi),$$

whence

$$\frac{\sin.\Pi\sin.\Delta}{\sin.(H+\Pi)}=\sin.P.\cos.l;$$

consequently,

$$\sin.\pi=\sin.l\sin.P\sin.(\Delta+\pi)$$
$$-\frac{\sin.P\cos.l\cos.(H+\frac{1}{2}\Pi)\cos.(\Delta+\pi)}{\cos.\frac{1}{2}\Pi}.$$

Make $\tan.x=\frac{\cos.(H+\frac{1}{2}\Pi)\cot.l}{\cos.\frac{1}{2}\Pi}$; then, by substituting,

$$\sin.\pi=\sin.l\sin.P\,[\sin.(\Delta+\pi)-\tan.x\cos.(\Delta+\pi)],$$

or $\sin.\pi=$

$$\frac{\sin.l\sin.P}{\cos.x}[\sin.(\Delta+\pi)\cos.x-\cos.(\Delta+\pi)\sin.x],$$

$$\sin.\pi=\frac{\sin.l\sin.P}{\cos.x}\sin.(\Delta+\pi-x),$$

$\sin.\pi=$

$$\frac{\sin.l\sin.P}{\cos.x}[\sin.(\Delta-x)\cos.\pi+\cos.(\Delta-x)\sin.\pi];$$

whence,

$\tan.\pi=$

$$\frac{\sin.l\sin.P}{\cos.x}[\sin.(\Delta-x)+\cos.(\Delta-x)\tan.\pi];$$

therefore (making $\frac{\sin.l\sin.P}{\cos.x}=B$),

$$\tan.\pi=\frac{B\sin.(\Delta-x)}{1-B\cos.(\Delta-x)},\text{ consequently}$$

$$\pi=B\frac{\sin.(\Delta-x)}{\sin.1''}+B^2\frac{\sin.2(\Delta-x)}{\sin.2''}$$
$$+B^3\frac{\sin.3(\Delta-x)}{\sin.3''}+,\&c.$$

PROBLEM XVII.—*To compute the altitude and longitude of the nonagesimal.*

The nonagesimal is the point of the ecliptic where that circle intersects the vertical plane passing through its pole. It is consequently the highest point of the ecliptic above the horizon, or 90° from the horizon measured on the ecliptic. Practical Astronomy.

Let HH′ (fig. 129) be the horizon, EO the ecliptic, EQ the equator, Z the zenith, P the pole of the equator, and P′ the pole of the ecliptic. The great circle passing through P′ and P intersects EO and EQ at right angles in C and D, whence EC = ED = 90° = MQ, and therefore EM = DQ. In like manner PD = 90° = P′C, consequently P′P = CD the obliquity of the ecliptic.

The great circle PZNI which passes through the pole of the ecliptic and the zenith is a circle of latitude and also a vertical circle; hence the angles at N and I are right angles, and O is the pole of PZNI; consequently OI = ON = 90°. Now since ON = 90°, the point N is the nonagesimal, and its altitude IN = 90° − ZN = ZP′ = the complement of the altitude of the pole of the ecliptic, or the co-latitude of the zenith. In like manner its longitude EN = 90° − NC = 90° − ZP′P. Now in order to compute ZP′ and the angle ZP′P, we have given, in the triangle ZPP′, the side ZP = the co-latitude, PP′ = the obliquity, and also the angle ZPP′, for ZPP′ = 180° − ZPD = 180° − MD = 180° − (ED − EM) = 180° − 90° + EM = 90° + EM, and EM (which is the right ascension of the zenith, or as it is technically called, the right ascension of the mid-heaven) is given, being equal to the sidereal time of observation converted into degrees.

Let R = EM the right ascension of the zenith, λ = PZ the co-latitude of the place (reduced by problem XIII.), ω = PP′ the obliquity of the ecliptic, K = P′Z the co-latitude of the zenith or altitude of the nonagesimal, N = 90° − ZP′P the longitude of the nonagesimal.

By the trigonometrical formulæ,

$$\cos.K=\cos.\lambda\cos.\omega+\sin.\lambda\sin.\omega\cos.(90°+R)$$
$$=\cos.\lambda\cos.\omega+\sin.\lambda\sin.\omega\sin.R.$$

Assume $\tan.\varphi=\tan.\lambda\sin.R$, then, by substituting and reducing, we obtain

$$\cos.K=\frac{\cos.\lambda}{\cos.\varphi}\cos.(\omega+\varphi).$$

To find the longitude L, we have

$$\tan.N=\frac{\cot.\lambda\sin.\omega}{\sin.(90°+R)}-\cot.(90+R)\cos.\omega$$
$$=\frac{\cot.\lambda\sin.\omega}{\cos.R}+\tan.R\cos.\omega,$$

But $\tan.\lambda=\frac{\tan.\varphi}{\sin.R}$, whence $\cot.\lambda=\frac{\sin.R}{\tan.\varphi}$,

whence, by substituting,

$$\tan.N.=\tan.R\left(\frac{\sin.\omega}{\tan.\varphi}+\cos.\omega\right),$$

and on reducing,

$$\tan.N=\frac{\tan.R}{\sin.\varphi}\sin.(\omega+\varphi),$$

PROBLEM XVIII.—*To compute the parallax in longitude and latitude.*

Let A (fig. 129) be the place of the star situated on the vertical ZAR; E*a* is its longitude, and P′A the complement of its latitude, or its distance from the pole of the ecliptic. Suppose that, through the effects of parallax, it is depressed from A to B; its longitude then becomes E*b*, and its distance from the pole of the ecliptic P′B, so that *ab* is the variation in longitude, and P′B − PA the variation in latitude, which it is required to compute. Now it is evident that these quantities will be given in terms of the different parts of the triangle AP′B, exactly in the same manner as the parallax in right ascension and declination has been found from the triangle APB

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(fig. 128). The angle ZPA, which was before denoted by H, now becomes ZP'A = Na = Ea — EN = longitude of the star — longitude of the nonagesimal, and ZPB becomes ZP'B = Nb = Na + ab. Retaining, therefore, the notation employed in the three last problems, and making L = Ea the longitude of the star, Δ' = PA its distance from the pole of the ecliptic, k = ZP' = 90° — K, Π' = ab its parallax in longitude, π' = P'B — P'A its parallax in latitude, we shall have Π' and π' from the same formulæ as Π and π in Problems XV. and XVI., by changing l into k, H into L — N, and Δ into Δ'. Hence (Problem XV.)

$$\text{sin. } \Pi' = \frac{\text{sin. P cos. } k}{\text{sin. } \Delta}, \text{ sin. (L — N + } \Pi'),$$

and by putting $C = \frac{\text{sin. P cos. } k}{\text{sin. } \Delta'}$, we deduce

$$\text{tan. } \Pi' = \frac{C \text{ sin. (L — N)}}{1 - C \text{ cos. (L — N)}} \text{ and}$$

$$\Pi' = \text{sin. } C \frac{\text{sin. (L — N)}}{\text{sin. } 1''} + C^2 \frac{\text{sin. } 2\text{ (L — N)}}{\text{sin. } 2''} +, \text{ \&c.}$$

In like manner the formula for the parallax in declination given in Problem XVI., viz.

$$\text{cot. } (\Delta + \pi) = \frac{\text{sin. (H + } \Pi)}{\text{sin. H}} \left[\text{cot. } \Delta - \frac{\text{sin. } l \text{ sin. P}}{\text{sin. } \Delta} \right]$$

becomes

$$\text{cot. } (\Delta' + \pi') = \frac{\text{sin. (L — N + } \Pi')}{\text{sin. (L — N)}} \left[\text{cot. } \Delta' - \frac{\text{sin. } k \text{ sin. P}}{\text{sin. } \Delta'} \right];$$

from which, by proceeding in the same manner as in Problem XVI., and making

$$\text{tan. } x' = \frac{\text{cos. (L — N + } \frac{1}{2} \Pi') \text{ cot. } k}{\text{cos. } \frac{1}{2} \Pi'}$$

we deduce tan. π'

$$= \frac{\text{sin. } k \text{ sin. P}}{\text{cos. } x'} \left[\text{sin. } (\Delta' - x') + \text{cos. } (\Delta' - x') \text{ tan. } \pi' \right]$$

whence, on making $\frac{\text{sin. } k \text{ sin. P}}{\text{cos. } x'} = D$,

$$\text{tan. } \pi' = \frac{D \text{ sin. } (\Delta - x')}{1 - D \text{ cos. } (\Delta' - x')},$$

consequently

$$\pi' = D \frac{\text{sin. } (\Delta' - x')}{\text{sin. } 1''} + D^2 \frac{\text{sin. } 2\ (\Delta' - x')}{\text{sin. } 2''} +, \text{ \&c.}$$

PROBLEM XIX.—*Given the apparent altitudes of the moon and the sun, or a star, and the apparent distance between them, to find the true distance.*

This is a problem of great importance in Practical Astronomy, because the observed distance between the moon and the sun or a star is the surest means the navigator has to determine his longitude.

To obtain the apparent distance and altitudes, it is convenient to have three observers: one, the most expert, takes the apparent distance of the limb of the moon from that of the sun, or from the star; another observes the moon's altitude at the moment of the observation of the distance; and a third takes the star's altitude. For greater accuracy, these simultaneous operations ought to be repeated several times, and a fourth assistant may, by a good watch, note the intervals of time between them. A mean of the whole will then be obtained, and the corresponding time by the watch, by which the true time at that place will be nearly known. If there be only one observer, he must take the altitudes immediately before and after the distance, and endeavour to allow for the change of altitude during the time between the observations.

The observed distance between the limbs of the moon and sun must be increased by their semidiameters to obtain the distance of their centres. If the distance from a star is taken, because its diameter is insensible, the distance is to be increased by the moon's semidiameter only. Practical Astronomy

The observed altitudes thus found are affected by parallax and refraction. The moon's horizontal parallax is given in the *Nautical Almanac*: from this the parallax at the time of observation may be found by Prob. XIV., but the navigator avails himself of aid from *The Requisite Tables*, which shorten the process of calculation. The sun's parallax is almost insensible, but it may be taken into account; that of a star is accounted nothing. The altitudes are diminished by the parallaxes, but they are increased by refraction. The sun's altitude is more increased by the latter than diminished by the former; but the reverse happens with the moon. At sea the altitudes must be also corrected for the *dip of the horizon* (that is, for the height of the observer above the surface of the sea), and the refraction for the height of the thermometer.

Supposing all this done, let S and M be the true places of the sun or star and moon (fig. 130), Z the zenith; because parallax and refraction take place only in vertical circles, the apparent place of the sun, s, will be in the vertical ZS above S, and that of the moon, m, in ZM below M. The apparent distance will be sm.

Let A = 90° — ZM be the moon's true altitude; a = 90° — ZS the star's true altitude; H = 90° — Zm the moon's apparent altitude; h = 90° — Zs the star's apparent altitude; D = SM the true, and d = sm the apparent distance.

By spherical trigonometry, in the triangles SZM, sZm,

$$\text{os. SZM} \begin{cases} = \dfrac{\text{cos. D — sin. A sin. } a}{\text{cos. A cos. } a}, \\ = \dfrac{\text{cos. } d \text{ — sin. H sin. } h}{\text{cos. H cos. } h}. \end{cases}$$

From these equal values of cos. SZM we find

$$\text{cos D} = (\text{cos. } d - \text{sin. H sin. } h) \frac{\text{cos. A cos. } a}{\text{cos. H cos. } h} + \text{sin. A sin. } a$$

$$= [\text{cos. } d + \text{cos. (H + } h) - \text{cos. H cos. } h] \frac{\text{cos. A cos. } a}{\text{cos. H cos. } h} + \text{sin. A sin. } a$$

$$= 2 \text{ cos. } \tfrac{1}{2} \text{ (H + } h + d) \text{ cos. } \tfrac{1}{2} \text{ (H + } h - d) \frac{\text{cos. A cos. } a}{\text{cos. H cos. } h} - (\text{cos. A cos. } a - \text{sin. A sin. } a).$$

But the last term = cos. (A + a); subtract now both sides from 1; then, observing that by the calculus of sines (see ALGEBRA)

$$1 - \text{cos. D} = 2 \text{ sin.}^2 \tfrac{1}{2} \text{ D},$$
$$1 + \text{cos. (A + } a) = 2 \text{ cos.}^2 \tfrac{1}{2} \text{ (A + } a),$$

we have, after dividing by 2, and putting

$$F = \frac{\text{cos. A cos. } a}{\text{cos. H cos. } h},$$

$$\text{sin.}^2 \tfrac{1}{2} \text{ D} = \text{cos.}^2 \tfrac{1}{2} \text{ (A + } a) - \text{cos. } \tfrac{1}{2} \text{ (H + } h + d) \text{ cos. } \tfrac{1}{2} \text{ (H + } h - d) \times F$$

$$= \text{cos.}^2 \tfrac{1}{2} \text{(A + } a) \left[1 - \frac{\text{cos. } \frac{1}{2} \text{(H + } h + d) \text{cos. } \frac{1}{2} \text{(H + } h - d)}{\text{cos.}^2 \frac{1}{2} \text{ (A + } a)} \times F \right].$$

Let θ be such an angle that

$$\text{sin.}^2 \theta = \frac{\text{cos. } \frac{1}{2} \text{ (H + } h + d) \text{ cos. } \frac{1}{2} \text{ (H + } h - d) \text{ cos. A cos. } a}{\text{cos.}^2 \frac{1}{2} \text{ (A + } a) \text{ cos. H cos. } h};$$

and in this expression the value of F is put instead of it, then we have

$$\text{sin.}^2 \tfrac{1}{2} \text{ D} = \text{cos.}^2 \tfrac{1}{2} \text{ (A + } a) \text{ cos.}^2 \theta;$$
$$\text{and sin. } \tfrac{1}{2} \text{ D} = \text{cos. } \tfrac{1}{2} \text{ (A + } a) \text{ cos. } \theta.$$

The value of cos. D in the first formula may serve to determine D, but not conveniently; by the various steps of the analytic process it is transformed into another, viz.

the last, which gives sin. $\frac{1}{2}$ D, and consequently D readily by logarithmic calculation.

The final result is the rule found by Borda: as a practical rule it is very convenient, because no attention is necessary to the signs of the trigonometrical quantities. On this account it is well adapted to seamen.

PROBLEM XX.—*To find the longitude of a ship at sea by an observation of the distance of the moon from the sun or a star.*

From the observed distance, the true distance as it would appear if it could be seen from the earth's centre, may be found by the last problem: Now by the *Nautical Almanac* this is given for every third hour, Greenwich time, therefore, by an easy calculation, the time at which the observation was made, as it would be given by a watch showing Greenwich time, may be obtained. But the time of observation as reckoned at the ship may be found from the ship's latitude, the moon's or star's zenith distances (found by the observation), and their polar distances as given by the Almanac. Therefore the difference between the time of the observation as estimated at the ship and the corresponding Greenwich time becomes known: This difference is the *ship's longitude.*

Example. At sea, June 5, 1793, about an hour and a half after noon, in 10° 46′ 50″ south latitude, and 149° longitude, by account, by means of a set of lunar observations made at a height of about 20 feet above the surface of the sea, it was found that

Distance of nearest limbs of ☉ and ☽ ...83° 26′ 46″
Altitude of lowest limb of ☉.....48 16 10
Altitude of upper limb of ☽.....27 53 30.

Hence the longitude of the ship is required.

Reduction of the apparent to the true altitude.

Dist. of nearest limbs of ☉ and ☽	83°	26′	46″
Semidiam. of ☉ } from Naut. Almanac..... of ☽ }	0	15	46
	0	14	54
Augmentation of the latter, prop. to altitude...	0	0	7
Apparent distance (d) of centres.....	83°	57′	33″
Altitude of sun's lower limb.....	48°	16′	10″
Subtract for dip of horizon.....	0	4	24
	48°	11′	46″
Semidiameter.....	0	15	46
Apparent altitude of sun's centre (h).....	48°	27′	32″
Refr. — par. — correct. for therm.....	— 0	0	43
True altitude of sun's centre (a).....	48°	26′	49″
Altitude of moon's upper limb.....	27°	53′	30′
Correct for dip.....	— 0	4	24
	27°	49′	6″
Semidiameter	0	15	1
Apparent altitude of moon's centre (H).....	27°	34′	5″
Par. — refr. + corr. for therm.....	0	46	43
True alt. of moon's centre (A).....	28°	20′	48″

Reduction of the apparent to the true distance by Prob. XIX.

	d	83°	57′	33″	
	h	48	27	32	ar. com. cos. ·1783835
	H	27	34	5	ar. com. cos. ·0523390
	sum	159°	59′	10″	
	$\frac{1}{2}$ sum	79	59	35	cos. 9·2399686
$d - \frac{1}{2}$	sum	3	57	58	cos. 9·9989587
	a	48	26	49	cos. 9·8217187
	A	28	20	48	cos. 9·9445275
A + a =		76°	47′	37″	39·2358960

$\frac{1}{2}$(A + a) =	38	23	48		2 log. cos. 19·7883324
					2)19·4475636
θ =	31	57	33		cos. θ 9·7237818
					sin. 9·9285875
$\frac{1}{2}$(A + a) =	38	23	48		cos. 9·8941662
$\frac{1}{2}$ D =	41	40	27⅔		sin. 9·8227537
D =	83	20	55	nearly.	

Computation of time at Greenwich.

By Nautical Almanac for 1793

Dist. ☽ from ☉ at 15 hours.....	83°	6′	1″
at 18.....	84	28	26
Increase of dist. in 3 hours =	1°	22′	25″
D..... =	83°	20′	55″
Dist. ☽ from ☉ at 15 hours....	83	6	1
	0°	14′	54″

Hence it appears that in 3 hours the distance of the moon from the sun was increased by 1° 22′ 25″ = 4595″, and that between the time of making the observation, and the 15th hour, Greenwich time, the increase of distance was 0° 14′ 54″ = 894.″ Now for small intervals the distances will increase nearly as the times, therefore we have

4945″ : 894″ : : 3h. : 0h. · 5425 = 32m. 33s.

Thus it appears that the observation must have been made 32 minutes 33 seconds after the 15th hour, Greenwich time.

We have yet to find the *correct* time of the observation as estimated at the ship. To determine this, we know the sun's altitude 48° 26′ 49″, and the sun's declination, which is given in the Almanac for Greenwich, noon; and from this the declination at the time of the observation is found by making allowance for the difference of longitude and the hour from noon at the ship, both known nearly. The declination thus found is 23° 22′ 48″ north. The ship's latitude, 10° 16′ 40″, is also known. Hence to find the hour angle by Problem IV. we have

λ the colat. = 79° 43′ 20″,
Δ the pol. dist. = 113 22 48,
z the zenith dist. = 41 33 11.

To find P the hour angle, the computation (see formula of Prob. IV.) may stand thus:—

sin. $\frac{1}{2}$ (z + λ — Δ)	3°	56′	51″		8·8378559
sin. $\frac{1}{2}$ (z — λ + Δ)	37	36	19		9·7854851
sin. $\frac{1}{2}$ (λ + Δ + z)	117	19	39	ar. comp.	0·0513929
sin. $\frac{1}{2}$ (λ + Δ — z)	75	46	28	ar. comp.	0·0135256
					2)18·6882595
tan. ($\frac{1}{2}$ P =	12°	27′	17½″)		9·3441297
P =	24°	54′	35″ =		1h 39m 38s·3
time at Greenwich =					15 32 33·0
Long. from Greenwich *westward*					13h 52m 54s·7
Therefore, longitude east of Greenwich is					10h 7m 4s·3

We have put down the result to seconds, as it comes out by the calculation; but such accuracy is not attainable in nautical practice. Delambre says, "even with the best instruments, the most skilful navigators find anomalies for which they cannot account. The lunar tables are in a state of continual improvement, yet we cannot be sure that there is not an error of 20″ in a distance, which will produce an error of 40″ of time. To this possible error of theory must be joined that of the observation, which may be still greater. The error of the time may therefore amount to 80″, which is equivalent to 20′, or $\frac{1}{3}$d of a degree. This should be the *maximum* of the error; and, in general, this degree of accuracy is sufficient. Indeed a greater accuracy than $\frac{1}{3}$d or $\frac{1}{4}$th of a degree may sometimes be obtained, but still it is uncertain.

CHAP. II.

CALCULATION OF NEW AND FULL MOON, AND ECLIPSES.

SECT. I.—*Tables for Computing New and Full Moon, and the Elements for Eclipses.*

TABLE I.

The Mean Time of New Moon in January, New Style, with the Mean Anomalies of the Sun and Moon, and the Moon's Mean Distance from the Ascending Node from 1801 to 1900 inclusive.

Years.	Mean New Moon in January.				Secular Equation.	Moon's Mean Anomaly.				Secular Equation.	Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.				Secular Equation.
	D.	H.	M.	S.	S.	S.	D.	M.	S.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.
1801	14	7	39	9	0	0	26	7	39	0	0	14	16	42	9	10	35	50	0
1802	3	16	27	43	0	11	5	55	49	0	0	3	32	33	9	18	38	37	0
1803	22	14	0	21	0	10	11	33	0	0	0	21	54	43	10	27	21	37	0
1804B.	11	22	48	55	0	8	21	21	11	0	0	11	10	35	11	5	24	24	0
1805	29	20	21	32	0	7	26	58	22	0	0	29	32	45	0	14	7	24	0
1806	19	5	10	7	0	6	6	46	32	0	0	18	48	36	0	22	10	11	0
1807	8	13	58	41	0	4	16	34	42	0	0	8	4	27	1	0	12	57	0
1808B.	27	11	31	18	0	3	22	11	53	0	0	26	26	38	2	8	55	58	0
1809	15	20	19	52	0	2	2	0	4	0	0	15	42	29	2	16	58	44	0
1810	5	5	8	27	0	0	11	48	14	0	0	4	58	20	2	25	1	31	0
1811	24	2	41	4	0	11	17	25	25	0	0	23	20	31	4	3	44	31	0
1812B.	13	11	29	38	0	9	27	13	35	+1	0	12	36	22	4	11	47	18	0
1813	1	20	18	13	0	8	7	1	46	1	0	1	52	13	4	19	50	4	0
1814	20	17	50	50	0	7	12	38	57	1	0	20	14	24	5	28	33	5	0
1815	10	2	39	25	0	5	22	27	7	1	0	9	30	15	6	6	35	51	0
1816B.	29	0	12	2	—1	4	28	4	18	1	0	27	52	26	7	15	18	52	0
1817	17	9	0	36	1	3	7	52	29	1	0	17	8	17	7	23	21	39	0
1818	6	17	49	11	1	1	17	40	39	1	0	6	24	8	8	1	24	25	0
1819	25	15	21	48	1	0	23	17	50	1	0	24	46	19	9	10	7	26	0
1820B.	15	0	10	23	1	11	3	6	1	2	0	14	2	10	9	18	10	12	0
1821	3	8	58	57	1	9	12	54	11	2	0	3	18	1	9	26	12	59	0
1822	22	6	31	34	1	8	18	31	22	2	0	21	40	12	11	4	55	59	0
1823	11	15	20	8	1	6	28	19	32	2	0	10	56	3	11	12	58	46	0
1824B.	1	0	8	43	1	5	8	7	42	2	0	0	11	54	11	21	1	32	0
1825	18	21	41	20	1	4	13	44	53	2	0	18	34	4	0	29	44	33	0
1826	8	6	29	54	1	2	23	33	4	3	0	7	49	56	1	7	47	19	—1
1827	27	4	2	31	2	1	29	10	15	3	0	26	12	6	2	16	30	19	1
1828B.	16	12	51	5	2	0	8	58	25	3	0	15	27	57	2	24	33	6	1
1829	4	21	39	40	2	10	18	46	35	3	0	4	43	49	3	2	35	52	1
1830	23	19	12	17	2	9	24	23	46	3	0	23	5	59	4	11	18	53	1
1831	13	4	0	51	2	8	4	11	56	4	0	12	21	49	4	19	21	39	1
1832B.	2	12	49	25	2	6	14	0	6	4	0	1	37	42	4	27	24	26	1
1833	20	10	22	3	2	5	19	37	18	4	0	19	59	52	6	6	7	26	1
1834	9	19	10	37	2	3	29	25	28	4	0	9	15	43	6	14	10	13	1
1835	28	16	43	15	3	3	5	2	39	5	0	27	37	54	7	22	53	13	1
1836B.	18	1	31	49	3	1	14	50	49	5	0	16	53	45	8	0	56	0	1
1837	6	10	20	23	3	11	24	39	0	5	0	6	9	36	8	8	58	47	1
1838	25	7	53	1	3	11	0	16	11	6	0	24	31	47	9	17	41	47	1
1839	14	16	41	35	3	9	10	4	21	6	0	13	47	38	9	25	44	34	1
1840B.	4	1	30	10	3	7	19	52	32	6	0	3	3	29	10	3	47	20	1
1841	21	23	2	47	4	6	25	29	43	6	0	21	25	40	11	12	30	21	1
1842	11	7	51	21	4	5	5	17	53	7	0	10	41	31	11	20	33	8	1
1843	30	5	23	59	4	4	10	55	5	7	0	29	3	41	0	29	16	8	1
1844B.	19	14	12	33	4	2	20	43	15	7	0	18	19	33	1	7	18	55	1
1845	7	23	1	8	4	1	0	31	25	8	0	7	35	24	1	15	21	41	2
1846	26	20	33	45	5	0	6	8	36	8	0	25	57	34	2	24	4	42	2
1847	16	5	22	19	5	10	15	56	47	8	0	15	13	26	3	2	7	28	2
1848B.	5	14	10	54	5	8	25	44	57	9	0	4	29	17	3	10	10	15	2
1849	23	11	43	31	5	8	1	22	8	9	0	22	51	27	4	18	53	15	2
1850	12	20	32	6	5	6	11	10	19	10	0	12	7	19	4	26	56	2	2

Years.	Mean New Moon in January.				Secular Equation.	Moon's Mean Anomaly.				Secular Equation.	Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.				Secular Equation.
	D.	H.	M.	S.	S.	S.	D.	M.	S.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.
1851	2	5	20	40	—6	4	20	58	29	+10	0	1	23	10	5	4	58	48	—2
1852B.	21	2	53	17	6	3	26	35	40	10	0	19	45	20	6	13	41	49	2
1853	9	11	41	52	6	2	6	23	50	11	0	9	1	12	6	21	44	35	2
1854	28	9	14	29	6	1	12	1	2	11	0	27	23	22	8	0	27	36	2
1855	17	18	3	3	6	11	21	49	12	12	0	16	39	13	8	8	30	22	2
1856B.	7	2	51	38	7	10	1	37	22	12	0	5	55	5	8	16	33	9	2
1857	25	0	24	15	7	9	7	14	33	12	0	24	17	15	9	25	16	10	2
1858	14	9	12	49	7	7	17	2	43	13	0	13	33	6	10	3	18	56	3
1859	3	18	1	23	7	5	26	50	54	13	0	2	48	58	10	11	21	43	3
1860B.	22	15	34	1	8	5	2	28	5	14	0	21	11	8	11	20	4	43	3
1861	11	0	22	35	8	3	12	16	15	14	0	10	26	59	11	28	7	30	3
1862	29	21	55	12	8	2	17	53	26	15	0	28	49	10	1	6	50	31	3
1863	19	6	43	47	8	0	27	41	36	15	0	18	5	1	1	14	53	17	3
1864B.	8	15	32	21	9	11	7	29	47	16	0	7	20	52	1	22	56	4	3
1865	26	13	4	58	9	10	13	6	58	16	0	25	43	3	3	1	39	4	3
1866	15	21	53	33	9	8	22	55	8	17	0	14	58	54	3	9	41	51	3
1867	5	6	42	7	10	7	2	43	18	17	0	4	14	45	3	17	44	37	3
1868B.	24	4	14	44	10	6	8	20	29	18	0	22	36	56	4	26	27	38	4
1869	12	13	3	18	10	4	18	8	40	18	0	11	52	47	5	4	30	24	4
1870	1	21	51	53	10	2	27	56	50	19	0	1	8	38	5	12	33	11	4
1871	20	19	24	30	11	2	3	34	1	19	0	19	30	49	6	21	16	11	4
1872B.	10	4	13	4	11	0	13	22	11	20	0	8	46	40	6	29	18	58	4
1873	28	1	45	42	11	11	18	59	22	20	0	27	8	50	8	8	1	58	4
1874	17	10	34	16	12	9	28	47	33	21	0	16	24	42	8	16	4	45	4
1875	6	19	22	50	12	8	8	35	43	22	0	5	40	33	8	24	7	31	4
1876B.	25	16	55	27	12	7	14	12	54	22	0	24	2	43	10	2	50	32	4
1877	14	1	44	2	13	5	24	1	5	23	0	13	18	35	10	10	53	18	5
1878	3	10	32	36	13	4	3	49	15	23	0	2	34	26	10	18	56	5	5
1879	22	8	5	13	13	3	9	26	26	24	0	20	56	36	11	27	39	5	5
1880B.	11	16	53	48	14	1	19	14	37	25	0	10	12	27	0	5	41	52	5
1881	29	14	26	25	14	0	24	51	48	25	0	28	34	38	1	14	24	52	5
1882	18	23	14	59	14	11	4	39	58	26	0	17	50	29	1	22	27	39	5
1883	8	8	3	34	15	9	14	28	8	26	0	7	6	20	2	0	30	25	5
1884B.	27	5	36	11	15	8	20	5	20	27	0	25	28	31	3	9	13	26	5
1885	15	14	24	46	16	6	29	53	30	28	0	14	44	22	3	17	16	12	5
1886	4	23	13	20	16	5	9	41	40	28	0	4	0	13	3	25	18	59	6
1887	23	20	45	57	16	4	15	18	51	29	0	22	22	24	5	4	2	0	6
1888B.	13	5	34	32	17	2	25	7	1	30	0	11	38	15	5	12	4	46	6
1889	1	14	23	6	17	1	4	55	12	30	0	0	54	6	5	20	7	33	6
1890	20	11	55	44	18	0	10	32	23	31	0	19	16	17	6	28	50	33	6
1891	9	20	44	18	18	10	20	20	33	32	0	8	32	8	7	6	53	20	6
1892B.	28	18	16	55	18	9	25	57	44	33	0	26	54	19	8	15	36	21	6
1893	17	3	5	30	19	8	5	45	54	33	0	16	10	10	8	23	39	7	7
1894	6	11	54	4	19	6	15	34	5	34	0	5	26	1	9	1	41	54	7
1895	25	9	26	42	20	5	21	11	16	35	0	23	48	12	10	10	24	54	7
1896B.	14	18	15	16	20	4	0	59	26	35	0	13	4	3	10	18	27	41	7
1897	3	3	3	50	20	2	10	47	36	36	0	2	19	54	10	26	30	27	7
1898	22	0	36	28	21	1	16	24	47	37	0	20	42	4	0	5	13	28	7
1899	11	9	25	2	21	11	26	12	58	38	0	9	57	56	0	13	16	14	7
1900C.	30	6	57	39	21	11	1	50	9	38	0	28	20	6	1	21	59	15	8

TABLE II.

Quantities to be added to the Epochs in Table I. for the Nineteenth Century, in order to obtain the Epochs of the corresponding Years in other Centuries. The sign — indicates the past Centuries, and + the future, in respect to the Nineteenth Century.

Years.	Mean New Moon.				Moon's Mean Anomaly.				Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.			
Old Style.	D.	H.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
— 2600	22	20	36	13	10	25	47	43	1	29	10	40	4	8	0	22
— 2500	27	4	43	18	7	11	18	23	2	2	29	56	8	27	26	33
— 2400	2	0	6	19	3	1	0	2	1	6	42	53	0	16	12	30
— 2300	6	8	13	24	11	16	30	42	1	10	2	9	5	5	38	42
— 2200	10	16	20	29	8	2	1	22	1	13	21	25	9	25	4	53
— 2100	15	0	27	33	4	17	32	2	1	16	40	41	2	14	31	4
— 2000	19	8	34	38	1	3	2	42	1	19	59	57	7	3	57	15
— 1900	23	16	41	42	9	18	33	22	1	23	19	13	11	23	23	26
— 1800	28	0	48	47	6	4	4	2	1	26	38	29	4	12	49	37
— 1700	2	20	11	49	1	23	45	42	1	0	51	26	8	1	35	34
— 1600	7	4	18	54	10	9	16	22	1	4	10	42	0	21	1	45
— 1500	11	12	25	59	6	24	47	2	1	7	29	58	5	10	27	57
— 1400	15	20	33	4	3	10	17	42	1	11	49	14	9	29	54	8
— 1300	20	4	40	8	11	25	48	22	1	14	8	30	2	19	20	19
— 1200	24	12	47	13	8	11	19	3	1	17	27	46	7	8	46	30
— 1100	28	20	54	18	4	26	49	43	1	20	47	2	11	28	12	41
— 1000	3	16	17	20	0	16	31	22	0	24	59	59	3	16	58	38
— 900	8	0	24	25	9	2	2	2	0	28	19	16	8	6	24	49
— 800	12	8	31	29	5	17	32	42	1	1	38	31	0	25	51	0
— 700	16	16	38	34	2	3	3	22	1	4	57	47	5	15	17	11
— 600	21	0	45	39	10	18	34	2	1	8	17	3	10	4	43	22
— 500	25	8	52	43	7	4	4	42	1	11	36	18	2	24	9	33
— 400	0	4	15	45	2	23	46	21	0	15	49	15	6	12	55	30
— 300	4	12	22	50	11	9	17	1	0	19	8	31	11	2	21	41
— 200	8	20	29	54	7	24	47	41	0	22	27	47	3	21	47	52
— 100	13	4	36	58	4	10	18	21	0	25	47	3	8	11	14	3
New Style.																
— 300	14	12	22	50	11	9	17	1	0	19	8	31	11	2	21	41
— 200	18	20	29	54	7	24	47	41	0	22	27	47	3	21	47	52
— 100	24	4	36	58	4	10	18	21	0	25	47	3	8	11	14	3
+ 100	5	8	7	5	8	15	30	40	0	3	19	16	4	19	26	11
+ 200	9	16	14	9	5	1	1	20	0	6	38	32	9	8	52	22

TABLE III.

Secular Equations.

Years.	Time of Mean New Moon.			Moon's Mean Anomaly.			Sun's Mean Anomaly.		Moon's Mean Distance from Ascending Node.			Years.	Time of Mean New Moon.			Moon's Mean Anomaly.			Sun's Mean Anomaly.		Moon's Mean Distance from Ascending Node.		
B. C.	H.	M.	S.	D.	M.	S.	M.	S.	D.	M.	S.	A. C.	H.	M.	S.	D.	M.	S.	M.	S.	D.	M.	S.
800	— 3	52	5	+ 6	56	7	— 18	44	— 1	22	19	701	— 0	42	30	+ 1	16	11	— 3	23	— 0	15	4
700	3	34	54	6	25	19	17	20	1	16	13	801	0	35	10	1	3	4	2	48	0	12	28
600	3	18	21	5	55	39	15	59	1	10	21	901	0	28	32	0	51	9	2	16	0	10	7
500	3	2	27	5	27	7	14	41	1	4	42	1001	0	22	35	0	40	29	1	48	0	8	0
400	2	47	11	4	59	45	13	17	0	59	18	1101	0	17	19	0	31	2	1	23	0	6	8
300	2	32	33	4	33	32	12	16	0	54	6												
200	2	18	35	4	8	29	11	8	0	49	9	1201	0	12	44	0	22	50	1	1	0	4	31
100	2	5	16	3	44	36	10	3	0	44	26	1301	0	8	51	0	15	53	0	42	0	3	9
A. C.												1401	0	5	41	0	10	11	0	27	0	2	1
1	1	52	36	3	21	53	9	2	0	39	56	1501	0	3	12	0	5	44	0	15	0	1	8
101	1	40	35	3	0	21	8	4	0	35	40	1601	0	1	25	0	2	32	0	7	0	0	30
201	1	29	14	2	39	59	7	9	0	31	39												
301	1	18	33	2	20	50	6	17	0	27	51	1701	0	0	21	0	0	38	0	2	0	0	8
401	1	8	31	2	2	52	5	29	0	24	18	1801	0	0	0	0	0	0	0	0	0	0	0
501	0	59	10	1	46	6	4	44	0	20	59	1901	0	0	21	0	0	38	0	2	0	0	8
601	0	50	30	1	30	32	4	2	0	17	54	2001	0	1	26	0	2	34	0	7	0	0	30

TABLE IV.

Mean Anomalies of the Sun and Moon, and Moon's Mean Distance from Ascending Node for Mean Lunations.

No.	Mean Lunations.					Moon's Mean Anomaly.				Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.			
		D.	H.	M.	S	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
1	January	29	12	44	3	0	25	49	1	0	29	6	19	1	0	40	14
2	February	28	1	28	6	1	21	38	2	1	28	12	39	2	1	20	27
3	March	29	14	12	9	2	17	27	3	2	27	18	58	3	2	0	41
4	April	28	2	56	11	3	13	16	3	3	26	25	17	4	2	40	54
5	May	27	15	40	14	4	9	5	4	4	25	31	37	5	3	21	8
6	June	26	4	24	17	5	4	54	5	5	24	37	56	6	4	1	21
7	July	25	17	8	20	6	0	43	6	6	23	44	16	7	4	41	35
8	August	24	5	52	23	6	26	32	7	7	22	50	35	8	5	21	48
9	September	22	18	36	26	7	22	21	8	8	21	56	54	9	6	2	2
10	October	22	7	20	29	8	18	10	9	9	21	3	14	10	6	42	15
11	November	20	20	4	31	9	13	59	9	10	20	9	33	11	7	22	29
12	December	20	8	48	34	10	9	48	10	11	19	15	52	0	8	2	42
½		14	18	22	1	6	12	54	30	0	14	33	10	6	15	20	7

TABLE V.

First Equation for the Times of New and Full Moon.

	Argument. Moon's Mean Anomaly.																		
	O.s. —			I.s. —			II.s. —			III.s. —			IV.s. —			V.s. —			
	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.	H.	M.	S.	
0°	0	0	0	4	34	26	8	10	3	9	48	59	8	50	0	5	14	24	30°
1	0	9	28	4	42	54	8	15	32	9	49	42	8	45	11	5	5	2	29
2	0	18	56	4	51	18	8	20	52	9	50	14	8	40	10	4	55	34	28
3	0	28	24	4	59	38	8	26	5	9	50	35	8	34	59	4	45	59	27
4	0	37	52	5	7	54	8	31	9	9	50	45	8	29	36	4	36	18	26
5	0	47	19	5	16	4	8	36	6	9	50	44	8	24	5	4	26	31	25
6	0	56	45	5	24	10	8	40	53	9	50	33	8	18	23	4	16	38	24
7	1	6	10	5	32	12	8	45	32	9	50	10	8	12	30	4	6	40	23
8	1	15	35	5	40	9	8	50	2	9	49	36	8	6	27	3	36	3	22
9	1	24	59	5	48	1	8	54	24	9	48	51	8	0	14	3	46	27	21
10	1	34	21	5	55	48	8	58	36	9	47	55	7	53	50	3	36	13	20
11	1	43	42	6	3	29	9	2	40	9	46	48	7	47	17	3	25	54	19
12	1	53	2	6	11	5	9	6	34	9	45	29	7	40	35	3	15	31	18
13	2	2	20	6	18	36	9	10	20	9	43	59	7	33	42	3	5	3	17
14	2	11	37	6	26	1	9	13	55	9	42	18	7	26	40	2	54	31	16
15	2	20	51	6	33	20	9	17	22	9	40	26	7	19	28	2	43	56	15
16	2	30	4	6	40	33	9	20	38	9	38	22	7	12	7	2	33	16	14
17	2	39	15	6	47	40	9	23	46	9	36	8	7	4	37	2	22	34	13
18	2	48	23	6	54	41	9	26	43	9	33	42	6	56	58	2	11	48	12
19	2	57	29	7	1	36	9	29	30	9	31	4	6	49	11	2	0	59	11
20	3	6	33	7	8	24	9	32	8	9	28	16	6	41	14	1	50	8	10
21	3	15	34	7	15	6	9	34	36	9	25	16	6	33	9	1	39	14	9
22	3	24	33	7	21	41	9	36	53	9	22	5	6	24	55	1	28	18	8
23	3	33	28	7	28	9	9	39	0	9	18	44	6	16	33	1	17	20	7
24	3	42	21	7	34	30	9	40	57	9	15	10	6	8	3	1	6	20	6
25	3	51	10	7	40	44	9	42	44	9	11	26	5	59	26	0	55	19	5
26	3	59	56	7	46	52	9	44	20	9	7	31	5	50	39	0	44	17	4
27	4	8	39	7	52	50	9	45	46	9	3	25	5	41	47	0	33	13	3
28	4	17	18	7	58	42	9	47	1	8	59	8	5	32	46	0	22	9	2
29	4	25	54	8	4	26	9	48	5	8	54	39	5	23	38	0	11	5	1
30	4	34	26	8	10	3	9	48	59	8	50	0	5	14	24	0	0	0	0
	+ XI.s.			+ X.s.			+ IX.s.			+ VIII.s.			+ VII.s.			+ VI.s.			

TABLE VI.

Second Equation for the Times of New and Full Moon for the year 1801, with the Secular Variation.

Argument. Sun's Mean Anomaly.

	O.s. +			Secular Variation.	I.s. +			Secular Variation.	II.s. +			Secular Variation.	III.s. +			Secular Variation.	IV.s. +			Secular Variation.	V.s. +			Secular Variation.	
	H.	M.	S.	S.	H.	M.	S.	S.	H.	M.	S.	S.	H.	M.	S.	S.	H.	M.	S.	S.	H.	M.	S.	S.	
0°	0	0	0	0	2	8	39	20	3	40	48	33	4	11	50	38	3	35	30	32	2	3	21	18	30°
1	0	4	30	1	2	12	30	20	3	42	54	34	4	11	41	38	3	33	13	32	1	59	35	18	29
2	0	9	1	1	2	16	17	21	3	44	56	34	4	11	28	38	3	30	52	31	1	55	47	17	28
3	0	13	31	2	2	20	3	21	3	46	54	34	4	11	10	38	3	28	28	31	1	51	56	16	27
4	0	18	1	3	2	23	45	22	3	48	48	35	4	10	48	38	3	26	0	31	1	48	4	16	26
5	0	22	30	3	2	27	25	22	3	50	37	35	4	10	20	38	3	23	29	30	1	44	10	15	25
6	0	26	59	4	2	31	1	23	3	52	22	35	4	9	49	37	3	20	53	30	1	40	14	15	24
7	0	31	28	5	2	34	35	24	3	54	3	35	4	9	13	37	3	18	15	29	1	36	17	14	23
8	0	35	55	5	2	38	6	24	3	55	39	36	4	8	32	37	3	15	33	29	1	32	17	14	22
9	0	40	23	6	2	41	34	25	3	57	11	36	4	7	47	37	3	12	47	29	1	28	16	13	21
10	0	44	49	7	2	44	59	25	3	58	38	36	4	6	58	37	3	9	58	28	1	24	14	12	20
11	0	49	15	8	2	48	20	26	4	0	1	36	4	6	4	37	3	7	6	28	1	20	10	12	19
12	0	53	39	8	2	51	38	26	4	1	20	36	4	5	6	37	3	4	11	27	1	16	5	11	18
13	0	58	3	9	2	54	53	27	4	2	33	37	4	4	3	37	3	1	12	27	1	11	59	11	17
14	1	2	25	10	2	58	5	27	4	3	43	37	4	2	56	36	2	58	11	26	1	7	51	10	16
15	1	6	46	10	3	1	13	28	4	4	48	37	4	1	44	36	2	55	6	26	1	3	42	9	15
16	1	11	6	11	3	4	18	28	4	5	48	37	3	0	28	36	2	51	58	25	0	59	32	9	14
17	1	15	24	12	3	7	19	28	4	6	44	37	3	59	8	36	2	48	47	25	0	55	22	8	13
18	1	19	41	12	3	10	16	29	4	7	35	37	3	57	44	36	2	45	33	25	0	51	10	8	12
19	1	23	56	13	3	13	10	29	4	8	21	37	3	56	15	35	2	42	16	24	0	46	57	7	11
20	1	28	10	14	3	16	0	30	4	9	3	37	3	54	42	35	2	38	57	24	0	42	43	6	10
21	1	32	22	14	3	18	46	30	4	9	41	38	3	53	5	35	2	35	35	23	0	38	29	6	9
22	1	36	32	15	3	21	29	31	4	10	14	38	3	51	24	35	2	32	10	23	0	34	14	5	8
23	1	40	41	15	3	24	8	31	4	10	42	38	3	49	38	34	2	28	42	22	0	29	59	4	7
24	1	44	47	16	3	26	43	31	4	11	5	38	3	47	49	34	2	25	12	21	0	25	43	4	6
25	1	48	51	17	3	29	14	32	4	11	24	38	3	45	56	34	2	21	40	21	0	21	27	3	5
26	1	52	53	17	3	31	40	32	4	11	39	38	3	43	58	33	2	18	5	20	0	17	9	3	4
27	1	56	53	18	3	34	3	32	4	11	48	38	3	41	57	33	2	16	27	20	0	12	52	2	3
28	2	0	51	18	3	36	22	33	4	11	53	38	3	39	52	33	2	10	47	19	0	8	35	1	2
29	2	4	46	19	3	38	37	33	4	11	54	38	3	37	43	32	2	7	5	19	0	4	18	1	1
30	2	8	39	20	3	40	48	33	4	11	50	38	3	35	30	32	2	3	21	18	0	0	0	0	0
	—	XI.s.		+	—	X.s.		+	—	IX.s.		+	—	VIII.s.		+	—	VII.s.		+	—	VI.s.		+	

Multiply the Secular Variations by the number of years between the given time and the year 1801, and divide the product by 100. If the given time be before 1801, change the sign of the Secular Variation.

TABLE VII.

Third Equation for the Times of New and Full Moon.

Argument. Moon's Mean Anomaly *plus* Sun's Mean Anomaly.									
	0.s. — VI.s. +		I.s. — VII.s. +		II.s. — VIII.s. +		
	M.	S.	M.	S.	M.	S.	
0°	0	0	3	33	6	9	30°
1	0	7	3	39	6	13	29
2	0	15	3	46	6	16	28
3	0	22	3	52	6	20	27
4	0	30	3	58	6	23	26
5	0	37	4	4	6	26	25
6	0	44	4	10	6	29	24
7	0	52	4	16	6	32	23
8	0	59	4	22	6	35	22
9	1	7	4	28	6	38	21
10	1	14	4	34	6	40	20
11	1	21	4	39	6	43	19
12	1	29	4	45	6	45	18
13	1	36	4	50	6	47	17
14	1	43	4	56	6	49	16
15	1	50	5	1	6	51	15
16	1	57	5	6	6	53	14
17	2	5	5	12	6	55	13
18	2	12	5	17	6	57	12
19	2	19	5	21	6	58	11
20	2	26	5	26	6	59	10
21	2	33	5	31	7	1	9
22	2	40	5	36	7	2	8
23	2	46	5	40	7	3	7
24	2	53	5	45	7	4	6
25	3	0	5	49	7	4	5
26	3	7	5	53	7	5	4
27	3	13	5	57	7	5	3
28	3	20	6	1	7	6	2
29	3	26	6	5	7	6	1
30	3	33	6	9	7	6	0
	+ XI.s. — V.s.		+ X.s. — IV.s.		+ IX.s. — III.s.		

TABLE VIII.

Fourth Equation for the Times of New and Full Moon.

Argument. Moon's Mean Anomaly *minus* Sun's Mean Anomaly.									
	0.s. + VII.s. —		I.s. + VII.s. —		II.s. + VIII.s. —		
	M.	S.	M.	S.	M.	S.	
0°	0	0	5	17	9	10	30°
1	0	11	5	27	9	15	29
2	0	22	5	37	9	20	28
3	0	33	5	46	9	25	27
4	0	44	5	55	9	30	26
5	0	55	6	4	9	36	25
6	1	6	6	13	9	41	24
7	1	18	6	22	9	45	23
8	1	29	6	31	9	49	22
9	1	40	6	39	9	53	21
10	1	50	6	48	9	57	20
11	2	1	6	56	10	1	19
12	2	12	7	5	10	4	18
13	2	23	7	13	10	7	17
14	2	33	7	21	10	11	16
15	2	44	7	29	10	14	15
16	2	55	7	37	10	16	14
17	3	5	7	45	10	19	13
18	3	16	7	52	10	21	12
19	3	27	7	59	10	23	11
20	3	37	8	7	10	25	10
21	3	48	8	14	10	27	9
22	3	58	8	20	10	29	8
23	4	8	8	27	10	30	7
24	4	18	8	34	10	32	6
25	4	28	8	40	10	33	5
26	4	38	8	46	10	33	4
27	4	48	8	52	10	34	3
28	4	58	8	58	10	35	2
29	5	7	9	4	10	35	1
30	5	17	9	10	10	35	0
	— XI.s. + V.s.		— X.s. + IV.s.		— IX.s. + III.s.		

TABLE IX.

Fifth Equation for the Times of New and Full Moon.

Argument. Twice Moon's Mean Distance from Ascending Node *minus* Moon's Mean Anomaly.									
	0.s. + VI.s. —		I.s. + VII.s. —		II.s. + VIII.s. —		
	M.	S.	M.	S.	M.	S.	
0°	0	0	1	18	2	16	30°
1	0	3	1	21	2	17	29
2	0	5	1	23	2	19	28
3	0	8	1	25	2	20	27
4	0	11	1	28	2	21	26
5	0	14	1	30	2	22	25
6	0	16	1	32	2	23	24
7	0	19	1	34	2	24	23
8	0	22	1	37	2	26	22
9	0	25	1	39	2	27	21
10	0	27	1	41	2	28	20
11	0	30	1	43	2	28	19
12	0	33	1	45	2	29	18
13	0	35	1	47	2	30	17
14	0	38	1	49	2	31	16
15	0	41	1	51	2	32	15
16	0	43	1	53	2	32	14
17	0	46	1	55	2	33	13
18	0	48	1	57	2	34	12
19	0	51	1	58	2	34	11
20	0	54	2	0	2	35	10
21	0	56	2	2	2	35	9
22	0	59	2	4	2	35	8
23	1	1	2	5	2	36	7
24	1	4	2	7	2	36	6
25	1	6	2	9	2	36	5
26	1	9	2	10	2	37	4
27	1	11	2	12	2	37	3
28	1	14	2	13	2	37	2
29	1	16	2	15	2	37	1
30	1	18	2	16	2	37	0
	— XI.s. + V.s.		— X.s. + IV.s.		— IX.s. + III.s.		

TABLE X.

Sixth Equation for the Times of New and Full Moon.

Argument. Moon's Mean Distance from Ascending Node.									
	0.s. + VI.s. +		I.s. + VII.s. +		II.s. + VIII.s. +		
	M.	S.	M.	S.	M.	S.	
0°	0	0	1	40	1	40	30°
1	0	4	1	42	1	38	29
2	0	8	1	44	1	36	28
3	0	12	1	46	1	34	27
4	0	16	1	48	1	31	26
5	0	20	1	49	1	29	25
6	0	24	1	50	1	26	24
7	0	28	1	51	1	23	23
8	0	32	1	53	1	21	22
9	0	36	1	53	1	18	21
10	0	40	1	54	1	15	20
11	0	43	1	55	1	11	19
12	0	47	1	55	1	8	18
13	0	51	1	56	1	5	17
14	0	54	1	56	1	1	16
15	0	58	1	56	0	58	15
16	1	1	1	56	0	54	14
17	1	5	1	56	0	51	13
18	1	8	1	55	0	47	12
19	1	11	1	55	0	43	11
20	1	15	1	54	0	40	10
21	1	18	1	53	0	36	9
22	1	21	1	53	0	32	8
23	1	23	1	51	0	28	7
24	1	26	1	50	0	24	6
25	1	29	1	49	0	20	5
26	1	31	1	48	0	16	4
27	1	34	1	46	0	12	3
28	1	36	1	44	0	8	2
29	1	38	1	42	0	4	1
30	1	40	1	40	0	0	0
	— XI.s. — V.s.		— X.s. — IV.s.		— IX.s. — III.s.		

TABLE XI.

Seventh Equation for the Times of New and Full Moon.

Argument. Twice the Moon's Mean Anomaly *plus* the Sun's Mean Anomaly.				
	O.s. — VI.s. +	I.s. — VII.s. +	II.s. — VIII.s. +	
	s.	s.	s.	
0°	0	18	31	30°
5	3	21	33	25
10	6	23	34	20
15	9	25	35	15
20	12	28	35	10
25	15	29	36	5
30	18	31	36	0
	+ XI.s. — V.s.	+ X.s. — IV.s.	+ IX.s. — III.s.	

TABLE XII.

Eighth Equation for the Times of New and Full Moon.

Argument. Twice the Moon's Mean Anomaly *minus* the Sun's Mean Anomaly.				
	O.s. — VI.s. +	I.s. — VII.s. +	II.s — VIII.s +	
	s.	s.	s.	
0°	0	5	9	30°
5	1	6	9	25
10	2	6	9	20
15	3	7	10	15
20	3	8	10	10
25	4	8	10	5
30	5	9	10	0
	+ XI.s. — V.s.	+ X.s. — IV.s.	+ IX.s. — III.s.	

TABLE XIII.

Ninth Equation for the Time of Full Moon *only*.

Argument. Moon's Mean Anomaly.								
	O.s. + VI.s. —		I.s. + VII.s —		II.s. + VIII.s. —		
	M.	S.	M.	S.	M.	S.	
0°	0	0	0	43	1	15	30°
1	0	1	0	45	1	16	29
2	0	3	0	46	1	17	28
3	0	5	0	47	1	17	27
4	0	6	0	49	1	18	26
5	0	8	0	50	1	19	25
6	0	9	0	51	1	19	24
7	0	11	0	52	1	20	23
8	0	12	0	54	1	21	22
9	0	14	0	55	1	21	21
10	0	15	0	56	1	22	20
11	0	17	0	57	1	22	19
12	0	18	0	58	1	23	18
13	0	20	0	59	1	23	17
14	0	21	1	0	1	24	16
15	0	22	1	1	1	24	15
16	0	24	1	3	1	24	14
17	0	25	1	4	1	25	13
18	0	27	1	5	1	25	12
19	0	28	1	6	1	25	11
20	0	30	1	7	1	26	10
21	0	31	1	8	1	26	9
22	0	33	1	9	1	26	8
23	0	34	1	9	1	26	7
24	0	35	1	10	1	26	6
25	0	37	1	11	1	27	5
26	0	38	1	12	1	27	4
27	0	39	1	13	1	27	3
28	0	41	1	14	1	27	2
29	0	42	1	15	1	27	1
30	0	43	1	15	1	27	0
	— XI.s. + V.s.		— X.s. + IV.s.		— IX.s. + III.s.		

TABLE XIV.

Tenth Equation for the Time of Full Moon *only*.

Argument. Sun's Mean Anomaly.				
	O.s. + VI.s. —	I.s. + VII.s. —	II.s. + VIII.s. —	
	s.	s.	s.	
0°	0	16	29	30°
5	3	19	30	25
10	6	21	31	20
15	9	23	32	15
20	11	25	32	10
25	14	27	33	5
30	16	29	33	0
	— XI.s. + V.s	— X.s. + IV.s.	— IX.s. + III.s.	

TABLE XV.

Sun s Mean Motion from the Moon's Perigee and Ascending Node, and Variation of the Sun's Mean Anomaly, for Hours, Minutes, and Seconds.

For Hours.

	Sun's Mean Motion from Moon's Perigee.		Sun's Mean Anomaly.		Sun's Mean Motion from Ascending Node.				Sun's Mean Motion from Moon's Perigee.		Sun's Mean Anomaly.		Sun's Mean Motion from Ascending Node.		
H.	M.	S.	M.	S.	D.	M.	S.	H.	M.	S.	M.	S.	D.	M.	S.
1	2	11	2	28	0	2	36	13	28	25	32	2	0	33	45
2	4	22	4	56	0	5	12	14	30	36	34	30	0	36	21
3	6	33	7	23	0	7	47	15	32	47	36	58	0	38	57
4	8	44	9	51	0	10	23	16	34	58	39	26	0	41	33
5	10	55	12	19	0	12	59	17	37	9	41	53	0	44	8
6	13	7	14	47	0	15	35	18	39	20	44	21	0	46	44
7	15	18	17	15	0	18	10	19	41	31	46	49	0	49	20
8	17	29	19	43	0	20	46	20	43	43	49	17	0	51	56
9	19	40	22	11	0	23	22	21	45	54	51	45	0	54	32
10	21	51	24	38	0	25	58	22	48	5	54	13	0	57	7
11	24	2	27	6	0	28	34	23	50	16	56	40	0	59	43
12	26	13	29	34	0	31	9	24	52	27	59	8	1	2	19

For Minutes and Seconds.

	Sun's Mean Motion from Moon's Perigee.		Sun's Mean Anomaly.		Sun's Mean Distance from Ascending Node.			Sun's Mean Motion from Moon's Perigee.		Sun's Mean Anomaly.		Sun's Mean Distance from Ascending Node.		
M.	M.	S.	M.	S.	M.	S.		M.	M.	S.	M.	S.	M.	S.	
S.	S.	T.	S.	T.	S.	T.		S.	S.	T.	S.	T.	S.	T.	
1	0	2	0	2	0	3		31	1	8	1	16	1	20	
2	0	4	0	5	0	5		32	1	10	1	19	1	23	
3	0	7	0	7	0	8		33	1	12	1	21	1	26	
4	0	9	0	10	0	10		34	1	15	1	24	1	28	
5	0	11	0	12	0	13		35	1	17	1	26	1	31	
6	0	13	0	15	0	16		36	1	19	1	29	1	33	
7	0	15	0	17	0	18		37	1	21	1	31	1	36	
8	0	17	0	20	0	21		38	1	23	1	34	1	39	
9	0	20	0	22	0	23		39	1	25	1	36	1	41	
10	0	22	0	25	0	26		40	1	27	1	39	1	44	
11	0	24	0	27	0	29		41	1	30	1	41	1	46	
12	0	26	0	30	0	31		42	1	32	1	43	1	49	
13	0	28	0	32	0	34		43	1	34	1	46	1	52	
14	0	31	0	34	0	36		44	1	36	1	48	1	54	
15	0	33	0	37	0	39		45	1	38	1	51	1	57	
16	0	35	0	39	0	41		46	1	41	1	53	1	59	
17	0	37	0	42	0	44		47	1	43	1	56	2	2	
18	0	39	0	44	0	47		48	1	45	1	58	2	5	
19	0	42	0	47	0	49		49	1	47	2	1	2	7	
20	0	44	0	49	0	52		50	1	49	2	3	2	10	
21	0	46	0	52	0	54		51	1	51	2	6	2	12	
22	0	48	0	54	0	57		52	1	54	2	8	2	15	
23	0	50	0	57	1	0		53	1	56	2	11	2	18	
24	0	52	0	59	1	2		54	1	58	2	13	2	20	
25	0	55	1	2	1	5		55	2	0	2	15	2	23	
26	0	57	1	4	1	7		56	2	2	2	18	2	25	
27	0	59	1	6	1	10		57	2	4	2	20	2	28	
28	1	1	1	9	1	13		58	2	6	2	23	2	31	
29	1	3	1	11	1	15		59	2	8	2	25	2	33	
30	1	6	1	14	1	18		60	2	11	2	28	2	36	

TABLE XVI.

Equation of the Sun's Centre for 1801, with the Secular Variation.

Argument. Sun's Mean Anomaly.

	O.s. +			Secular Variation. —	I.s. +			Secular Variation. —	II.s. +			Secular Variation. —	III.s. +			Secular Variation. —	IV.s. +			Secular Variation. —	V.s. +			Secular Variation. —	
	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	
0°	0	0	0	0	0	58	48	9	1	41	3	15	1	55	27	17	1	38	57	15	0	56	42	8	30°
1	0	2	4	0	1	0	34	9	1	42	1	15	1	55	23	17	1	37	54	14	0	54	58	8	29
2	0	4	7	1	1	2	18	9	1	42	57	15	1	55	18	17	1	36	50	14	0	53	13	8	28
3	0	6	10	1	1	4	1	10	1	43	52	16	1	55	10	17	1	35	44	14	0	51	27	8	27
4	0	8	14	1	1	5	43	10	1	44	44	16	1	55	0	17	1	34	36	14	0	49	41	7	26
5	0	10	17	2	1	7	23	10	1	45	34	16	1	54	48	17	1	33	27	14	0	47	53	7	25
6	0	12	20	2	1	9	3	10	1	46	23	16	1	54	34	17	1	32	16	14	0	46	5	7	24
7	0	14	22	2	1	10	41	11	1	47	9	16	1	54	18	17	1	31	3	13	0	44	16	6	23
8	0	16	25	2	1	12	17	11	1	47	54	16	1	54	0	17	1	29	49	13	0	42	26	6	22
9	0	18	27	3	1	13	52	11	1	48	36	16	1	53	39	17	1	28	33	13	0	40	35	6	21
10	0	20	28	3	1	15	26	11	1	49	17	16	1	53	17	17	1	27	16	13	0	38	44	6	20
11	0	22	30	3	1	16	58	12	1	49	55	16	1	52	53	17	1	25	57	13	0	36	52	5	19
12	0	24	31	4	1	18	29	12	1	50	31	17	1	52	26	17	1	24	37	12	0	34	59	5	18
13	0	26	31	4	1	19	58	12	1	51	5	17	1	51	58	17	1	23	15	12	0	33	6	5	17
14	0	28	31	4	1	21	26	12	1	51	37	17	1	51	27	16	1	21	52	12	0	31	12	5	16
15	0	30	30	5	1	22	53	13	1	52	8	17	1	50	55	16	1	20	27	12	0	29	17	4	15
16	0	32	29	5	1	24	17	13	1	52	36	17	1	50	20	16	1	19	1	12	0	27	23	4	14
17	0	34	27	5	1	25	40	13	1	53	2	17	1	49	44	16	1	17	33	11	0	25	27	4	13
18	0	36	25	6	1	27	2	13	1	53	25	17	1	49	6	16	1	16	4	11	0	23	31	3	12
19	0	38	21	6	1	28	21	13	1	53	47	17	1	48	25	16	1	14	34	11	0	21	35	3	11
20	0	40	17	6	1	29	39	14	1	54	7	17	1	47	43	16	1	13	2	11	0	19	39	3	10
21	0	42	13	6	1	30	56	14	1	54	24	17	1	46	59	16	1	11	29	10	0	17	42	3	9
22	0	44	7	7	1	32	10	14	1	54	40	17	1	46	13	16	1	9	56	10	0	15	45	2	8
23	0	46	0	7	1	33	23	14	1	54	53	17	1	45	25	16	1	8	20	10	0	13	47	2	7
24	0	47	53	7	1	34	34	14	1	55	4	17	1	44	35	15	1	6	44	10	0	11	49	2	6
25	0	49	45	8	1	35	44	14	1	55	13	17	1	43	43	15	1	5	6	10	0	9	51	1	5
26	0	51	35	8	1	36	51	15	1	55	20	17	1	42	49	15	1	3	28	9	0	7	53	1	4
27	0	53	25	8	1	37	57	15	1	55	25	17	1	41	54	15	1	1	48	9	0	5	55	1	3
28	0	55	14	8	1	39	1	15	1	55	28	17	1	40	57	15	1	0	7	9	0	3	57	1	2
29	0	57	2	9	1	40	3	15	1	55	28	17	1	39	58	15	0	58	25	9	0	1	58	0	1
30	0	58	48	9	1	41	3	15	1	55	27	17	1	38	57	15	0	56	42	8	0	0	0	0	0
		— XI.s.		+		— X.s.		+		— IX.s.		+		— VIII.s.		+		— VII.s.		+		— VI.s.		+	

Multiply the secular variations by the number of years between the given time and the year 1801, and divide the product by 100. If the time is before 1801, change the sign of the secular variation.

TABLE XVII.

For the Moon's Latitude and Inclination of her relative Orbit to the Ecliptic in Eclipses.

Argument. Moon's True distance from Ascending Node.						
	Latitude.				Inclination.	
	O.s. + increasing. VI.s. — increasing.				O.s. left. VI.s. right.	
	D.	M.	S.		D.	M.
0°	0	0	0	30°	5	44
1	0	5	17	29	5	44
2	0	10	33	28	5	44
3	0	15	49	27	5	43
4	0	21	5	26	5	43
5	0	26	21	25	5	43
6	0	31	36	24	5	42
7	0	36	50	23	5	41
8	0	42	4	22	5	41
9	0	47	17	21	5	40
10	0	52	30	20	5	39
11	0	57	41	19	5	38
12	1	2	51	18	5	37
13	1	8	0	17	5	35
14	1	13	8	16	5	34
15	1	18	14	15	5	32
16	1	23	19	14	5	31
17	1	28	23	13	5	29
18	1	33	24	12	5	27
19	1	38	24	11	5	25
20	1	43	23	10	5	23
	+ decreasing. V.s. — decreasing. XI.s.				right. V.s. left. XI.s.	

In Lunar Eclipses change the designation "right" or "left" of the Inclination.

TABLE XVIII.

For the Moon's Latitude in Eclipses.

Argument. Moon's True Anomaly *minus* True Distance from Ascending Node.				
	O.s. — VI.s. +	I.s. — VII.s. +	II.s. — VIII.s. +	
	S.	S.	S.	
0°	0	6	11	30°
5	1	7	11	25
10	2	8	12	20
15	3	9	12	15
20	4	10	12	10
25	5	10	13	5
30	6	11	13	0
	+ XI.s. — V.s.	+ X.s. — IV.s.	+ IX.s. — III.s.	

TABLE XIX.

For the Moon's Latitude in Eclipses.

Argument. Preceding argument, *plus* Moon's True Anomaly.				
	O.s. + VI.s. —	I.s. + VII.s. —	II.s. + VIII.s. —	
	S.	S.	S.	
0°	0	13	22	30°
5	2	15	23	25
10	4	17	24	20
15	7	18	25	15
20	9	20	25	10
25	11	21	26	5
30	13	22	26	0
	— XI.s. + V.s.	— X.s. + IV.s.	— IX.s. + III.s.	

TABLE XX.

For the Moon's Latitude in Eclipses.

Argument. Moon's True Anomaly *plus* True Distance from Ascending Node.				
	O.s. + VI.s. —	I.s. + VII.s. —	II.s. + VIII.s. —	
	S.	S.	S.	
0°	0	8	15	30°
5	1	10	15	25
10	3	11	16	20
15	4	12	16	15
20	6	13	17	10
25	7	14	17	5
30	8	15	17	0
	— XI.s. + V.s.	— X.s. + IV.s.	— IX.s. + III.s.	

TABLE XXI.

For the Moon's Latitude in Eclipses.

Argument. Sun's True Anomaly *plus* Moon's True Distance from Ascending Node.				
	O.s. + VI.s. —	I.s. + VII.s. —	II.s. + VIII.s. —	
	S.	S.	S.	
0°	0	10	17	30°
5	2	11	18	25
10	3	13	18	20
15	5	14	19	15
20	7	15	19	10
25	8	16	20	5
30	10	17	20	0
	— XI.s. + V.s.	— X.s. + IV.s.	— IX.s. + III.s.	

TABLE XXII.

For the Moon's Latitude in Eclipses.

Argument. Sun's True Anomaly *minus* Moon's True Distance from Ascending Node.				
	O.s. + VI.s. —	I.s. + VII.s. —	II.s. + VIII.s. —	
	s.	s.	s.	
0°	0	16	28	30°
5	3	19	30	25
10	6	21	31	20
15	8	23	31	15
20	11	25	32	10
25	14	27	32	5
30	16	28	33	0
	—	—	—	
	XI.s. + V.s.	X.s. + IV.s.	IX.s. + III.s.	

TABLE XXIV.

Diminution of the Moon's Equatorial Horizontal Parallax, and of the Latitude of a Place, on account of the Spheroidal Figure of the Earth.

Arguments. Latitude at the Side, and Moon's Horizontal Parallax at the Top.				
	Diminution of Parallax.			Diminution of Latitude.
	M. 53	M. 57	M. 61	
	s.	s.	s.	m.
0°	0	0	0	0·0
5	0	0	0	2·0
10	0	0	0	4·0
15	1	1	1	5·8
20	1	1	1	7·5
25	2	2	2	8·9
30	3	3	3	10·1
35	3	4	4	11·0
40	4	5	5	11·5
45	5	6	6	11·7
50	6	7	7	11·5
55	7	8	8	11·0
60	8	9	9	10·1
65	9	10	10	9·0
70	10	10	11	7·5
75	10	11	12	5·9
80	10	11	12	4·0
85	11	12	12	2·0
90	11	12	12	0·0

TABLE XXIII

The Moon's Equatorial Horizontal Parallax, Semidiameter, and Horary Motion in her Orbit, at New and Full Moon; and the Semidiameter and Horary Motion of the Sun.

Argument. Moon's True Anomaly, or Sun's Mean Anomaly.						
Argument.	Moon's Equatorial Horizontal Parallax.	Moon's Semidiameter.	Moon's Horary Motion.	Sun's Semidiameter.	Sun's Horary Motion.	Argument.
s.	M. s.	M. s.	M. s.	M. s.	M. s.	s.
O. 0°	61 23	16 44	38 13	16 18	2 33	XII. 0°
6	61 22	16 43	38 11	16 18	2 33	24
12	61 18	16 42	38 7	16 17	2 33	18
18	61 12	16 41	37 59	16 17	2 33	12
24	61 4	16 38	37 49	16 16	2 32	6
I. 0	60 53	16 35	37 36	16 15	2 32	XI. 0
6	60 41	16 32	37 21	16 15	2 32	24
12	60 26	16 28	37 3	16 13	2 32	18
18	60 9	16 23	36 43	16 12	2 31	12
24	59 51	16 19	36 21	16 11	2 31	6
II. 0	59 31	16 13	35 58	16 9	2 30	X. 0
6	59 10	16 7	35 33	16 8	2 30	24
12	58 49	16 2	35 7	16 6	2 29	18
18	58 26	15 55	34 40	16 4	2 29	12
24	58 3	15 49	34 14	16 3	2 28	6
III. 0	57 39	15 43	33 46	16 1	2 28	IX. 0
6	57 16	15 36	33 19	15 59	2 27	24
12	56 53	15 30	32 53	15 58	2 27	18
18	56 30	15 24	32 27	15 56	2 26	12
24	56 8	15 18	32 2	15 55	2 26	6
IV. 0	55 47	15 12	31 39	15 53	2 25	VIII. 0
6	55 28	15 7	31 17	15 52	2 25	24
12	55 10	15 2	30 56	15 51	2 25	18
18	54 53	14 57	30 38	15 49	2 24	12
24	54 38	14 53	30 22	15 48	2 24	6
V. 0	54 25	14 50	30 8	15 48	2 24	VII. 0
6	54 15	14 47	29 56	15 47	2 23	24
12	54 6	14 45	29 47	15 46	2 23	18
18	54 0	14 43	29 40	15 46	2 23	12
24	53 57	14 42	29 36	15 46	2 23	6
VI. 0	53 55	14 42	29 35	15 46	2 23	VI. 0

TABLE XXV.

Epochs of the Mean Longitude of the Sun's Perigee, including the Secular Variation of the Precession of the Equinoxes.

Years.	Longitude of Sun's Perigee.				Secular Variation of Precession of Equinoxes.
B. C. Old Style.	S.	D.	M.	S.	S.
800	7	25	1	10	— 60
700	7	26	43	20	57
600	7	28	25	33	56
500	8	0	7	47	53
400	8	1	50	4	— 50
300	8	3	32	24	49
200	8	5	14	45	46
100	8	6	57	9	44
A. C. Old Style.					
1	8	8	39	35	— 42
101	8	10	22	3	39
201	8	12	4	34	37
301	8	13	47	7	34
401	8	15	29	43	— 33
501	8	17	12	20	30
601	8	18	55	0	27
701	8	20	37	43	25
801	8	22	20	28	— 23
901	8	24	3	15	21
1001	8	25	46	4	18
1101	8	27	28	56	15
1201	8	29	11	51	— 14
1301	9	0	54	47	11
1401	9	2	37	46	8
1501	9	4	20	48	6
1601	9	6	3	52	— 4
1701	9	7	46	58	— 1
A. C. New Style.					
1501	9	4	20	46	— 6
1601	9	6	3	50	4
1701	9	7	46	56	— 1
1801	9	9	30	5	+ 1
1901	9	11	13	16	4
2001	9	12	56	30	

TABLE XXVI.

Mean Motion of the Sun's Perigee in Years, Months, and Days.

Years.	Motion of Sun's Perigee.			Months.	Motion of Sun's Perigee.		Days.	Motion of Sun's Perigee.
	D.	M.	S.		M.	S.		S.
1	0	1	2	January,	0	0	7	1
2	0	2	4	February,	0	5	13	2
3	0	3	6	March,	0	10	19	3
4	0	4	8	April,	0	15	25	4
5	0	5	9					
				May,	0	20	31	5
6	0	6	11	June,	0	26		
7	0	7	13	July,	0	31		
8	0	8	15	August,	0	36		
9	0	9	17					
10	0	10	19	September,	0	41		
				October,	0	46		
20	0	20	38	November,	0	52		
30	0	30	57	December,	0	57		
40	0	41	16					
50	0	51	35					
60	1	1	54					
70	1	12	13					
80	1	22	32					
90	1	32	51					
100	1	43	10					

TABLE XXVII.

The Sun's Declination for the Year 1801, with the Secular Variation.

Argument. Sun's True Longitude.									
	O.s. + VI.s. —		Secular Variation.	I.s. + VII.s. —		Secular Variation.	II.s. + VIII.s. —		Secular Variation.	
	D.	M.	M.	D.	M.	M.	D.	M.	M.	
0°	0	0·0	— 0·0	11	29·1	— 0·4	20	10·4	— 0·7	30
1	0	23·9	— 0·0	11	50·1	— 0·4	20	22·9	— 0·7	29
2	0	47·8	0·0	12	10·9	0·4	20	35·1	0·7	28
3	1	11·6	0·0	12	31·5	0·4	20	46·9	0·7	27
4	1	35·5	0·1	12	52·0	0·4	20	58·3	0·7	26
5	1	59·3	0·1	13	12·2	0·4	21	9·3	0·7	25
6	2	23·1	— 0·1	13	32·2	— 0·4	21	19·9	— 0·7	24
7	2	46·9	0·1	13	51·9	0·5	21	30·2	0·7	23
8	3	10·6	0·1	14	11·5	0·5	21	40·0	0·7	22
9	3	34·3	0·1	14	30·8	0·5	21	49·4	0·7	21
10	3	57·9	0·1	14	49·8	0·5	21	58·4	0·7	20
11	4	21·5	— 0·1	15	8·6	— 0·5	22	7·1	— 0·8	19
12	4	44·9	0·2	15	27·2	0·5	22	15·2	0·8	18
13	5	8·4	0·2	15	45·5	0·5	22	23·0	0·8	17
14	5	31·7	0·2	16	3·5	0·5	22	30·3	0·8	16
15	5	54·9	0·2	16	21·2	0·5	22	37·3	0·8	15
16	6	18·1	— 0·2	16	38·7	— 0·6	22	43·7	— 0·8	14
17	6	41·1	0·2	16	55·9	0·6	22	49·8	0·8	13
18	7	4·1	0·2	17	12·8	0·6	22	55·4	0·8	12
19	7	26·9	0·2	17	29·4	0·6	23	0·6	0·8	11
20	7	49·7	0·3	17	45·6	0·6	23	5·3	0·8	10
21	8	12·3	— 0·3	18	1·6	— 0·6	23	9·6	— 0·8	9
22	8	34·7	0·3	18	17·3	0·6	23	13·4	0·8	8
23	8	57·1	0·3	18	32·6	0·6	23	16·8	0·8	7
24	9	19·3	0·3	18	47·6	0·6	23	19·8	0·8	6
25	9	41·3	0·3	19	2·3	0·6	23	22·3	0·8	5
26	10	3·2	— 0·3	19	16·6	— 0·6	23	24·3	— 0·8	4
27	10	24·9	0·3	19	30·6	0·7	23	25·9	0·8	3
28	10	46·5	0·4	19	44·2	0·7	23	27·0	0·8	2
29	11	7·9	0·4	19	57·5	0·7	23	27·7	0·8	1
30	11	29·1	0·4	20	10·4	0·7	23	27·9	0·8	0
	XI.s. + V.s. —			X.s. + IV.s. —			IX.s. + III.s. —			

Multiply the secular variation by the number of years between the given time and the year 1801, and divide the product by 100. If the given time be before 1801, change the sign of the secular variation.

TABLE XXVIII.

Equation of Time for converting Mean Time into Apparent Time for the Year 1801, with the Secular Variation.

Argument. Sun's True Longitude.

	O.s.	Secular Variation.	I.s.	Secular Variation.	II.s.	Secular Variation.	III.s.	Secular Variation.	IV.s.	Secular Variation.	V.s	Secular Variation.		VI.s.	Secular Variation.	VII.s.	Secular Variation.	VIII.s.	Secular Variation.	IX.s.	Secular Variation.	X.s.	Secular Variation.	XI.s.	Secular Variation.	
	M. S.	S.	M. S.	S.	M. S.	S.	M. S.	S.	M. S.	S.	M. S.	S.		M. S.	S.	M. S.	S.	M. S.	S.	M. S.	S.	M. S.	S.	M. S.	S.	
0°	—7 36	+ 4	+1 9	— 4	+3 49	—10	—1 17	—14	—6 1	—13	—2 23	— 8	0°	+ 7 37	— 3	+15 34	+ 3	+13 36	+10	+ 1 16	+15	—11 25	+15	—14 18	+11	0°
1	—7 17	+ 3	+1 22	— 4	+3 45	—10	—1 31	—14	—6 3	—13	—2 7	— 8	1	+ 7 58	— 3	+15 43	+ 3	+13 20	+10	+ 0 46	+15	—11 42	+15	—14 12	+10	1
2	6 58	3	1 35	5	3 41	11	1 44	14	6 4	—13	1 51	8	2	8 19	3	15 50	3	13 3	10	+ 0 17	15	11 58	14	14 5	10	2
3	6 40	3	1 48	5	3 36	11	1 58	14	6 5	—13	1 34	8	3	8 39	3	15 56	3	12 45	11	— 0 13	15	12 15	14	13 58	10	3
4	6 21	3	2 0	5	3 30	11	2 11	14	6 6	—13	1 17	8	4	8 59	3	16 1	4	12 26	11	0 42	15	12 30	14	13 50	10	4
5	6 2	2	2 12	5	3 24	11	2 24	14	6 6	—13	0 59	7	5	9 19	2	16 5	4	12 6	11	1 12	15	12 44	14	13 41	9	5
6	—5 43	+ 2	+2 22	— 5	+3 17	—11	—2 37	—14	—6 5	—12	0 41	— 7	6	+ 9 39	— 2	+16 9	+ 4	+11 46	+11	— 1 41	+15	—12 57	+14	—13 32	+ 9	6
7	5 24	2	2 32	6	3 10	12	2 50	14	6 3	—12	0 23	7	7	9 59	2	16 12	4	11 25	11	2 10	15	13 9	14	13 22	9	7
8	5 5	1	2 41	6	3 2	12	3 3	14	6 0	12	—0 4	7	8	10 19	2	16 14	5	11 4	12	2 39	15	13 21	14	13 12	9	8
9	4 46	1	2 50	6	2 54	12	3 15	14	5 56	12	+0 15	7	9	10 38	2	16 15	5	10 42	12	3 7	15	13 32	14	13 1	9	9
10	4 27	1	2 58	6	2 45	12	3 27	14	5 52	12	0 34	7	10	10 57	1	16 16	5	10 19	12	3 36	15	13 42	14	12 50	8	10
11	—4 8	+ 1	+3 6	— 7	+2 36	—12	—3 39	—14	—5 47	—12	+0 54	— 6	11	+11 15	— 1	+16 16	+ 5	+ 9 56	+12	— 4 4	+15	—13 51	+13	—12 38	+ 8	11
12	3 50	0	3 14	7	2 27	12	3 51	14	5 42	11	1 14	6	12	11 33	1	16 15	6	9 32	12	4 32	15	13 59	13	12 25	8	12
13	3 31	0	3 22	7	2 17	12	4 2	14	5 36	11	1 35	6	13	11 51	1	16 13	6	9 8	13	4 59	15	14 7	13	12 12	8	13
14	3 13	0	3 29	7	2 7	13	4 13	14	5 29	11	1 56	6	14	12 8	1	16 10	6	8 43	13	5 26	15	14 14	13	11 58	7	14
15	2 54	0	3 35	7	1 56	13	4 23	14	5 22	11	2 17	6	15	12 25	0	16 7	6	8 18	13	5 52	15	14 20	13	11 44	7	15
16	—2 36	— 1	+3 40	— 8	+1 45	—13	—4 33	—14	—5 14	—11	+2 38	— 6	16	+12 41	0	+16 3	+ 7	+ 7 52	+13	— 6 18	+15	—14 25	+13	—11 30	+ 7	16
17	2 18	1	3 44	8	1 33	13	4 43	14	5 6	11	2 59	5	17	12 57	0	15 58	7	7 25	13	6 44	15	14 29	13	11 16	7	17
18	2 0	1	3 48	8	1 20	13	4 52	14	4 57	10	3 20	5	18	13 13	0	15 52	7	6 58	13	7 9	15	14 33	12	11 1	6	18
19	1 42	1	3 52	8	1 8	13	5 1	14	4 47	10	3 41	5	19	13 29	0	15 45	7	6 31	14	7 34	15	14 37	12	10 46	6	19
20	1 25	2	3 54	9	0 56	13	5 9	14	4 36	10	4 2	5	20	13 44	+ 1	15 37	8	6 3	14	7 58	15	14 39	12	10 30	6	20
21	—1 8	— 2	+3 56	— 9	+0 43	—13	—5 17	—14	—4 25	—10	+4 24	— 5	21	+13 58	+ 1	+15 28	+ 8	+ 5 35	+14	— 8 22	+15	—14 40	+12	—10 14	+ 6	21
22	0 52	2	3 58	9	0 30	14	5 24	14	4 14	10	4 45	5	22	14 11	1	15 19	8	5 8	14	8 45	15	14 39	12	9 57	6	22
23	0 36	2	3 59	10	0 17	14	5 31	14	4 2	10	5 7	4	23	14 23	1	15 9	8	4 40	14	9 7	15	14 39	12	9 40	5	23
24	0 20	3	3 59	10	+0 4	14	5 37	14	3 50	9	5 28	4	24	14 35	1	14 58	9	4 11	14	9 29	15	14 38	12	9 23	5	24
25	—0 4	3	3 59	10	—0 9	14	5 43	14	3 37	9	5 49	4	25	14 46	2	14 46	9	3 42	14	9 50	15	14 36	12	9 6	5	25
26	+0 11	— 3	+3 58	—10	—0 23	—14	—5 48	—14	—3 23	— 9	+6 11	— 4	26	+14 57	+ 2	+14 34	+ 9	+ 3 13	+14	—10 10	+15	—14 35	+11	— 8 49	+ 5	26
27	0 26	3	3 57	10	0 36	14	5 52	13	3 9	9	6 33	4	27	15 7	2	14 21	9	2 44	15	10 30	15	14 32	11	8 31	4	27
28	0 41	4	3 55	10	0 50	14	5 55	13	2 54	9	6 55	4	28	15 17	2	14 7	9	2 15	15	10 49	15	14 28	11	8 13	4	28
29	0 55	4	3 52	10	1 3	14	5 58	13	2 39	8	7 16	3	29	15 26	3	13 52	10	1 45	15	11 7	15	14 23	11	7 55	4	29
30	1 9	4	3 49	10	1 17	14	6 1	13	2 23	8	7 37	3	30	15 34	3	13 36	10	1 16	15	11 25	15	14 18	11	7 36	4	30

Multiply the secular variation by the number of years between the given time and the year 1801, and divide the product by 100. If the given time be before 1801, change the sign of the secular variation.

SECT. II.—*Application of the Tables, and Projection of Eclipses.*

PROBLEM I.—*To calculate the time of true new or full moon for any period within the limits of the nineteenth century.*

Precept 1. Write out the time of mean new moon in January for the proposed year from Table I., together with the mean anomalies of the moon and sun, and the moon's mean distance from her ascending node, applying to each of these quantities the secular equation found by its side by addition or subtraction, according as it has the sign + or —. If you want the time of full moon in January, add the half-lunation at the foot of Table IV., with its anomalies, &c. to the former numbers if the new moon falls before the 15th of January; but if it falls after, subtract the half-lunation, with the anomalies, &c. belonging to it, from the former numbers, and write down the respective sums or remainders.

2. In these additions or subtractions, observe that 60 seconds make a minute, 60 minutes make a degree, 30 degrees make a sign, and 12 signs make a circle. When you exceed 12 signs in addition, reject 12, and set down the remainder. When the number of signs to be subtracted is greater than the number you subtract from, add 12 signs to the lesser number, and then you will have a remainder to set down. In the tables, signs are marked S, degrees D, minutes M, and seconds S.

3. When the required new or full moon is in any given month after January, write out from Table IV. such one of the mean lunations, with the anomalies, &c. as, added to the time of mean new or full moon in January, will make the mean new or full moon to fall within the given month, setting them below the number taken out for January.

4. Add all these together, and in leap-years (which in Table I. have the letter B annexed to them) subtract one day from the time of mean new or full moon when it happens after 28th February. You will then have the time of the required mean new or full moon, with the mean anomalies, and the moon's mean distance from the ascending node, which are the arguments for finding the proper equations.

5. With the signs and degrees of the moon's mean anomaly enter Table V., and therewith take out the first equation for reducing the mean syzigy to the true; taking care to make proportions in the table for the odd minutes and seconds of anomaly, as the table gives the equation only to whole degrees.

Observe in this and every other case of finding equations, that, if the signs are at the head of the table, their degrees are at the left hand, and are reckoned downwards; the equation being in the body of the table under or over the signs in a collateral line with the degrees. The signs + and — at the head or foot of the tables where the signs are found, show whether the equation is to be added to the time of mean new or full moon, or to be subtracted from it.

6. With the signs and degrees of the sun's mean anomaly enter Table VI. and take out the second equation for reducing the time of mean to that of new or full moon, with a proportional part of its secular variation in the column adjoining, corresponding to the number of years elapsed since 1801, the whole variation being adapted for a period of 100 years.

7. Add together the mean anomalies of the sun and moon, and with the sum enter Table VII. and take out the third equation. For this and the following equations it will be sufficient to compute the arguments to minutes, neglecting the seconds.

8. Subtract the sun's mean anomaly from the moon's mean anomaly, and with the remainder enter Table VIII. and take out the fourth equation.

9. Subtract the moon's mean anomaly from twice the moon's distance from the ascending node, and with the remainder enter Table IX. and take out the fifth equation.

10. The moon's mean distance from the ascending node is the argument of Table X., with which take out the sixth equation.

11. To twice the moon's mean anomaly add the sun's mean anomaly, and with the sum enter Table XI. and take out the seventh equation.

12. From twice the moon's mean anomaly subtract the sun's mean anomaly, and with the remainder enter Table XII. and take out the eighth equation.

13. These are all the equations for reducing the time of mean new moon to the time of true new moon; but for full moon other two equations are required, the argument for equation ninth being the moon's mean anomaly, which equation is exhibited in Table XIII.; and the argument of the tenth equation being the sun's mean anomaly, the equation being exhibited in Table XIV.

14. Add together the equations which have the sign of addition, and also those which have the sign of subtraction, and subtract the lesser sum from the greater, giving to the remainder the sign of the greater; and add or subtract the remainder, according as its sign denotes, to or from the time of mean new or full moon, and you have the time of true new or full moon required.

These tables are adapted to the meridian of Greenwich observatory; and for any other place, its longitude in time is to be added to or subtracted from the time given by the tables, according as it is to the east or west of Greenwich, and the time as reckoned at the given place is obtained. The tables begin the day at noon, and reckon forward from thence to the noon following. Thus January the 31st, at 22 hours 30 minutes 25 seconds of tabular time, is February 1st (in common reckoning), at 30 minutes 25 seconds after 10 o'clock in the morning. It is to be further observed, that the time obtained from the tables is mean time, or that shown by a well-regulated clock or watch. But to make it agree with solar or apparent time, or that given by a sun-dial, which is necessary in the computation of solar eclipses, you must apply the equation of time contained in Table XXVIII. as afterwards directed.

The method of calculating the time of any new or full moon, without the limits of the nineteenth century, will be shown farther on; and a few examples compared with the precepts will make the whole work plain.

EXAMPLE I.

Required the Time of True New Moon in May 1836 at Edinburgh, long. 0 hours 12 minutes 44 seconds west of Greenwich.

		Time of New Moon.				Moon's Mean Anomaly.				Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.			
		D.	H.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
1836. B		18	1	31	49	1	14	50	49	0	16	53	45	8	0	56	0
Secular equations					— 3				+ 5								— 1
Four lunations	April..	28	2	56	11	3	13	16	3	3	26	25	17	4	2	40	54
Sum	May..	16	4	27	57	4	28	6	57	4	13	19	2	0	3	36	53
Subtract 1 day for leap-year		1															
	May..	15	4	27	57												
Sum of equations			— 2	24	2												
Time of true new moon at Greenwich	May..	15	2	3	55												
Subtract for Edinburgh				12	44												
True time of new moon at Edinburgh	May..	15	1	51	11												

EQUATIONS.

	S.	D.	M.	S.	+ H.	M.	S.	— H.	M.	S.
Argument I. ☽ mean anomaly	4	28	6	57				5	31	43
II. ☉ mean anomaly	4	13	19	2	3	0	15			
Secular variation										10
III. ☽ mean anomaly + ☉ mean anomaly	9	11	26			6	58			
IV. ☽ mean anomaly — ☉ mean anomaly	0	14	48			2	42			
Twice ☽ mean distance from ascending node	0	7	14							
V. Do. — ☽ mean anomaly	7	9	7						1	39
VI. ☽ mean distance from node	0	3	7				12			
Twice ☽ mean anomaly	9	26	14							
VII. Do. + ☉ mean anomaly	2	9	33							34
VIII. Do. — ☉ mean anomaly	5	12	55							3
					+ 3	10	7	— 5	34	9
								+ 3	10	7
Sum of equations								— 2	24	2

EXAMPLE II.

Required the Time of True Full Moon in September 1830 at Greenwich.

		Time of Full Moon.				Moon's Mean Anomaly.				Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.			
		D.	H.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
1830		23	19	12	17	9	24	23	46	0	23	5	59	4	11	18	53
Secular equations					— 2				+ 3								— 1
Subtract a half-lunation		14	18	22	1	6	12	54	30	0	14	33	10	6	15	20	7
Full moon	Jan.	9	0	50	14	3	11	29	13	0	8	32	49	9	25	58	45
Eight lunations	Aug.	24	5	52	23	6	26	32	7	7	22	50	35	8	5	21	48
	Sept.	2	6	42	37	10	8	1	20	8	1	23	24	6	1	20	33
Sum of equations			+ 3	54	10												
True full moon		2	10	36	47												

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EQUATIONS.

	S.	D.	M.	S.	+ H.	M.	S.	— H.	M.	S.
Argument I.	10	8	1	20	7	21	32			
II.	8	1	23	24				3	38	33
Secular variation.....							10			
III.	6	9	24			1	10			
IV.	2	6	38			9	43			
V.	1	24	40			2	8			
VI.	0	1	21				5			
VII.	4	17	25							24
VIII.	0	14	39							3
IX.	10	8	1						1	9
X.	8	1	23							29
					+7	34	48	—3	40	38
					—3	40	38			
Sum of equations.....					+3	54	10			

PROBLEM II.—*To calculate the time of new and full moon in a given year and month of any particular century between the Christian era and the nineteenth century.*

Note.—Prior to the sixteenth century the times are supposed to be reckoned according to the Julian calendar, or old style. Between it and the nineteenth century they may be reckoned according to either the Julian or Gregorian calendar, or old or new style.

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Precept 1. Find a year of the same number in the nineteenth century, with that of the year in the century proposed, and take out the time of mean new moon in January for that year, with the mean anomalies, and the moon's mean distance from the node at that time, as already taught, neglecting the secular equations contained in Table I.

Precept 2. Take from Table II. as many complete centuries of years having the sign — prefixed, and titled either old style or new style, according to the given date, as, when subtracted from the above said year in the nineteeth century, will answer to the given year, and take out the time of mean new moon and its anomalies, &c. belonging to the said centuries, and add them to those for the year in the nineteenth century, and the sums, after applying to them the secular equations taken from Table III., making proportions for the odd years, will be the times and anomalies, &c. of mean new moon in January or February, according as the time is less or more than 31 days, in the given year of the century proposed. Then work in all respects for the time of true new or full moon, as shown in the above precepts and examples.

EXAMPLE III.

Required the True Time of New Moon in July 1339, Old Style.

		Time of New Moon. D.	H.	M.	S.	Moon's Mean Anomaly. S.	D.	M.	S.	Sun's Mean Anomaly. S.	D.	M.	S.	Moon's Mean Distance from Ascending Node. S.	D.	M.	S.
1839		14	16	41	35	9	10	4	21	0	13	47	38	9	25	44	34
— 500		25	8	52	43	7	4	4	42	1	11	36	18	2	24	9	33
1339		40	1	34	18	4	14	9	3	1	25	23	56	0	19	54	7
Secular equations.....			—	7	39			+13	44			—36				— 2	43
		40	1	26	39	4	14	22	47	1	25	23	20	0	19	51	24
Five lunations.....	May...	27	15	40	14	4	9	5	4	4	25	31	37	5	3	21	8
	July...	6	17	6	53	8	23	27	51	6	20	54	57	5	23	12	32
Equations.....			+ 8	26	6												
Time of true new moon..	July...	7	1	32	59												

EQUATIONS.

	S.	D.	M.	S.	+ H.	M.	S.	— H.	M.	S.
Argument I.	8	23	27	51	9	50	21			
II.	6	20	54	57				1	27	56
Secular variation.....									1	0
III.	3	14	23						6	52
IV.	2	2	33			9	23			
V.	2	22	57			2	36			
VI.	5	23	13							27
VII.	0	7	51							5
VIII.	10	26	1				6			
					+10	2	26	—1	36	20
					—1	36	20			
Sum of equations.....					+ 8	26	6			

PROBLEM III.—*To calculate the true time of new or full moon in any given year and month before the Christian era.*

Precept 1. Find a year in the nineteenth century which, being added to the given number of years before Christ diminished by one, shall make a number of complete centuries.

2. Find this number of centuries in Table II. and add the time and anomalies belonging to it to those of the above-found year of the nineteenth century, applying the secular equations for the given year in Table III., and the sums will denote the time and anomalies, &c. of mean new moon in January or February of the given year before Christ. Then for the true time of new or full moon proceed as above taught, for any year between the Christian era and the nineteenth century, observing that the given year before Christ is or is not leap-year, according as the above-mentioned year in the nineteenth century is leap-year or not.

EXAMPLE IV.

Required the True Time of New Moon in September 610 before Christ.

		Time of New Moon.				Moon's Mean Anomaly.				Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.			
		D.	H.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
1891		9	20	44	18	10	20	20	33	0	8	32	8	7	6	53	20
— 2500		27	4	43	18	7	11	18	23	2	2	29	56	8	27	26	33
610 B. C.		37	1	27	36	6	1	38	56	2	11	2	4	4	4	19	53
Secular equations			—3	20	0		+ 5	58	37			—16	7		—1	10	56
		36	22	7	36	6	7	37	33	2	10	45	57	4	3	8	57
Eight lunations	August	24	5	52	23	6	26	32	7	7	22	50	35	8	5	21	48
	Sept...	30	3	59	59	1	4	9	40	10	3	36	32	0	8	30	45
Equations			—8	41	51												
Time of true new moon.	Sept...	29	19	18	8												

EQUATIONS.

	S.	D.	M.	S.	+ H.	M.	S.	— H.	M.	S.
Argument I.	1	4	9	40				5	9	13
II.	10	3	36	32				3	32	36
Secular variation									12	51
III.	11	7	46			2	41			
IV.	3	0	33			10	35			
V.	11	12	51							46
VI.	0	8	31				34			
VII.	0	11	56							7
VIII.	4	4	42							8
					+ 0	13	50	—8	55	41
								+ 0	13	50
Sum of equations								— 8	41	51

PROBLEM IV.—*To calculate the time of true new or full moon, according to the Gregorian calendar or new style, in any given year or month of the 20th or 21st century.*

Precept 1. Find a year of the same number in the nineteenth century with that of the year proposed, and take out the mean time and anomalies, &c. of new moon for that year in Table I., omitting the secular equations.

2. Take so many years from Table II. having the sign + prefixed, as, when added to the above-mentioned year in the nineteenth century, will answer to the given year in which the new or full moon is required; and take out the time of new moon, with its anomalies, for these complete centuries.

3. Add these together, and to the sum apply the secular equations for the given year found in Table III., then work in all respects as above shown.

EXAMPLE V.

Required the Time of True New Moon in August 1999.

		Time of New Moon.				Moon's Mean Anomaly.				Sun's Mean Anomaly.				Moon's Mean Distance from Ascending Node.			
		D.	H.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.	S.	D.	M.	S.
1899		11	9	25	2	11	26	12	58	0	9	57	56	0	13	16	14
+ 100		5	8	7	5	8	15	30	40	0	3	19	16	4	19	26	11
1999		16	17	32	7	8	11	43	38	0	13	17	12	5	2	42	25
Secular equations				—1	25			+ 2	32				—7				—30
		16	17	30	42	8	11	46	10	0	13	17	5	5	2	41	55
Seven lunations	July....	25	17	8	20	6	0	43	6	6	23	44	16	7	4	41	35
	August	11	10	39	2	2	12	29	16	7	7	1	21	0	7	23	30
Equations			—11	37	28												
Time of true new moon..		10	23	1	34												

EQUATIONS.

	S.	D.	M.	S.	+ H.	M.	S.	— H.	M.	S.
Argument I.	2	12	29	16				9	8	24
II.	7	7	1	21				2	28	47
Secular Variation..							44			
III.	9	19	31				6 42			
IV.	7	5	28						6	8
V.	10	2	18						2	13
VI.	0	7	23				0 30			
VII.	0	2	0							1
VIII.	9	17	57				9			
					+ 0	8	5	—11	45	33
								+ 0	8	5
Sum of equations.....								—11	37	28

PROBLEM V.—*To find the true anomalies of the sun and moon, and the moon's true distance from the ascending node at the true time of new or full moon.*

With the sum of equations already found for reducing the time of mean new or full moon to that of the true, enter Table XV., and take therefrom the sun's mean motion from the moon's perigee, the change of the sun's mean anomaly, and the sun's mean motion from the ascending node, and apply these quantities to the mean anomalies and mean distance from the node at the time of mean new or full moon by addition or subtraction, according as the sum of the equations has the sign + or —. Then with the sun's corrected mean anomaly as argument, take from Table XVI. the equation of the sun's centre, correcting it for the secular variation as directed at the bottom of the table, and add or subtract the same to or from the corrected mean anomalies and mean distance from the node, and there will be obtained the true anomalies of the sun and moon, and the moon's true distance from the ascending node at the time of true new moon or full moon.

EXAMPLE VI.

Required the True Anomalies of the Sun and Moon, and the Moon's True Distance from the Ascending Node at the time of True New Moon in 1836.

The Sum of Equations is — 2h. 24m. 2s.

	Sun's Mean Motion from Moon's Perigee.				Sun's Mean Anomaly.				Sun's Mean Motion from Ascending Node.			
	S.	O.	M.	S.	S.	O.	M.	S.	S.	O.	M.	S.
2 Hours.....	0	0	4	22	0	0	4	56	0	0	5	12
24 Minutes.....				52				59			1	2
2 Seconds.....				0				0				0
			— 5	14			— 5	55			— 6	14
Mean anomalies, &c.....	4	28	6	57	4	13	19	2	0	3	36	53
	4	28	1	43	4	13	13	7	0	3	30	39
Equation of sun's centre.....		+ 1	22	57		+ 1	22	57		+ 1	22	57
Secular variation.....			—	4			—	4			—	4
	4	29	24	36	4	14	36	0	0	4	53	32
	Moon's True Anomaly,				Sun's True Anomaly,				Moon's True Distance from Ascending Node,			
	At True New Moon.											

Elements for the Projection of Solar Eclipses.

When at the time of true new moon the moon's true distance from the ascending node is between 11s 11° 50′ and 0s 18° 10′, or 5s 11° 50′ and 6s 18° 10′, there may at that time be an eclipse of the sun to some place on the earth's surface; but if it is beyond those limits there can be no eclipse. At the new moon in May 1836, the moon's distance from the node being within the limits, there may be an eclipse of the sun at that time.

It being ascertained that there may be an eclipse, the elements for predicting it are to be obtained as explained in the following example of the solar eclipse in May 1836, which is to be predicted, as it will happen at Edinburgh, in latitude 55° 57′ N.

1. *The moon's latitude at the true time of new moon.* The moon's true distance from the ascending node at the time of true new moon is the argument of Table XVII.; the moon's true anomaly *minus* her true distance from the ascending node is the argument of Table XVIII.; this argument *plus* the moon's true anomaly is the argument of Table XIX.; the moon's true anomaly *plus* her true distance from the ascending node is the argument of Table XX.; the sun's true anomaly *plus* the moon's true distance from the ascending node is the argument of Table XXI.; and the sun's true anomaly *minus* the moon's true distance from the ascending node is the argument of Table XXII. With these arguments enter the respective tables, and take out the proper quantities, and add together such as have the sign +, and also such as have the sign —, and the difference of the two sums is the moon's latitude required, north if the greater sum has the sign +, south if it has —.

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Example.

The Moon's Latitude at the time of true New Moon in May 1836.

	s.	d.	m.	s.	+ d.	m.	s.	— s.
Arg. Table XVII.	0	4	53	32	0	25	47	
.... XVIII.	4	24	31					7
.... XIX.	9	23	56					23
.... XX.	5	4	18				7	
.... XXI.	4	19	30				13	
.... XXII.	4	9	42				25	
					+ 0	26	32	— 30
							— 30	
Moon's latitude north.....					+ 0	26	2	

II. *The inclination of the moon's relative orbit to the ecliptic* is found in Table XVII., with the moon's true distance from the ascending node for argument. In the present instance the inclination is 5° 43', left, signifying that the axis of the moon's orbit is to the left hand of the northern axis of the ecliptic.

III. *The semidiameter of the earth's disk* is equal to the difference of the moon's horizontal parallax corrected for the latitude of the given place, and the sun's horizontal parallax, which may always be assumed equal to nine seconds. The moon's equatorial horizontal parallax is found in Table XXIII., with her true anomaly for argument; and the correction to be subtracted therefrom is obtained in Table XXIV., with the latitude of the place and equatorial parallax as joint arguments. Thus, in the present instance, the moon's equatorial horizontal parallax is.....54′ 26″
The correction to be subtracted..... 8″

Leaving for reduced horizontal parallax.....54′ 18″
which being again diminished by the sun's horizontal parallax, there remains 54′ 9″ for the semidiameter of the earth's disk.

IV. *The sun's semidiameter* is also obtained in Table XXII., with his mean anomaly as argument. We have, therefore, sun's semidiameter 15′ 51″.

V. *The moon's semidiameter* is likewise obtained in Table XXII., with her true anomaly as argument. Hence, moon's semidiameter = 14′ 50″. Practical Astronomy

VI. *The moon's horary motion from the sun* is equal to the difference of the sun's and moon's horary motions; both of which are found in Table XXII., with the sun's mean anomaly and the moon's true anomaly as arguments. Hence

Sun's horary motion ..... 2′ 25″
Moon's horary motion .....30′ 9″
Moon's horary motion from the sun.....27′ 44″

VII. *The sun's true longitude at the true time of new moon* is equal to the longitude of the sun's perigee added to his true anomaly. The longitude of the perigee is obtained by taking from Table XXV. the epoch of the first year of the century to which the given year belongs, and adding thereto the motion in Table XXVI. answering to the remaining number of years, months, and days, but subtracting therefrom a proportional part of the secular variation of the precession of the equinoxes found in Table XXV. opposite the first year of the given century, corresponding to the remaining number of years.

Example.

	Longitude of Perigee. s.	d.	m.	s.
1801.....	9	9	30	5
30 years.....			30	57
5 do.....			5	9
May.....				20
15 days.....				2
Longitude of perigee...	9	10	6	33
Sun's true anomaly.....	4	14	36	0
Sun's true longitude.....	1	24	42	33

VIII. *The sun's declination* is found in Table XXVII., with the sun's true longitude for argument, and is to be corrected by the secular variation given in the same table, as directed at the bottom. The declination is north or south according as it bears the sign + or —, and, in the table, is given to tenths of a minute.

Example.

	s.	d.	m.	s.		d.	m.
Sun's true longitude.....	1	24	42	33	Declination	+18	58·0
Secular variation		$\frac{-0{\cdot}6 \times 35}{100}$			=		−0·2
Sun's declination, north.....						+18	57·8

IX. *The apparent time of new moon.* The mean time of new moon, already found and reduced to the place for which the prediction is to be made, is to be converted into apparent time, by applying thereto, according to the sign, the equation of time found in Table XXVIII., with the sun's true longitude for argument, and corrected for the secular variation given in the same table, as in the following example:

Example.

Mean time of true new moon at Edinburgh on May 15, 1836..... H. 1 M. 51 S. 11

	s.	d.	m.		m.	s.	
Sun's true longitude	1	24	43	Equation of time,	+3	59	
Secular variation.....	$\frac{-10^s \times 35}{100}$			=	−3		.....+3 56

Apparent time of true new moon..... 1 55 7

X. *The reduced latitude of the given place* is obtained by subtracting from the true latitude the correction in the last column of Table XXIV. answering to the latitude. In this particular case,

Edinburgh being in north latitude.....55° 57′
The correction is..... 10′·8

Reduced latitude.....55° 46′·2

Practical Astronomy

To Project an Eclipse of the Sun geometrically.

Take from a scale of any convenient length as many equal parts as the semidiameter of the earth's disk contains minutes of a degree, which for Edinburgh at the time of the eclipse in May 1836 is 54′ 10″, or 54$\frac{1}{6}$′. Then with this quantity as a radius describe the semicircle AHB upon the centre C (Plate XCI. fig. 136); which semicircle shall represent the northern half of the earth's enlightened disk as seen from the sun. If the given place were in south latitude, the southern half of the earth's disk must be represented.

Upon the centre C raise the straight line CH perpendicular to the diameter ACB; so ACB shall be a part of the ecliptic, and CH its axis.

Being provided with a sector,[1] open it to the radius CA in the line of chords; and taking from thence the chord of the sun's greatest declination or the obliquity of the ecliptic for the given time (in the present instance 23° 28′) in your compasses, set it off both ways from H to *g*, and to *h* in the periphery of the semi-disk; and draw the straight line *g* V *h*, in which the north pole of the disk will be always found.

When the sun's longitude is between O^s. and VI^s. the north pole of the earth is enlightened by the sun; but whilst the sun is in the other six signs, the south pole is enlightened and the north pole is in the dark.

And when the sun's longitude is between IX^s. and III^s. the northern half of the earth's axis C XII. P lies to the right hand of the axis of the ecliptic as seen from the sun; and to the left hand while the sun is in the other six signs. It is evident that a contrary rule prevails with regard to the southern half of the earth's axis.

Open the sector till the radius of the sines be equal to the length of V^h, and take the sine of the difference of the sun's longitude from III.^{s} or IX.^{s}, whichever it is nearest (in the present instance 35° 17′), in your compasses from the line of the sines, and set off that distance from V to P in the line *g*V*h*, because the northern half of the earth's axis lies to the right hand of the axis of the ecliptic in this case; and draw the straight line C XII. P for the earth's axis, of which P is the north pole. If the earth's axis had lain to the left hand of the axis of the ecliptic, the distance VP would have been set off from V towards *g*.

To draw the parallel of latitude of the given place, Edinburgh, or the path of that place, on the earth's enlightened disk, as seen from the sun from sunrise till sunset, take the following method:—

Find the sum and difference of the reduced latitude 55° 46′ and the sun's declination 18° 58′, which are 74° 44′ and 36° 48′. Take these arcs from the line of sines on the sector, CA being radius, and set them off from C to the two points, each marked XII. in the line of the earth's axis.

Bisect XII. — XII., and through the point K draw the line VI. K VI. perpendicular to the axis. Then, making CA or CB the radius of a line of sines on the sector, take the co-latitude of Edinburgh, 34° 14′, from the sines in your compasses, and set it both ways from K to VI. and VI. These hours will be just in the edge of the disk at the equinoxes; but at no other time in the whole year.

With the extent K VI. taken into your compasses, set one foot in K as a centre, and with the other foot describe the semicircle VI., 7, 8, 9, 10, &c., and divide it into 12 equal parts. Then from these points of division draw lines parallel to the earth's axis C XII. P.

With the extent K XII. as a radius, describe the quadrantal arc XII. *f*, and divide it into six equal parts, as XII. *a*, *ab*, *bc*, *cd*, *de*, and *ef*, and through the division points, *a*, *b*, *c*, *d*, *e*, draw the lines VII. *e* V., VIII. *d* IV., IX. *c* III., X. *b* II., and XI. *a* I., all parallel to VI. K VI., and meeting the former lines in the points VII., VIII., IX., X., XI., V., IV., III., II., and I.; which points shall mark the several situations of Edinburgh on the earth's disk, at these hours respectively as seen from the sun; and the elliptic curve VI., VII., VIII., &c. being drawn through these points, shall represent the parallel of latitude, or path of Edinburgh, as seen from the sun from six in the morning to six in the afternoon. On continuing the lines VII. *p*, VIII. *o*, &c. IV. *u*, V. *x*, &c. on the other side of VI. K VI., and setting off *p* V. equal to VII. *p*, *o* IV. equal to VIII. *o*, &c., and continuing the elliptic curve through the points V. IV. &c., VII. VIII. &c., the path of Edinburgh, as seen from the sun before six in the morning and after six in the afternoon, will be had; but it is needless to draw the curve farther than the points where it meets the periphery of the earth's disk, which represent the times of sunrise and sunsetting.

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N. B. If the sun's declination had been south, the diurnal path of Edinburgh would have been on the upper side of the line VI. K VI. If the latitude of the given place were south, in which case the southern half of the earth's disk would be represented, the diurnal path between six in the morning and six in the afternoon would be between the line VI. K VI. and the centre of the disk, when the sun's declination was south, and the contrary when north. It is requisite to divide the horary spaces into quarters as in the figure, and if possible into minutes also.

In the present case the northern half of the axis of the moon's relative orbit lies to the left hand of the axis of the ecliptic. Make CB the radius of a line of chords on the sector, and taking therefrom the chord of 5° 43′, the inclination of the moon's relative orbit to the ecliptic, set it off from H to M on the left hand of CH, the axis of the ecliptic; then draw CM for the axis of the moon's orbit, and take the moon's latitude 26′ 2″ from the scale CA in your compasses, and set it from C to *y* in the line CH, and through *y* draw the straight line N*y*S at right angles to the axis of the moon's orbit CM for the path of the penumbra's centre over the earth's disk.

Take the moon's horary motion from the sun, 27′ 44″, in your compasses, from the scale CA (every division of which is a minute of a degree), and with that extent make marks along the path of the penumbra's centre, and divide each space from mark to mark into 60 equal parts or horary minutes by dots; and set the hours to every 60th minute in such a manner that the dot signifying the instant of new moon by the tables may fall into the point Z, half-way between the axis of the moon's orbit and the axis of the ecliptic; and then the rest of the dots will show the points of the earth's disk, where the penumbra's centre is at the instants denoted by them in its transit over the earth.

Apply one side of a square to the line of the penumbra's path, and move the square backwards and forwards, until the other side of it cuts the same hour and minute (as at 3 hours and 2$\frac{1}{2}$ minutes) both in the path of Edinburgh and in the path of the penumbra's centre; and the particular minute or instant so pointed out is the instant of the greatest obscuration of the sun, at the place for which the construction is made, namely, Edinburgh in the present example.

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[1] Although a sector be a convenient instrument in these projections, yet it is not absolutely necessary. The intelligent student will be able to lay off an arc of any number of degrees, also to make an angle of a given number of degrees, in various ways.

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Take the sun's semidiameter, 15′ 51″, in your compasses, from the scale CA, and setting one foot on the path of Edinburgh, at the point answering to the instant of the greatest obscuration, namely, at $2\frac{1}{2}$ minutes past three, with the other foot describe the circle UY, which represents the sun's disk as seen from Edinburgh at the greatest obscuration. Then take the moon's semidiameter, 14′ 50″, in your compasses, from the same scale, and setting one foot on the path of the penumbra's centre at the point $2\frac{1}{2}$ minutes past three, describe the circle TX for the moon's disk as seen from Edinburgh at the time when the eclipse is at the greatest, and the portion of the sun's disk which is hid or cut off by the moon's will show the quantity of the eclipse at that time; which quantity may be measured on a line equal to the sun's diameter, and divided into 12 equal parts for digits. As the moon's disk is entirely contained within the sun's, the eclipse as seen from Edinburgh will be annular.

Lastly, take the sum of the semidiameters of the sun and moon, 30′ 41″, from the scale CA, in your compasses; and setting one foot in the line of the penumbra's centre path, on the left hand from the axis of the ecliptic, direct the other foot toward the path of Edinburgh, and carry that extent backwards and forwards till both the points of the compasses fall into the same instants in both the paths, and these instants will denote the time when the eclipse begins at Edinburgh. Then do the like on the right hand of the axis of the ecliptic; and where the points of the compasses fall into the same instants in both the paths, they will show at what time the eclipse ends at Edinburgh.

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These trials give $35\frac{1}{2}$ minutes after one in the afternoon for the beginning of the eclipse at Edinburgh at the points N and O, $2\frac{1}{2}$ minutes after three for the time of greatest obscuration, and $23\frac{1}{2}$ minutes after four at R and S for the time when the eclipse ends, according to apparent time. To have the mean time, or that shown by well-regulated clocks and watches, apply the equation of time in the contrary manner to that used for converting the mean time of new moon into apparent time. Therefore, in the present instance, subtract 3 minutes 56 seconds, or 4 minutes approximately, from the apparent times, and we have

	H.	M.	
Beginning of eclipse at Edinburgh,	1	$31\frac{1}{2}$	P. M.
Greatest obscuration	2	$58\frac{1}{2}$	—
End of eclipse.....	4	$19\frac{1}{2}$	—

all according to mean time.

The Projection of Lunar Eclipses.

When the moon's mean distance from either of her nodes at the time of mean full moon is less than 13° 21′ there may be an eclipse of the moon; but if greater, there cannot be an eclipse.

We find by Example II. that at the time of mean full moon in September 1830, the moon's mean distance from the descending node is only 1° 20′ 33″, which being so much less than the limit, there will then be an eclipse.

By Problem V. find the true anomalies of the sun and moon, and the moon's true distance from the ascending node, at the true time of full moon.

Sum of Equations, + 3h. 54m. 10s.

	Sun's Mean Motion from Moon's Perigee.				Sun's Mean Anomaly.				Sun's Mean Motion from Ascending Node.			
	S.	O.	M.	S.	S.	O.	M.	S.	S.	O.	M.	S.
3 Hours.....	0	0	6	33	0	0	7	23	0	0	7	47
54 Minutes.....			1	58			2	13			2	20
10 Seconds.....				0				0				0
			+ 8	31			+ 9	36			+ 10	7
Mean anomalies, &c.....	10	8	1	20	8	1	23	24	6	1	20	33
	10	8	9	51	8	1	33	0	6	1	30	40
Equation of sun's centre.....		— 1	40	30		— 1	40	30		— 1	40	30
Secular variation.....				+ 4				+ 4				+ 4
	10	6	29	25	7	29	52	34	5	29	50	14
	Moon's True Anomaly,				Sun's True Anomaly,				Moon's True Distance from Ascending Node,			
	At True Full Moon.											

The elements for constructing an eclipse of the moon are eight in number, as follows:

1. The true time of full moon, and at that time; 2. the moon's horizontal parallax; 3. the sun's semidiameter; 4. the moon's; 5. the semidiameter of the earth's shadow at the moon; 6. the moon's latitude; 7. the angle of the moon's visible path with the ecliptic; 8. the moon's true horary motion from the sun. Therefore,

1. *To find the true time of full moon.* Work as already taught in the precepts. Thus we have the true time of full moon in September 1830 (see Example II.) to be the 2d day at $10^h.\ 36^m.\ 47^s.$ mean time at Greenwich.

2. *To find the moon's horizontal parallax.* Enter Table XXIII. with the moon's true anomaly $10^s.\ 6°\ 29'\ 25''$, and thereby take out her horizontal parallax; which, by making the requisite proportions, will be found to be 59′ 52″.

3. 4. *To find the semidiameters of the sun and moon.* Enter Table XXIII. with the sun's mean anomaly and moon's true anomaly ($8^s.\ 1°\ 33'\ 0''$ and $10^s.\ 6°\ 29'\ 25''$), and thereby take out their respective semidiameters, the sun's 15′ 54″, and the moon's 16′ 19″.

5. *To find the semidiameter of the earth's shadow at the moon.* Add the sun's horizontal parallax, which is always 9″, to the moon's, which in the present case is 59′ 52″; the sum is 60′ 1″, from which subtract the sun's semidiameter, 15′ 54″, and the remainder, 44′ 7″, being increased by 50″ for the effect of the earth's atmosphere, we have 44′ 57″ for the semidiameter of the earth's shadow, which the moon then passes through.

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6. *To find the moon's latitude.* Proceed as already directed under the prediction of solar eclipses. Thus,

	s.	°	′	″	+ s.	— s.
Argument, Table XVII.	5	29	50	14	52	
XVIII.	4	6	39			10
XIX.	2	13	9		25	
XX.	4	6	20		14	
XXI.	1	29	43		17	
XXII.	2	0	2		28	
					+ 2 16	— 10
					—10	

Moon's latitude north + 2 6

7. *To find the angle of the moon's visible path with the ecliptic.* Enter Table XVII. with the moon's true distance from the ascending node for argument, and the angle is found to be 5° 44′, left, signifying that the axis of the moon's orbit is to the left hand of the northern axis of the ecliptic.

8. *To find the moon's true horary motion from the sun.* With the true anomaly of the moon and the mean anomaly of the sun, take out their horary motions from Table XXIII., and the sun's horary motion subtracted from the moon's leaves remaining the moon's true horary motion from the sun; in the present case 33′ 58″.

These elements being found for the construction of the moon's eclipse in September 1830, proceed as follows:

Draw the line ACB for part of the ecliptic, and CD perpendicular thereto for the northern part of its axis, the moon having north latitude. (Plate XCI. fig. 137.)

Add the semidiameters of the moon's and earth's shadow together, which in the eclipse make 61′ 16″; and take this in your compasses, from a scale of equal parts, and setting one foot on the point C as a centre, with the other foot describe the arch ADB, in one point of which the moon's centre will be at the beginning of the eclipse, and in another at the end thereof.

Take the semidiameter of the earth's shadow, 44′ 57″, in your compasses, from the scale, and setting one foot in the centre C, with the other foot describe the semicircle KLM for the northern half of the earth's shadow; because the moon's latitude is north in this eclipse.

Subtract the semidiameter of the moon from the semidiameter of the earth's shadow, and the remainder is 28′ 38″, which take in your compasses from the scale, and setting one foot on the point C as a centre, with the other foot describe the arch OPQ; in one point of which the moon's centre will be at the beginning of total darkness, and in another at the end thereof.

Draw the line CE on the left hand of the northern axis of the ecliptic, and making an angle of 5° 44′ therewith, which line represents the northern part of the axis of the moon's orbit, the moon's latitude being north. Practical Astronomy

Take the moon's latitude, 2′ 6″, from the scale with your compasses, and set it from C to G in the axis of the ecliptic, and through the point G draw the straight line RSGTU, at right angles to the axis of the moon's orbit, for the path of the moon's centre. Then F, in the line CE, is the point in the earth's shadow where the moon's centre is at the middle of the eclipse; G, the point where her centre is at the instant of her ecliptical conjunction; and the middle between them, the point where her centre is at the time of true full moon by the tables.

Take the moon's horary motion from the sun, 33′ 58″, in your compasses, from the scale, and with that extent make marks along the line of the moon's path; then divide each space from mark to mark into 60 equal parts or horary minutes, and set the hours to the proper dots, in such a manner, that the dot signifying the instant of full moon (36 minutes and 47 seconds after ten) may be midway between the points F and G.

The point U, where the moon's path intersects on the right hand the arch described with the sum of the semidiameters of the moon and earth's shadow, denotes the instant when the eclipse begins, namely, at 52 minutes after eight; the point T, where the moon's path intersects on the right hand the arch described, with the difference of the semidiameters, denotes the instant when the moon's total darkness begins, namely, at 48 minutes after nine; the point F denotes the middle of the eclipse at 39 minutes after 10; the point S, where the moon's path intersects on the left hand the arch described, with the difference of the semidiameters, denotes the end of the moon's total darkness at 30 minutes after eleven; and the point R, where the moon's path intersects the arch described, with the sum of the semidiameters, denotes the end of the eclipse at 26 minutes after 12, all mean time according to the meridian of Greenwich. If the times reckoned by any other meridian are required, apply the longitude from Greenwich to the Greenwich times, by addition or subtraction, according as the place is east or west of Greenwich.

On F as a centre, with a radius equal to the moon's semidiameter, describe a circle which represents the moon's disk at the middle of the eclipse.

The line VX denotes the quantity eclipsed at the middle of the eclipse, which may be measured on a line equal to the moon's diameter, and divided into equal parts for digits. In the present case, the eclipse being total, the quantity eclipsed is said to be greater than the moon's diameter, and is found to be $21\frac{1}{3}$ digits.

CHAPTER III.

CATALOGUE OF FIXED STARS, AND TABLE OF REFRACTIONS.

SECT. I.—*Right Ascensions and North Polar Distances of* 652 *Stars, extracted from the Greenwich Twelve-Year Catalogue of* 2156 *Stars, and reduced to the epoch* 1850, *January* 1; *with the Annual Variations, including the Geometrical Precessions given in the British Association Catalogue, and the Proper Motions given in Mr* MAIN's *Paper in vol. xix. of the Memoirs of the Royal Astronomical Society.*

No.	Star's Name.	Mag.	Mean R. A. 1850, Jan. 1.	Annual Variation in R. A.	Mean N. P. D. 1850, Jan. 1.	Annual Variation in N. P. D.	No.	Star's Name.	Mag.	Mean R. A. 1850, Jan. 1.	Annual Variation in R. A.	Mean N. P. D. 1850, Jan. 1.	Annual Variation in N. P. D.
			H. M. S.	s.	° ′ ″	″				H. M. S.	s.	° ′ ″	″
1	21 Andromedæ, α	2	0 0 38·57	+ 3·082	61 44 16·61	−19·91	63	23 Persei, γ	3	2 53 57·67	+ 4·289	37 5 8·83	−14·56
2	11 Cassiopeiæ, β	2·3	0 1 12·32	+ 3·145	31 40 40·17	−19·87	64	Persei, k	5	2 54 18·41	+ 4·440	33 53 16·76	−14·61
3	8 Ceti, ι	3·4	0 11 46·85	+ 3·053	99 39 22·07	−19·97	65	92 Ceti, α	2·3	2 54 26·56	+ 3·125	86 30 7·61	−14·41
4	15 Cassiopeiæ, κ	4·5	0 24 30·69	+ 3·339	27 53 48·17	−19·95	66	Persei, ι	4	2 58 14·38	+ 4·151	40 57 51·56	−14·29
5	17 Cassiopeiæ, ζ	4	0 28 38·43	+ 3·295	36 55 46·16	−19·89	67	26 Persei, β	var.	2 58 25·54	+ 3·867	49 37 34·85	−14·29
6	30 Andromedæ, ε	4	0 30 38·27	+ 3·139	61 30 13·14	−19·64	68	27 Persei, κ	4·5	2 59 24·00	+ 4·016	45 42 54·35	−14·07
7	18 Cassiopeiæ, α	var.	0 32 1·57	+ 3·350	34 17 10·17	−19·82	69	57 Arietis, δ	4·5	3 3 3 47	+ 3·413	70 50 39 80	−13·99
8	16 Ceti, β	2	0 36 3·42	+ 3·012	108 48 38·93	−19·83	70	12 Eridani	3·4	3 5 42·06	+ 2·546	119 34 53·43	−14·44
9	58 Piscium	5	0 39 12·15	+ 3·116	78 50 42·28	−19·76	71	58 Arietis, ζ	4·5	3 6 17·10	+ 3·427	69 30 53 32	−13·72
10	34 Andromedæ, ζ	4	0 39 23·77	+ 3·163	66 32 59·82	−19·65	72	Bradley 448	5	3 6 51·25	+ 5·152	24 54 8·53	−13·71
11	24 Cassiopeiæ, η	4·3	0 40 3·39	+ 3·561	32 58 48·61	−19·26	73	13 Eridani, ζ	4·5	3 8 33·07	+ 2·907	99 22 48·83	−13·66
12	63 Piscium, δ	4·5	0 40 54·20	+ 3·102	83 13 57·28	−19·69	74	Piazzi, iii. 32	5	3 11 16·61	+ 3·632	61 29 57·72	−13·41
13	35 Andromedæ, ν	4·5	0 41 33·34	+ 3·272	49 44 20·34	−19·72	75	61 Arietis, τ^1	5	3 12 34·38	+ 3·444	69 23 49·96	−13·35
14	27 Cassiopeiæ, γ	2	0 47 41·79	+ 3·539	30 5 47·78	−19·64	76	16 Eridani, τ^4	4·3	3 12 50·66	+ 2·661	112 18 24·89	−13·39
15	37 Andromedæ, μ	4	0 48 26·29	+ 3·292	52 18 54·19	−19·66	77	33 Persei, α	2	3 13 38·36	+ 4·236	40 40 39·24	−13·26
16	2 Ursæ Majoris	4·5	0 49 9·48	+ 6·709	4 33 2·44	−19·59	78	Piazzi, iii. 51	5·4	3 16 57·92	+ 4·789	30 35 16·94	−13·13
17	Sculptoris, α	5·4	0 51 22·51	+ 2·899	120 10 8·62	−19·52	79	Piazzi, iii. 54	4	3 17 58·42	+ 4·725	31 38 48·99	−13·06
18	71 Piscium, ε	4	0 55 9·68	+ 3·108	82 55 7·32	−19·48	80	2 Tauri, ξ	4·3	3 19 2·66	+ 3·238	80 47 37·60	−12·91
19	42 Andromedæ, φ	4·5	1 0 49·09	+ 3·435	43 33 34·38	−19·34	81	35 Persei, σ	5	3 20 1·28	+ 4·189	42 31 38·78	−12·89
20	43 Andromedæ, β	2·3	1 1 20·96	+ 3·342	55 10 33·72	−19·25	82	5 Tauri, f	4	3 22 35·90	+ 3·300	77 34 53·08	−12·69
21	33 Cassiopeiæ, θ	4·5	1 1 59·95	+ 3·592	35 38 58·53	−19·31	83	37 Persei, ψ	5	3 25 50·99	+ 4·222	42 18 40·67	−12·43
22	1 Ur. Min., α (Polaris)	2	1 5 0·53	+17·521	1 29 24·85	−19·25	84	20 Eridani	5	3 29 27·45	+ 2·726	107 58 1·42	−12·23
23	86 Piscium, ζ^1	5·4	1 5 53·82	+ 3·124	83 13 9·00	−19·16	85	39 Persei, δ	3	3 32 15·83	+ 4·230	42 41 50·24	−12·00
24	34 Cassiopeiæ, φ	5	1 10 41·17	+ 3·704	32 33 31·49	−19·10	86	38 Persei, o	4	3 34 55·45	+ 3·733	58 11 26·65	−11·96
25	36 Cassiopeiæ, ψ	5	1 15 24·12	+ 4·111	22 39 17·23	−19·00	87	41 Persei, ν	4	3 35 1·06	+ 4·039	47 54 1·64	−11·83
26	37 Cassiopeiæ, δ	3	1 16 2·87	+ 3·851	30 32 47·50	−18·91	88	17 Tauri	4	3 35 58·59	+ 3·544	66 21 43 94	−11·75
27	45 Ceti, ϑ	3	1 16 31·58	+ 2·995	98 57 32·58	−18·73	89	19 Tauri	5	3 36 17·16	+ 3·551	66 0 28·41	−11·71
28	48 Andromedæ, ω	5	1 18 42·27	+ 3·546	45 22 10·70	−18·77	90	20 Tauri	5	3 36 54·45	+ 3·550	66 6 19·13	−11·67
29	98 Piscium, μ	5	1 22 19·71	+ 3·134	84 37 53·77	−18·60	91	23 Tauri	5	3 37 25·89	+ 3·546	66 31 23·65	−11·64
30	99 Piscium, η	4·3	1 23 27·76	+ 3·194	75 25 45·41	−18·74	92	25 Tauri, η	3	3 38 34·55	+ 3·547	66 21 46·98	−11·55
31	50 Andromedæ	4·5	1 28 0·80	+ 3·485	49 20 48·42	−18·20	93	27 Tauri	4	3 40 15·00	+ 3·548	66 24 34·40	−11·42
32	51 Andromedæ	4·3	1 28 48·67	+ 3·635	42 8 2·65	−18·43	94	28 Eridani, τ^7	5	3 41 12·55	+ 2·573	114 20 34·48	−11·44
33	106 Piscium, ν	5·4	1 33 37·68	+ 3·111	85 16 25·28	−18·36	95	44 Persei, ζ	3	3 44 42·82	+ 3·751	58 33 59·71	−11·11
34	54 Andromedæ	4	1 34 17·23	+ 3·705	40 4 8·61	−18·33	96	45 Persei, s	3·4	3 47 48·04	+ 3·994	50 25 43·95	−10·91
35	110 Piscium, o	4	1 37 28·66	+ 3·158	81 35 57·83	−18·28	97	34 Eridani, γ	3	3 51 1·95	+ 2·792	103 56 19·81	−10·58
36	53 Ceti, χ	5·4	1 42 13·11	+ 2·937	101 25 50·03	−17·97	98	35 Tauri, λ	3·4	3 52 22·48	+ 3·311	77 56 15·98	−10·58
37	45 Cassiopeiæ, s	3·4	1 43 39·68	+ 4·240	27 4 18·24	−18·02	99	47 Persei, λ	4·5	3 55 25·81	+ 4·429	40 3 42·14	−10·32
38	46 Cassiopeiæ	5	1 44 25·83	+ 4·523	22 3 17·77	−17·98	100	37 Tauri, A^1	5·4	3 55 49·98	+ 5·530	68 19 57·76	−10·25
39	2 Trianguli, α	4·3	1 44 32·54	+ 3·395	61 9 15·07	−17·78	101	48 Persei, o	4	3 57 47·20	+ 4·319	42 41 36·92	−10·13
40	111 Piscium, ξ	4	1 45 47·52	+ 3·094	87 33 19·98	−17·88	102	51 Persei, μ	4·5	4 3 53·96	+ 4·367	41 58 38·96	− 9·68
41	6 Arietis, β	3·2	1 46 21·73	+ 3·291	69 55 38·45	−17·82	103	53 Persei, d	5	4 10 43·17	+ 4·306	43 51 55·25	− 9·14
42	48 Cassiopeiæ	5·4	1 49 43·95	+ 4·776	19 49 26·45	−17·80	104	54 Tauri, γ	4	4 11 15·69	+ 3·404	74 44 21·24	− 9·13
43	50 Cassiopeiæ	4	1 50 44·28	+ 4·939	18 18 28·81	−17·78	105	41 Eridani, o^4	4·3	4 12 12·86	+ 2·264	124 10 6·88	− 9·07
44	Andromedæ, γ	3	1 54 42·62	+ 3·642	48 23 33·62	−17·49	106	61 Tauri, δ^1	4	4 14 17·26	+ 3·445	72 48 50·13	− 8·90
45	13 Arietis, α	2	1 58 43·67	+ 3·360	67 14 58·23	−17·27	107	69 Tauri, o^1	5·4	4 17 20·25	+ 3·576	67 31 53·07	− 8·64
46	4 Trianguli, β	2	2 0 37·98	+ 3·541	55 43 30·35	−17·29	108	74 Tauri, s	4·3	4 19 51·81	+ 3·489	71 9 24·69	− 8·46
47	65 Ceti, ξ^1	4·5	2 5 3·17	+ 3·166	81 51 33·31	−17·10	109	77 Tauri, δ^2	4·5	4 20 0·51	+ 3·410	74 22 31·61	− 8·46
48	65 Andromedæ	5	2 15 38·72	+ 3·948	40 24 13·96	−16·58	110	78 Tauri, δ^2	4·5	4 20 6·12	+ 3·415	74 28 0 12	− 8·45
49	Bradley 332	4	2 16 46·70	+ 4·808	23 16 34·39	−16·57	111	Bradley 619	5	4 21 58·62	+ 3·427	74 8 13·92	− 8·28
50	73 Ceti, ξ^2	4	2 20 11·32	+ 3·177	82 12 54·08	−16·40	112	86 Tauri, ϱ	5	4 25 20·36	+ 3·396	75 28 32·94	− 8·01
51	78 Ceti, ν	5	2 28 0·41	+ 3·132	85 3 50·94	−15·99	113	58 Persei, e	5	4 26 18·47	+ 4·132	49 2 55·59	− 7·96
52	12 Persei	5	2 32 47·98	+ 3·752	50 26 36·71	−15·58	114	87 Tauri, α (Aldeb.)	1	4 27 19·12	+ 3·432	73 47 49 55	− 7·72
53	13 Persei, θ	4	2 33 58·79	+ 4·047	41 24 35·47	−15·56	115	Groombridge 856	5	4 32 30·16	+10·841	9 4 15·33	− 7·47
54	86 Ceti, γ	3·4	2 35 31·92	+ 3·098	87 23 58·02	−15·42	116	94 Tauri, τ	4·5	4 33 14·81	+ 3·589	67 20 8·48	− 7·39
55	38 Arietis	5	2 36 47·51	+ 3·255	78 11 19·13	−15·44	117	9 Camelopard	4	4 39 9·48	+ 5·906	23 55 14·26	− 6·91
56	87 Ceti, μ	4	2 36 50·36	+ 3·229	80 31 20·65	−15·47	118	3 Aurigæ, ι	3	4 47 13·83	+ 3·890	57 4 37·57	− 6·24
57	39 Arietis	5	2 38 59·26	+ 3·546	61 22 44·31	−15·31	119	9 Orionis, o^2	5	4 47 56·46	+ 3·366	76 43 38·03	− 6·15
58	15 Persei, η	4·3	2 39 47·50	+ 4·312	34 43 53·32	−15·25	120	8 Aurigæ, ζ	4	4 52 0·09	+ 4·176	49 8 56·89	− 5·85
59	41 Arietis	4	2 41 9·97	+ 3·507	63 21 40·01	−15·20	121	102 Tauri, ι	5	4 54 8·00	+ 3·576	68 37 45·28	− 5·63
60	18 Persei, τ	4	2 43 39·02	+ 4·193	37 51 20·43	−15·13	122	11 Orionis	5	4 56 0·10	+ 3·420	74 48 35·15	− 5·50
61	22 Persei, π	5	2 49 11·20	+ 3·803	50 56 28·90	−14·82	123	10 Aurigæ, η	4·3	4 56 0·29	+ 4·192	48 58 27·10	− 5·45
62	48 Arietis, ε	4·5	2 50 38·61	+ 3·413	69 15 47·05	−14·73	124	2 Leporis, ε	4·3	4 59 6·72	+ 2·534	112 34 34·24	− 5·20

No. 66, ι Persei. The proper motion of this star in R. A. given in the *British Association Catalogue*, is + 0ˢ·129; this probably results from some error, and is not included in the annual variation.

RIGHT ASCENSIONS AND NORTH POLAR DISTANCES OF 652 STARS.

No.	Star's Name.	Mag.	Mean R. A. 1850, Jan. 1.	Annual Variation in R. A.	Mean N. P. D. 1850, Jan. 1.	Annual Variation in N. P. D.	No.	Star's Name.	Mag.	Mean R. A. 1850, Jan. 1.	Annual Variation in R. A.	Mean N. P. D. 1850, Jan. 1.	Annual Variation in N. P. D.
			h. m. s.	s.	° ′ ″	″				h. m s.	s.	° ′ ″	″
425	66 Herculis	5	17 11 33·98	+ 2·815	78 58 8·16	+ 4·30	496	43 Sagittarii, *d*....	5	19 8 51·17	+ 3·512	109 12 53·44	− 5·95
426	40 Ophiuchi, ξ ..	5	17 12 1·02	+ 3·588	110 56 48·00	+ 4·38	497	21 Lyræ, *θ*.....	4·5	19 11 9·62	+ 2·076	52 7 50 67	− 6 06
427	53 Serpentis, ν . .	5·4	17 12 23·52	+ 3·366	102 41 23 08	+ 4 09	498	57 Draconis, δ..	3	19 12 30 36	+ 0·039	22 36 8·12	− 6·31
428	42 Ophiuchi, *θ* ...	3 4	17 12 47 97	+ 3 674	114 50 39·26	+ 4·08	499	26 Aquilæ, *f*.. ...	5	19 12 32·31	+ 3·203	95 41 29·62	− 6 29
429	44 Ophiuchi, *b* ..	5	17 17 12·63	+ 3·654	114 1 54·77	+ 3·84	500	44 Sagittarii, ζ^1	4	19 12 58·18	+ 3·483	108 7 28·85	− 6 31
430	Piazzi, xvii. 99 ...	5 4	17 18 40·49	+ 3·186	94 56 58·13	+ 3·71	501	46 Sagittarii, *v* ...	5·4	19 13 7·97	+ 3·438	106 13 54 46	− 6·24
431	49 Ophiuchi, *σ* ..	5	17 19 4·46	+ 2 973	85 43 30·24	+ 3·54	502	1 Cygni, *κ*.....	4	19 13 37·92	+ 1·386	36 54 22 98	− 6·42
432	51 Ophiuchi, c^2...	5	17 22 16 06	+ 3·653	113 50 28 06	+ 3·34	503	30 Aquilæ, δ.....	3·4	19 17 56·07	+ 3·023	87 10 48·48	− 6·79
433	76 Herculis, λ .	5	17 24 40·61	+ 2·419	63 46 22·40	+ 3 05	504	2 Cygni	5	19 18 12·75	+ 2·364	60 40 7·73	− 6·76
434	23 Draconis, β ..	3·2	17 27 2·67	+ 1·349	37 35 8·28	+ 2 87	505	32 Aquilæ, *v*.....	5	19 18 50·75	+ 3·070	89 57 22·85	− 6·80
435	55 Ophiuchi, *e* ..	2	17 27 58·36	+ 2·777	77 19 36 02	+ 2·99	506	4 Vulpeculæ ...	5	19 18 53·58	+ 2·627	70 29 31·23	− 6·72
436	55 Serpentis, ξ . .	4·3	17 28 59·95	+ 3·429	105 17 55·82	+ 2·74	507	58 Draconis, *π* .	5	19 19 53·25	+ 0·332	24 34 26·19	− 6·87
437	24 Draconis, ν^1...	4	17 29 13·38	+ 1·188	34 42 41·46	+ 2·63	508	6 Cygni, β	3	19 24 40·33	+ 2·416	62 21 7·53	− 7·24
438	25 Draconis, ν^2...	4	17 29 18·80	+ 1 179	34 43 23·70	+ 2 67	509	10 Cygni, i^2	4	19 25 55·41	+ 1·512	38 35 16·37	− 7·47
439	56 Serpentis, *e* ...	5·4	17 32 59·13	+ 3·364	102 47 24·61	+ 2·40	510	38 Aquilæ, *μ*. . .	5·4	19 26 45·65	+ 2·930	82 56 8·64	− 7·27
440	58 Ophiuchi	5	17 34 26·60	+ 3·587	111 36 17·62	+ 2·19	511	52 Sagittarii, h^2	5·4	19 27 34·31	+ 3·657	115 12 34·01	− 7·50
441	85 Herculis, *i* ...	3·4	17 35 14·07	+ 1·704	43 54 41·03	+ 2·15	512	44 Aquilæ, *σ*.....	5	19 31 47·33	+ 2·960	84 56 24·71	− 7 82
442	60 Ophiuchi, β ...	3	17 36 3·68	+ 2 958	85 21 56·46	+ 1·92	513	13 Cygni, *θ*	5·4	19 32 25·17	+ 1·610	40 7 28·57	− 8·02
443	28 Draconis, *ω* ...	5	17 37 50 06	− 0·362	21 10 23·36	+ 1·63	514	55 Sagittarii, c^2...	5	19 33 56·10	+ 3·434	106 28 13·62	− 8·01
444	3 Sagittarii.....	5	17 38 6·98	+ 3 761	117 46 4·41	+ 1·93	515	56 Sagittarii, *f*....	5	19 37 36·47	+ 3 504	110 7 1·00	− 8·22
445	62 Ophiuchi, *γ* .	4·3	17 40 22·20	+ 2·999	87 13 55·35	+ 1·80	516	50 Aquilæ, *γ*	3	19 39 7·66	+ 2·852	79 44 54·55	− 8·41
446	30 Draconis	5	17 45 29·31	+ 1·426	39 10 54·23	+ 1·08	517	18 Cygni, δ	3	19 40 17·23	+ 1·875	45 13 58·90	− 8·50
447	Piazzi, xvii. 294 ..	5	17 49 27·22	+ 3 852	120 13 55·85	+ 1·00	518	53 Aquilæ, *α*.....	1·2	19 43 27 82	+ 2·927	81 31 26·29	− 9·13
448	4 Sagittarii.....	5	17 50 38 14	+ 3·655	113 47 48·54	+ 0·86	519	58 Sagittarii, *ω*	5	19 46 38·60	+ 3 684	116 41 33 95	− 9 08
449	64 Ophiuchi, *ν* ...	4·3	17 50 46·20	+ 3·299	99 45 1·22	+ 0·82	520	59 Aquilæ, ξ.....	5	19 46 58·65	+ 2·908	81 55 23·25	− 8 97
450	32 Draconis, ξ ...	3·4	17 50 56·33	+ 1·036	33 6 8 27	+ 0·72	521	59 Sagittarii, *b*...	5	19 47 44·13	+ 3·700	117 33 44 88	− 9·07
451	94 Herculis, *ν* ...	4 5	17 52 45·78	+ 2 291	59 47 42 30	+ 0·62	522	60 Aquilæ, β...	4	19 47 56·71	+ 2·957	83 57 50·95	− 8·63
452	33 Draconis, *γ* ..	2·3	17 53 7·44	+ 1·390	38 29 29·35	+ 0·64	523	63 Draconis, *ε*..	4	19 48 39·66	− 0·162	20 6 51·41	− 9·15
453	93 Herculis	5	17 53 22·66	+ 2·664	73 14 12·20	+ 0·55	524	60 Sagittarii, *A*...	5	19 49 48·30	+ 3·661	116 35 49·18	− 9·26
454	9 Sagittarii.....	5·4	17 54 40·50	+ 3·670	114 21 29·32	+ 0·49	525	62 Sagittarii, *c* ...	5	19 53 25·51	+ 3 699	118 7 19·25	− 9·55
455	35 Draconis	5	17 56 10·36	− 2 696	13 1 16 37	+ 0·10	526	Piazzi, xix. 366.	5	19 54 48·47	+ 3·794	122 28 23·13	− 9·54
456	10 Sagittarii, *γ* ..	3·4	17 56 10·52	+ 3·860	120 25 12·36	+ 0·57	527	15 Vulpeculæ ...	5	19 54 55·38	+ 2·466	62 39 28·60	− 9·69
457	70 Ophi. (1st star)	4·5	17 57 52·35	+ 3 028	87 27 38·71	+ 1·28	528	67 Draconis, *ϱ* ...	5	20 2 7·70	+ 0·301	22 33 14·08	−10·23
458	72 Ophiuchi	3·4	18 0 14·40	+ 2·841	80 27 13·12	− 0·08	529	65 Aquilæ, *θ* ...	3	20 3 33 70	+ 3·097	91 15 44·89	−10·30
459	103 Herculis, *e* ...	4·3	18 1 41·51	+ 2·336	61 15 16·88	− 0·16	530	28 Cygni, b^2.....	5	20 3 51·41	+ 2·224	53 35 56·95	−10·38
460	13 Sagittarii, *μ*....	4	18 4 47·59	+ 3·582	111 5 33·44	− 0·41	531	31 Cygni, o^2	4	20 8 54·58	+ 1·889	43 42 41·11	−10·74
461	15 Sagittarii.....	5	18 6 15·83	+ 3·571	110 46 5·63	− 0·53	532	5 Capricorni, α^1.	3·4	20 9 19·79	+ 3·329	102 58 4·01	−10·73
462	19 Sagittarii, δ ...	3·4	18 11 23·38	+ 3·837	119 53 9·91	− 0·96	533	6 Capricorni, α^2	3·4	20 9 43·67	+ 3·332	103 0 20 73	−10·76
463	36 Draconis	5	18 13 1·88	+ 0·342	25 39 10·78	− 1·15	534	33 Cygni	4·5	20 9 54·47	+ 1 399	33 53 22·57	−10·81
464	58 Serpentis, *η* ...	3	18 13 33·12	+ 3·100	92 56 0 49	− 0·51	535	32 Cygni	4 5	29 10 49·96	+ 1·851	42 44 39·34	−10·85
465	20 Sagittarii, *ε* ...	3·2	18 14 12·91	+ 3 982	124 27 1·89	− 1·10	536	8 Capricorni, *ν*...	5	20 12 20·27	+ 3·331	103 13 36·65	−10·93
466	1 Lyræ, *κ*.....	5·4	18 14 36·36	+ 2·099	54 0 0·32	− 1·30	537	9 Capricorni, β...	3	20 12 34·72	+ 3·375	105 15 2·97	−11·00
467	21 Sagittarii	5	18 16 24·92	+ 3·569	110 37 0·13	− 1·42	538	Ursæ Minor. λ	5	20 13 1·91	−53·177	1 8 22·07	−11·01
468	Groomb. 2555 ...	5	18 17 42·50	+ 1·535	40 57 7·87	− 1·55	539	1 Cephei, *κ*	4·5	20 13 50·42	− 1·859	12 44 34·27	−11·06
469	22 Sagittarii, λ...	3	18 18 42·70	+ 3·701	115 29 57·97	− 1·40	540	37 Cygni, *γ*	3·2	20 16 50·79	+ 2·150	50 13 15·37	−11·30
470	Bradley 2313 ...	5·4	18 20 38 96	+ 3·419	104 39 23·98	− 1·78	541	10 Capricorni, *π*..	5	20 18 43·68	+ 3·441	108 41 56·86	−11·43
471	23 Ursæ Minoris, δ	4·5	18 20 43·69	−19·275	3 24 10·02	− 1 84	542	11 Capricorni, *ϱ*..	5	20 20 17·88	+ 3·427	108 18 19·35	−11·51
472	39 Draconis, *b*....	5	18 21 42·91	+ 0 871	31 17 5·79	− 1 95	543	2 Delphini, *ε* ...	4	20 26 2·64	+ 2·863	79 12 11·31	−11·91
473	42 Draconis	5	18 25 33·01	+ 0·169	24 31 45·49	− 2·17	544	2 Cephei, *θ*	4	20 27 3·32	+ 1·018	27 30 32·09	−11·98
474	1 Aquilæ.....	4·5	18 27 2·61	+ 3·261	98 20 39·58	− 2·03	545	4 Delphini, ζ ...	5·4	20 28 17·70	+ 2·802	75 50 24·03	−12·11
475	45 Draconis, *d*....	5	18 29 59·24	+ 1·042	33 4 4·26	− 2·58	546	6 Delphini, β ...	3·4	20 30 30·83	+ 2·810	75 55 25·12	−12·20
476	3 Lyræ, *α*... ...	1	18 31 51·57	+ 2·029	51 21 13·69	− 2·50	547	14 Capricorni, τ^2	5	20 30 52·76	+ 3·365	105 28 38·46	−12·24
477	3 Aquilæ.....	5	18 35 21·03	+ 3·266	98 25 7·21	− 3·09	548	9 Delphini, *α*.....	4·3	20 32 40·24	+ 2·787	74 36 49·36	−12·42
478	27 Sagittarii, *φ*...	4·3	18 36 16·88	+ 3·751	117 8 22·62	− 3·17	549	50 Cygni, *α*	2·1	20 36 19·13	+ 2·040	45 15 12·29	−12·64
479	6 Aquilæ.....	5·4	18 39 13·22	+ 3·233	94 54 14·06	− 3 34	550	16 Capricorni, *ψ*.	4·5	20 37 12·25	+ 3·564	115 48 18·44	−12·87
480	4 Lyræ, ε^1(N. st.)	4	18 39 22·10	+ 1·982	50 29 2·41	− 3·47	551	2 Aquarii, *ε*.....	4·3	20 39 33·14	+ 3·251	100 2 28·67	−12·85
481	5 Lyræ, ε^2(1st st.)	4	18 39 24·44	+ 1·982	50 32 28·00	− 3·52	552	3 Aquarii	4·5	20 39 49·04	+ 3·167	95 34 24·33	−12·84
482	10 Lyræ, β.....	var.	18 44 32·50	+ 2·211	56 48 30·41	− 3·84	553	3 Cephei, *η*	4·3	20 42 13·98	+ 1·233	28 44 32·26	− 13 91
483	32 Sagittarii, ν^1 ..	5	18 45 6·56	+ 3·621	112 55 26·09	− 3·91	554	18 Capricorni, *ω*	4·5	20 42 51·53	+ 3·595	117 28 35·70	−13·05
484	34 Sagittarii, *σ*...	2 3	18 45 57·67	+ 3·723	116 28 38·82	− 3·92	555	6 Aquarii, *μ* ...	5·4	20 44 33·58	+ 3·240	99 32 32·51	−13·16
485	35 Sagittarii, ν^2...	5	18 46 2·94	+ 3·629	112 51 9·82	− 4·01	556	58 Cygni, *ν*	4	20 51 35 03	+ 2·232	49 24 29·00	−13·66
486	63 Serpentis, *θ* ...	4·3	18 48 45·52	+ 2·976	85 59 14·26	− 4·32	557	Bradley 2727	5	20 52 16 14	+ 1·605	33 41 18·52	−13·66
487	37 Sagittarii, ξ^2..	4	18 48 46·68	+ 3·579	111 17 55·53	− 4·21	558	23 Capricorni, *θ*...	4	20 57 30·49	+ 3·382	107 49 30·24	−13·98
488	47 Draconis, *ε*....	5·4	18 48 58·85	+ 0·883	30 47 37·72	− 4·26	559	62 Cygni, ξ	4	20 59 28·67	+ 2·178	46 40 6·09	−14·17
489	13 Lyræ	5·4	18 50 46·27	+ 1·821	46 14 57·57	− 4·41	560	13 Aquarii, *ν*.....	4·5	21 1 25·02	+ 3·271	101 58 32·90	−14·26
490	13 Aquilæ, *ε*	4	18 52 48·75	+ 2·717	75 7 53·88	− 4·48	561	64 Cygni, ζ	3	21 6 33·23	+ 2·546	60 23 9·39	−14·51
491	38 Sagittarii, ζ...	3·4	18 53 3·69	+ 3·820	120 5 20·72	− 4·57	562	8 Equulei, *α*	4	21 8 19·35	+ 2·999	85 22 10·10	−14·60
492	39 Sagittarii, *e* ...	4	18 55 41·45	+ 3·595	111 57 20·78	− 4·78	563	65 Cygni, *τ*.....	4	21 8 48·33	+ 2·389	52 35 32·82	−15 19
493	40 Sagittarii, *τ*...	4·3	18 57 34·20	+ 3·748	117 53 2·83	− 4·73	564	4 Piscis Austral.	5	21 8 49·67	+ 3·657	122 47 45·87	−14·68
494	17 Aquilæ, ζ.....	3	18 58 30·90	+ 2·751	76 21 19·92	− 5·00	565	32 Capricorni, *ι*	4·5	21 13 53·15	+ 3·350	107 28 11·82	−15·03
495	41 Sagittarii, *π*...	3	19 0 50·33	+ 3·569	111 15 23·51	− 5·23	566	5 Cephei, *α*.....	3·2	21 14 59·77	+ 1·437	28 2 55·57	−15·09

No. 468, Groombridge 2555. The annual variations do not include proper motions.
No. 470, Bradley 2313. The annual variation in R. A. does not include proper motion.
No. 557, Bradley 2727. The annual variation in R. A. does not include proper motion.

RIGHT ASCENSIONS AND NORTH POLAR DISTANCES OF 652 STARS.

No.	Star's Name.	Mag.	Mean R. A. 1850, Jan. 1.	Annual Variation in R. A.	Mean N. P. D. 1850, Jan. 1.	Annual Variation in N. P. D.	No.	Star's Name.	Mag.	Mean R. A. 1850, Jan. 1.	Annual Variation in R. A.	Mean N. P. D. 1850, Jan. 1.	Annual Variation in N. P. D.
			H. M. S.	s.	° ′ ″	″				H. M. S.	s.	° ′ ″	″
567	34 Capricorni, ζ	4	21 18 5·57	+ 3·438	113 3 28·40	− 15·28	611	18 Piscis Austr. ε	4	22 32 20·99	+3·333	117 49 29·04	−18·57
568	22 Aquarii, β	3	21 23 39·50	+ 3·162	96 13 41·74	− 15·57	612	42 Pegasi, ζ	3·4	22 33 58·88	+2·985	79 57 0·63	−18·66
569	71 Cygni, g	5	21 23 54·76	+ 2·201	44 7 9·09	− 15·47	613	43 Pegasi, o	5	22 34 43·24	+2·807	61 28 25·93	−18·65
570	8 Cephei, β	3	21 26 42·34	+ 0·805	20 5 49·54	− 15·69	614	44 Pegasi, η	3	22 35 58·55	+2·800	60 33 43·19	−18·68
571	73 Cygni, ρ	4·5	21 28 20·59	+ 2·248	45 4 10·18	− 15·73	615	71 Aquarii, τ^2	4	22 41 38·64	+3·182	104 22 58·54	−18·87
572	39 Capricorni, ε...	5·4	21 28 40·34	+ 3·369	110 8 6·99	− 15·84	616	48 Pegasi, μ	4	22 42 46·09	+2·885	66 11 21·44	−18·89
573	23 Aquarii, ξ	5·4	21 29 45·80	+ 3·197	98 31 27·87	− 15·86	617	32 Cephei, ι	4·3	22 44 21·26	+2·112	24 35 15·18	−18·83
574	40 Capricorni, γ..	4·3	21 31 46·30	+ 3·335	107 20 13·82	− 15·98	618	73 Aquarii, λ	4	22 44 47·02	+3·128	98 22 35·79	−18·95
575	43 Capricorni, $\varkappa$..	5	21 34 16·46	+ 3·358	109 32 49·84	− 16·13	619	76 Aquarii, δ	3	22 46 40·80	+3·189	106 37 1·58	−19·04
576	9 Piscis Aust. ι	5	21 36 0·00	+ 3·595	123 42 26·62	− 16·12	620	Bradley 3038	5	22 47 55·55	−0·006	7 38 32·07	−19·12
577	80 Cygni, π^1	5·4	21 36 46 17	+ 2·117	39 29 36·70	− 16·25	621	24 Pis. Austr. α (Fomalhaut)	1·2	22 49 21·07	+3·331	120 24 57·91	−18·93
578	8 Pegasi, ε	2 3	21 36 49·10	+ 2·947	80 48 37·09	− 16·27							
579	78 Cygni, μ^1	4·5	21 37 26·16	+ 2·681	61 55 58·66	− 16·04	622	1 Andromedæ, o	4·3	22 55 1·78	+2·742	48 28 44·70	−19·24
580	78 Cygni, μ^2		21 37 26·57	+ 2·681	61 56 0·84	− 16·04	623	4 Piscium, β	3·4	22 56 14·66	+3·052	86 59 12·12	−19·26
581	49 Capricorni, δ..	3	21 38 45·22	+ 3·318	106 48 18·83	− 16·09	624	53 Pegasi, β	2·3	22 56 30·52	+2·896	62 43 46·87	−19·44
582	11 Cephei.....	5	21 39 42·90	+ 0·914	19 22 42·77	− 16·49	625	54 Pegasi, α	2	22 57 17·51	+2·981	75 36 3·27	−19·29
583	10 Cephei, ν	5	21 41 7·52	+ 1·729	29 34 12·21	− 16·45	626	33 Cephei, π	5·4	23 3 8·54	+1·883	15 25 22·01	−19·40
584	81 Cygni, π^2.....	4·5	21 41 15·37	+ 2·207	41 22 58·42	− 16·47	627	7 Andromedæ..	5	23 5 41·49	+2·723	41 24 44·56	−19·59
585	Groomb. 3590	5	21 44 21·69	+ 1·096	20 32 37·12	− 16·65	628	90 Aquarii, φ	4·5	23 6 33·11	+3·109	96 51 24·71	−19·32
586	51 Capricorni, μ	5	21 45 6·72	+ 3·280	104 15 18·52	− 16·70	629	91 Aquarii, ψ^1 ..	5·4	23 8 1·54	+3·146	99 54 15·18	−19·52
587	34 Aquarii, α ...	3	21 58 4·64	+ 3·080	91 2 47·27	− 17·26	630	6 Piscium, γ.....	4	23 9 23·39	+3·105	87 32 11·58	−19·55
588	33 Aquarii, ι... .	4	21 58 19·69	+ 3·246	104 35 41·89	− 17·23	631	Sculptoris, γ...	5·4	23 10 42·65	+3·260	123 20 54·34	−19·52
589	17 Cephei, ξ^1	5·4	21 59 16·04	+ 1·738	26 6 6·28	− 17·42	632	95 Aquarii, ψ^3 ..	5	23 11 9·28	+3·121	100 25 48·20	−19·61
590	17 Cephei, ξ^2 ...		21 59 26·94	+ 1·701	26 6 6·99	− 17·34	633	62 Pegasi, τ..	5·4	23 13 13·17	+2·957	67 4 47·38	−19·63
591	27 Pegasi, π^1.....	5	22 2 35·10	+ 2·651	57 33 31·19	− 17·43	634	68 Pegasi, v	5·4	23 17 53·89	+2·982	67 25 15·63	−19·75
592	26 Pegasi, θ	3·4	22 2 37·93	+ 3·029	84 32 17·34	− 17·52	635	8 Piscium, $\varkappa$	5·4	23 19 14·62	+3·074	89 33 54·17	−19·62
593	29 Pegasi, π^2.....	4	22 3 19·75	+ 2·655	57 33 22·10	− 17·51	636	10 Piscium, θ	4·5	23 20 21·59	+3·037	84 26 40·00	−19·70
594	21 Cephei, ζ	4·3	22 5 39·53	+ 2·071	32 32 13·08	− 17·59	637	16 Andromedæ, λ	4	23 30 14·42	+2·911	44 21 15·03	−19·46
595	43 Aquarii, θ	4·5	22 8 54·77	+ 3·170	98 31 42·32	− 17·72	638	17 Andromedæ, ι..	4	23 30 47·55	+2·914	47 33 42·83	−19·91
596	23 Cephei, ε	5·4	22 9 31·12	+ 2·196	33 42 11·28	− 17·79	639	17 Piscium, ι	4·5	23 32 14·22	+3·082	85 11 10·70	−19·45
597	48 Aquarii, γ	4·3	22 13 54·42	+ 3·100	92 8 28·37	− 17·97	640	19 Andromedæ, $\varkappa$	4	23 33 1·99	+2·926	46 29 45·48	−19·93
598	32 Pegasi	5	22 14 24·00	+ 2·759	62 25 24·31	− 17·97	641	35 Cephei, γ	3·4	23 33 14·00	+2·387	13 12 16·77	−20·07
599	2 Lacertæ	5·4	22 14 50·22	+ 2·463	44 13 2·06	− 17·99	642	18 Piscium, λ	5	23 34 23·58	+3·057	89 2 42·85	−19·76
600	52 Aquarii, π	5·4	22 17 36·97	+ 3·064	89 22 55·93	− 18·08	643	20 Andromedæ, ψ	5	23 38 36·97	+2·944	44 24 44·71	−19·96
601	3 Lacertæ, β	4·5	22 17 40·37	+ 2·346	38 31 16·87	− 17·88	644	5 Cassiopeiæ, τ ..	5	23 39 44·76	+2·889	32 11 0·38	−20·04
602	55 Aqua. ζ (N. st.)	3·4	22 21 6·35	+ 3·087	90 47 8·23	− 18·25	645	Sculptoris, δ...	4·5	23 41 6·39	+3·141	118 57 33·43	−19·89
603	57 Aquarii, σ.....	5·4	22 22 42·11	+ 3·173	101 26 37·21	− 18·33	646	7 Cassiopeiæ, ϱ...	5	23 46 54·85	+2·952	33 20 6·68	−20·01
604	17 Piscis Austr. β	4	22 22 57·89	+ 3·431	123 6 51·25	− 18·21	647	8 Cassiopeiæ, σ..	5	23 51 25·58	+2·998	35 4 47·75	−20·07
605	27 Cephei, δ^2.....	var.	22 23 36·64	+ 2·211	32 21 5·44	− 18·29	648	28 Piscium, ω	4	23 51 36·59	+3·075	83 58 2·62	−19·91
606	7 Lacertæ	4	22 25 7·35	+ 2·456	40 29 14·37	− 18·36	649	Bradley 3195	5	23 53 59 60	+3·009	29 36 44·60	−20·04
607	62 Aquarii, η	4·3	22 27 38·70	+ 3·082	90 53 20·61	− 18·39	650	30 Piscium	5	23 54 15·93	+3·077	96 50 52·10	−20·01
608	63 Aquarii, $\varkappa$.....	5	22 29 59·02	+ 3·108	95 0 0·84	− 18·42	651	2 Ceti	4·5	23 56 3·10	+3·077	108 10 14·18	−20·05
609	9 Lacertæ	5	22 31 13·20	+ 2·452	39 13 41·39	− 18·46	652	33 Piscium	5	23 57 39·28	+3·070	96 32 48·93	−20·08
610	31 Cephei.....	5	22 32 3·92	+ 1·490	17 8 4·94	− 18·64							

No. 590, ξ^2 Cephei. The annual variations do not include proper motion.
No. 649, Bradley, 3195. The annual variation in R.A. does not include proper motion.

SECT. II.—*Table of Atmospherical Refractions, with Corrections for the Height of the Barometer and Thermometer.*

App. Altitude.	Refr. B. 30 Th 50°.	Dif. for 1′ Alt.	Diff. for +1 B.	Diff. for −1° Fa.	App. Altitude.	Refr B. 30 Th. 50°.	Dif. for 1′ Alt.	Diff. for +1 B.	Diff. for −1° Fa.	App. Altitude.	Refr B. 30 Th. 50°.	Dif. for 1′ Alt.	Diff. for + B.	Diff. for −1° Fa.	App. Altitude.	Refr. B. 30 Th. 50°.	Diff. for 1′ Alt.	Dif. for +1 B.	Diff. for −1° Fa.
° ′	′ ″	″	″	″	° ′	′ ″	″	″	″	° ′	′ ″	″	″	″	°	′ ″	′	″	″
0 0	33 51	11·7	74	8·1	4 0	11 52	2·2	24·1	1·70	12 0	4 28·1	0·38	9·00	0·556	42	1 4·6	0·038	2·16	0·130
5	32 53	11·3	71	7·6	10	11 30	2·1	23·4	1·64	10	4 24·4	0·37	8·86	0·548	43	1 2·4	0·036	2·09	0·125
10	31 58	10·9	69	7·3	20	11 10	2·0	22·7	1·58	20	4 20·8	0·36	8·74	0·541	44	1 0·3	0·034	2·02	0·120
15	31 5	10·5	67	7·0	30	10 50	1·9	22·0	1·53	30	4 17·3	0·35	8·63	0·533	45	0 58·1	0·034	1·94	0·117
20	30 13	10·1	65	6·7	40	10 32	1·8	21·3	1·48	40	4 13·9	0·33	8·51	0·524	46	56·1	0·033	1·88	0·112
25	29 24	9·7	63	6·4	50	10 15	1·7	20·7	1·43	50	4 10·7	0·32	8·41	0·517	47	54·2	0·032	1·81	0·108
30	28 37	9·4	61	6·1	5 0	9 58	1·6	20·1	1·38	13 0	4 7·5	0·31	8·30	0·509	48	52·3	0·031	1·75	0·104
35	27 51	9·0	59	5·9	10	9 42	1·5	19 6	1·34	10	4 4·4	0·31	8·20	0·503	49	50·5	0·030	1·69	0·101
40	27 6	8·7	58	5·6	20	9 27	1·5	19·1	1·30	20	4 1·4	0·30	8·10	0·496	50	48·8	0·029	1·63	0·097
45	26 24	8·4	56	5·4	30	9 11	1·4	18·6	1·26	30	3 58·4	0·30	8·00	0·490	51	47·1	0·028	1·58	0·094
50	25 43	8·0	55	5·1	40	8 58	1·3	18·1	1·22	40	3 55·5	0·29	7·89	0·482	52	45·4	0·027	1·52	0·090
55	25 3	7·7	53	4·9	50	8 45	1·3	17·6	1·19	50	3 52·6	0·29	7·79	0·476	53	43·8	0·026	1·47	0·088
1 0	24 25	7·4	52	4·7	6 0	8 32	1·2	17·2	1·15	14 0	3 49·9	0·28	7·70	0·469	54	42·2	0·026	1·41	0·085
5	23 48	7·1	50	4·6	10	8 20	1·2	16·8	1·11	10	3 47·1	0·28	7·61	0·464	55	40·8	0·025	1·36	0·082
10	23 13	6·9	49	4·5	20	8 9	1·1	16·4	1·09	20	3 44·4	0·27	7·52	0·458	56	39·3	0·025	1·31	0·079
15	22 40	6·6	48	4·4	30	7 58	1·1	16·0	1·06	30	3 41·8	0·26	7·43	0·453	57	37·8	0·025	1·26	0·076
20	22 8	6·3	46	4·2	40	7 47	1·0	15·7	1·03	40	3 39·2	0·26	7·34	0·448	58	36·4	0·024	1·22	0·073
25	21 37	6·1	45	4·0	50	7 37	1·0	15·3	1·00	50	3 36·7	0·25	7·26	0·444	59	35·0	0·024	1·17	0·070
30	21 7	5·9	44	3·9	7 0	7 27	1·0	15·0	0·98	15 0	3 34·3	0·24	7·18	0·439	60	33·6	0·023	1 12	0·067
35	20 38	5·7	43	3·8	10	7 17	0·9	14·6	0·95	30	3 27·3	0·22	6·95	0·424	61	32·3	0·022	1·08	0·065
40	20 10	5·5	42	3·6	20	7 8	0·9	14·3	0·93	16 0	3 20·6	0·21	6·73	0·411	62	31·0	0·022	1·04	0·062
45	19 43	5·3	40	3·5	30	6 59	0·8	14·1	0·91	30	3 14·4	0·20	6·51	0·399	63	29·7	0·021	0·99	0·060
50	19 17	5·1	39	3·4	40	6 51	0·8	13·8	0·89	17 0	3 8·5	0·19	6·31	0·386	64	28·4	0·021	0·95	0·057
55	18 52	4·9	39	3·3	50	6 43	0·8	13·5	0·87	30	3 2·9	0·18	6·12	0·374	65	27·2	0·020	0·91	0·055
2 0	18 29	4·8	38	3·2	8 0	6 35	0·7	13·3	0·85	18	2 57·6	0·17	5·98	0·362	66	25·9	0·020	0·87	0·052
5	18 5	4·6	37	3·1	10	6 28	0·7	13·1	0·83	19	2 47·7	0·16	5·61	0·340	67	24·7	0·020	0·83	0·050
10	17 43	4·4	36	3·0	20	6 21	0·7	12·8	0·82	20	2 38·7	0·15	5·31	0·322	68	23·5	0·020	0·79	0·047
15	17 21	4·3	36	2·9	30	6 14	0·7	12·6	0·80	21	2 30·5	0·13	5·04	0·305	69	22·4	0·020	0·75	0·045
20	17 0	4·1	35	2·8	40	6 7	0·7	12·3	0·79	22	2 23·2	0·12	4·79	0·290	70	21·2	0·020	0·71	0·043
25	16 40	4·0	34	2·8	50	6 0	0·6	12·1	0·77	23	2 16·5	0·11	4·57	0·276	71	19·9	0·020	0·67	0·040
30	16 21	3·9	33	2·7	9 0	5 54	0·6	11·9	0·76	24	2 10·1	0·10	4·35	0·264	72	18·8	0·019	0·63	0·038
35	16 2	3·7	33	2·7	10	5 47	0·6	11·7	0·74	25	2 4·2	0·09	4·16	0·252	73	17·7	0·018	0·59	0·036
40	15 43	3·6	32	2·6	20	5 41	0·6	11·5	0·73	26	1 58·8	0·09	3·97	0·241	74	16·6	0·018	0·56	0·033
45	15 25	3·5	32	2·5	30	5 36	0·6	11·3	0·71	27	1 53·8	0·08	3·81	0·230	75	15·5	0·018	0·52	0·031
50	15 8	3·4	31	2·4	40	5 30	0·5	11·1	0·71	28	1 49·1	0·08	3·65	0·219	76	14·4	0·018	0·48	0·029
55	14 51	3·3	30	2·3	50	5 25	0·5	11·0	0·70	29	1 44·7	0·07	3·50	0·209	77	13·4	0·017	0·45	0·027
3 0	14 35	3·2	30	2·3	10 6	5 20	0·5	10·8	0·69	30	1 40·5	0·07	3·36	0·201	78	12·3	0·017	0·41	0·025
5	14 19	3·1	29	2·2	10	5 15	0·5	10·6	0·67	31	1 36·6	0·06	3·23	0·193	79	11·2	0 017	0·38	0·023
10	14 4	3·0	29	2·2	20	5 10	0·5	10·4	0·65	32	1 33·0	0·06	3·11	0·186	80	10·2	0·017	0·34	0·021
15	13 50	2·9	28	2·1	30	5 5	0·5	10·2	0·64	33	1 29·5	0·06	2·99	0·179	81	9·2	0·017	0·31	0·018
20	13 35	2·8	28	2·1	40	5 0	0·5	10·1	0·63	34	1 26·1	0·05	2·88	0·173	82	8·2	0·017	0·27	0·016
25	13 21	2·7	27	2·0	50	4 56	0·4	9·9	0·62	35	1 23·0	0·05	2·78	0·167	83	7·1	0·017	0·24	0·014
30	13 7	2·7	27	2·0	11 0	4 51	0·4	9·8	0·60	36	1 20·0	0·05	2·68	0·161	84	6·1	0·017	0·20	0·012
35	12 53	2·6	26	2·0	10	4 47	0·4	9·6	0·59	37	1 17·1	0·05	2·58	0·155	85	5·1	0·017	0·17	0·010
40	12 41	2·5	26	1·9	20	4 43	0·4	9·5	0·58	38	1 14·4	0·05	2·49	0·149	86	4·1	0·017	0·14	0·008
45	12 28	2·4	25	1·9	30	4 39	0·4	9·4	0·57	39	1 11·8	0·04	2·40	0·144	87	3·1	0·017	0·10	0·006
50	12 16	2·4	25	1·9	40	4 35	0·4	9·2	0·56	40	1 9·3	0·04	2·32	0·139	88	2·0	0·017	0·07	0·004
55	12 3	2·3	25	1·8	50	4 31	0·4	9·1	0·55	41	1 6·9	0·04	2·24	0·134	89	1·0	0·017	0·03	0·002

Explanation of the Table of Refractions.

This table is computed upon principles explained by the late Dr Young in the *Philosophical Transactions* for 1819; and it appears to agree more perfectly with the latest observations than any other table before published.

The apparent altitude being found in the first column, the second shows the refraction when the barometer stands at 30 inches, which is its mean height on the level of the sea, and the thermometer at 50° of Fahrenheit. The third column contains the difference to be subtracted or added for every minute of altitude, reckoned from the nearest number in the first column. The fourth shows the number of seconds to be added for every inch that the height of the barometer exceeds 30, or to be subtracted for each inch that it wants of 30: and the last contains the number of seconds to be subtracted for each degree that the thermometer stands above 50°, or to be added for each degree that its height wants of 50°.

If great accuracy be required, we must also deduct from the observed height of the barometer ·003 inch for each degree that the thermometer near it is above 50°, and add an equal quantity for an equal depression. In fact, however, the table, as it now stands, is found to require the temperature to be estimated from the height of the thermometer within; and if we employed the height of the thermometer without, which would be more consistent with the theory, it would probably be necessary to suppose the standard temperature of the table 48° only (or rather 47°), instead of 50°.

Examples.

1. At 7° 18′ 13″, barometer 29·87, thermometer 66°, the refraction is 6′ 52″·26, from twenty-two observations of Bradley.

2. At 19° 18′ 19″, barometer 30·045, thermometer 34°, the refraction is 2′ 51″·5, from three observations of Bradley.

3. At 13° 43′, barometer 29·85, thermometer 45°, the refraction is 3′ 55″·85, from 156 observations of Mr Pond.

1. Alt. 7° 20′ R. 7′ 8″ + 1·62 = 9·62; 16·74; 6 52·88; 6 52·26. Error..... 0·62
   Diff. Alt. ″·9; 1′ 47″ = 1′ ·8; + 1 ·62
   B. 14″·3 — ·13 = 1 ·86
   Th. ″·93 — 16 = 14·88; 1·86 = 16·74

2. Alt. 19° R. 2′ 47″·7 — 2 ·93; 2 44 ·77; ·25; 5 ·44. Error 1″·0 2 50 ·46
   Diff. Alt. ″·16; 18′ 19″ = 18 ·3; — 2·93
   B. 5″·61 + ·045 = ·252
   Th. ″·34 + 16 = 5·44

3. Alt. 13° 40′ R. 3′ 55″·5 + ·36; 3 55 ·86; 3 55 ·85. Error..... ·01
   Diff. Alt. ″·29; 3; — 87
   B. 7″·89 ·15; — 1 ·18; ·87; 2 ·05
   Th. ″·482 5 = + 2 ·41; 2 ·05 = + ·36

Practical Astronomy

CHAP. IV.

ASTRONOMICAL INSTRUMENTS.

There are two principal objects to be accomplished by astronomical instruments; the one is the extension and improvement of the science; and the other its application to geography, navigation, and the ordinary wants of society. Here we give the name astronomical instruments to such as in their application are directed to the heavenly bodies, as a telescope is directed to a star, and the axis of a sun-dial to the pole; but we do not consider as astronomical instruments *orreries*, and machines composed of wheels and pinions, such as exhibit imperfectly representations of the celestial motions. Globes are indeed appropriate furniture in an observatory, because they truly exhibit the relative positions of the stars and the different countries; and they serve to resolve approximately the different problems of the sphere. But complex orreries and planetary clocks are mere playthings. They excite admiration by the ingenuity displayed in their construction, but they are of no practical use. Showmen pretend to teach astronomy by their assistance; but their inutility in giving just notions of the dimensions and magnitudes of the bodies which form the solar system may be easily conceived by reflecting, that if in an orrery the earth be represented by a sphere one inch in diameter, the representation of the sun should be nine feet; also, that if the representation of Mercury describe a circle of about four inches radius, then the orbit of Uranus should have its radius sixteen feet.

Judicious teachers of astronomy may, however, employ with advantage simple contrivances to facilitate the acquiring of correct notions of the celestial motions; but they will direct the attention to a single object at a time, and not attempt to exhibit all the phenomena of the heavens at once. Wooden wheels and catgut bands are just as useful for the purpose in question as metallic wheels and pinions. A globe moved by the hand round a candle will serve to show the changes of the seasons; and in like manner the phases of the moon, her nodes and their motion, and the nature of eclipses, may be all explained by simple and easy contrivances.

1. *Astronomical Telescope.*

In a subsequent part of this work the theory of the telescope, and the various kinds of telescopes, will be fully explained. As, however, the telescope forms an essential part of almost all complex astronomical instruments, it will be proper to explain here in a general way its principles and use.

The astronomical telescope is composed of two principal parts, the *object-glass*, and the *eye-glass* or *eye-piece*. These are in opposite ends of a tube; and in its application the former is next the object, and the latter next the eye. In telescopes of the best construction the object-glass is composed of two and sometimes of three pieces. (See ACHROMATIC GLASSES.) We shall here, however, suppose it of the simplest form; that is, a very thin double convex glass, the opposite sides being portions of spherical surfaces.

Let ABDE (Plate XC. fig. 131) be a lens of this form, C being the centre of a sphere, of which ABE is a portion of the surface. Let L be any point in an object to be viewed with the telescope, and let a ray of light proceeding from L fall perpendicularly on the convex surface in B: it will pass through the glass without being turned out of its direction, and will proceed straight forward on the prolongation of the line LBD.

Let another ray LI fall obliquely on the convex surface at I: by the principles of optics this will be *refracted*, that is, turned out of the direction LI, and take a new direction IP. Draw CI to the centre; the new direction will be such that the sine of the angle of incidence MIL or CIL will be to the sine of the refracted angle CIP in the constant ratio of a given number n to 1. Practical Astronomy

We have therefore

$$n = \frac{\text{sin. CIL}}{\text{sin. CIP}} = \frac{\text{sin. CIL}}{\text{sin. ICL}} \cdot \frac{\text{sin. ICP}}{\text{sin. CIP}} = \frac{\text{CL}}{\text{IL}} \cdot \frac{\text{IP}}{\text{CP}}.$$

Let us suppose the point I to be near B; then IP=BP nearly, and IL = BL nearly, and we have

$$n = \frac{\text{CL} \cdot \text{BP}}{\text{BL} \cdot \text{CP}}, \text{ nearly} \ldots\ldots\ldots\ldots (1)$$

When the ray arrives at the concave surface ADE, it suffers a second refraction in passing into the air, and changes its direction from IP into a new direction IL'. Let C' be the centre of a sphere, of which ADE is a part of the surface: draw the radius C'I', and we shall have sin. C'I'L' : sin. C'I'P :: n : 1; and therefore

$$n = \frac{\text{sin. C'I'L'}}{\text{sin. C'I'P}} = \frac{\text{sin. C'I'L'}}{\text{sin. I'C'L'}} \cdot \frac{\text{sin. I'C'P}}{\text{sin. C'I'P}} = \frac{\text{C'L'}}{\text{I'L'}} \cdot \frac{\text{I'P}}{\text{C'P}}.$$

We suppose the arcs IB, I'D, to be small; therefore I'P = PD nearly, and I'L' = DL' nearly; hence

$$n = \frac{\text{C'L'} \cdot \text{PD}}{\text{DL'} \cdot \text{C'P}}, \text{ nearly.}$$

Since the thickness of the lens is supposed to be inconsiderable, we may assume that PD = PB nearly, and that DL' = BL nearly, and then we have

$$n = \frac{\text{C'L'} \cdot \text{PB}}{\text{BL'} \cdot \text{C'P}} \ldots\ldots\ldots\ldots (2)$$

Let r = CB, r' = C'B, Δ = BL, Δ' = BL', v = PB, and equations (1) and (2) become

$$n = \frac{v(r+\Delta)}{\Delta(v-r)}; \qquad n = \frac{v(r'+\Delta')}{\Delta'(v+r')};$$

from these we obtain

$$\frac{n}{v} = \frac{n-1}{r} - \frac{1}{\Delta}, \text{ and } \frac{n}{v} = \frac{1}{\Delta'} - \frac{n-1}{r'};$$

and hence

$$\frac{1}{\Delta} + \frac{1}{\Delta'} = (n-1)\left\{\frac{1}{r} + \frac{1}{r'}\right\}.$$

When a ray of light passes out of air into glass, the sine of the angle of incidence is to the sine of the angle of refraction as 3 to 2 nearly, or as $1\frac{1}{2}$ to 1. In this case $n = 1\frac{1}{2}$, and

$$\frac{1}{\Delta} + \frac{1}{\Delta'} = \tfrac{1}{2}\left(\frac{1}{r} + \frac{1}{r'}\right).$$

This expression will be the very same if we put r instead of r', and r' instead of r; also, if we put Δ for Δ', and Δ' for Δ. Hence we may infer, that whichever of the two convex sides of the object-glass be turned towards the object L, the value of Δ' will be the same for a given value of Δ; also, that if L' be the *focus* to which rays issuing from L converge after refraction, then L will be the focus to which rays issuing from L' would converge after passing through the object-glass.

If Δ, the distance of L from the object-glass, be very great, then $\frac{1}{\Delta}$ will be very small in respect of $\frac{1}{\Delta'}$; and in the case of the heavenly bodies $\frac{1}{\Delta}$ vanishes, and we have simply

$$\frac{1}{\Delta'} = \tfrac{1}{2}\left(\frac{1}{r} + \frac{1}{r'}\right).$$

If we suppose both sides of the object-glass to be alike convex, that is, $r = r'$, then $\Delta' = r$; hence we learn, 1*st*, that all rays which come from any point whatever of a

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very remote object, and which traverse a double convex glass of equal curvature on both sides, are united by refraction about its centre of sphericity, which is called its *principal focus*; 2*d*, that rays which proceed from a point at the centre of sphericity do, after refraction, proceed in lines which may be considered as parallel. All these conclusions are only true approximately. They suppose the convex arcs ABE ADE small, and the thickness of the glass very little; nevertheless they differ but little from truth: the focus L is not indeed a mathematical point, but has a certain magnitude, which varies with the distance of the object and the breadth of the lens.

If we now suppose that two lenses, BD, *bd* (fig. 132), are adapted to the extremity of a tube, so that their centres of sphericity coincide at the same point F, and that this point and the centres of the lenses are in the same straight line, then, from what has been explained, it follows that rays coming from a distant object L, after passing through the lens BD or object-glass, will be collected at F (which is therefore called the *focus of parallel rays*), and will there form an image of the object L: also, that all the rays, after crossing in the focus F, will proceed forward; but in passing through the second lens or *eye-glass bd*, they will be again refracted, and emerge on the other side in parallel lines; and if they enter an eye now situated at O, these parallel rays will produce distinct vision.

The eye does not see directly the remote object AC, but only its image formed at the focus F, and this in respect to the object is inverted; for the rays proceeding from A and falling on the object-glass at B, are by refraction turned into the direction BF, and meet the glass at δ. In like manner, the rays which are emitted from C, and pass through the object-glass at D, meet the eye-glass on the opposite side at β: thus the object AC and its image formed at F have opposite positions.

The astronomical telescope, then, differs from the common telescope for viewing objects at a distance, in reversing the position of objects seen through it, also the direction of their motions, the upper limb of the sun or moon appearing the lower, and all the heavenly bodies appearing to move from west to east. This, which would be an inconvenience with terrestrial objects, is of no consequence in viewing the stars.

The surface of the object-glass being always much greater than that of the eye-glass, which has a shorter focus, and all the rays which fall on the surface BD of the former being collected on the surface *bd* of the latter, they are there condensed, and the illumination is increased in the inverse proportion of the areas of the glasses; so that if the intensity of the light which falls on the object-glass be represented by 1, that on the eye-glass will be $\left(\frac{BD}{bd}\right)^2$; hence telescopes in general render objects more luminous and more easily distinguished. They also magnify objects; for let A be the centre and B the border of an object (fig. 133). The point A is visible to the eye O, by the ray AD*a*EO which traverses the object-glass D and eye-glass E, but suffers no refraction. (We here do not consider the oblique rays, which, proceeding from A, are collected at the principal focus.) The border B is visible by the ray BD*b* at the focus *b* of the object-glass. This ray meets the eye-glass at *d*, and is there turned by refraction into the direction *de*; and, in emerging from the glass at *e*, is again refracted to O, its focus, so that OE is parallel to E*b*. The image is seen under the angle *e*OE = *b*E*a*: but *ab* = D*a* tan. D, therefore

$$\text{tan. E} = \frac{Da}{Ea}\,\text{tan. D} = \frac{R}{r}\,\text{tan. D, or E} = \frac{R}{r}\,D;$$

R being the radius of sphericity of the object-glass, and *r* that of the eye-glass. The angle under which the object is seen is therefore increased in the proportion of the two radii, and the magnifying power is the greater, as the radius of the eye-glass is less than that of the object-glass.

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Common astronomical telescopes generally magnify from 70 to 100 times; some even magnify 300 times. This, however, must not be understood in a rigorous sense; if, for example, we expect to see the moon 100 times larger with a telescope which is said to magnify 100 times, we may be disappointed. To produce this effect, the telescope ought to magnify more: it only represents the moon under an angle 100 times greater; but it is not by the visual angle alone that we judge of magnitude; our opinion is greatly influenced by the distance at which we suppose the object. When we see an object under the angle AKB (fig 134), nothing determines whether this object is truly AB, or CD, or EFF; and according as we judge it to be in the first, or second, or third of these positions, or in one more remote, we assign to it magnitudes always increasing although the angle is still the same. But this judgment being uncertain, and such as cannot be subjected to calculation, the magnifying power of a telescope is in practice estimated by the angle of vision, which can always be exactly determined.

Let F be the principal focus of the object-glass C (fig. 135). If the angle HCG is such, that HG (=2 HF)=2 CF tan. HCF is equal to the diameter of the interior tube of the telescope, the angle HCG is called the *field of view*: every object whose focal image is greater than HG cannot be seen entirely in the telescope. This happens in the case of the sun and moon when viewed with telescopes of about $8\frac{1}{2}$ feet, such as are used in considerable observatories. In these, the sun's image will be about $9\frac{1}{2}$ inches. This exceeds the diameter of the tube. But the opening is yet more contracted by a perforated diaphragm, which, besides other purposes, serves to cut off the rays irregularly reflected from the inside of the tube, also those which produce colour in the image. To determine the field in view as limited by the diaphragm, then, we have this equation; $2\,\text{tan. HCF} = \frac{HG}{CF} = \frac{2\,HF}{CF}$. If we put *r* for HF, the radius of the diaphragm, and R for CF, the radius of sphericity of the object-glass, the field of view in seconds is $\frac{2r}{R \sin. 1''}$.

2. *Dorpat Telescope.*

The late Joseph Fraunhofer of Munich, a most skilful artist and experimenter in optics (whose demise in 1826, in the prime of life, was a great loss to science), constructed a magnificent refracting telescope for the observatory of the Imperial University at Dorpat. It was received by Professor Struve in the year 1825, and has since been found to fulfil most satisfactorily his expectation and the intentions of the maker. As this is one of the most magnificent instruments of the kind that has hitherto been constructed, and described by a figure, we have given an engraving of it, copied from the *Memoirs of the Astronomical Society*. (See Plate XCII.)

The object-glass of this telescope is about $9\frac{1}{2}$ inches in diameter, and its focal length about 14 English feet. The main tube is 13·8 feet; and, in addition, there is the small tube which holds the eye-pieces. Of these there are four; the least magnifying power is 175, and the greatest 700. After the telescope was received at Dorpat, a perfect micrometrical apparatus was ordered to be made for it. This was to consist of four annular micrometers, of which two were to be double; a lamp circular micrometer, with four

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eye-pieces; a refracting lamp net micrometer, with position circles, and four eye-pieces.

The frame-work of the stand is made of oak, and the tube of deal, veneered with mahogany. The whole weight of the telescope and its counterpoises is supported at one point, namely, at the common centre of gravity of all the ponderous parts. These weigh 3000 Russian pounds, of which the frame-work contains 1000; the remaining 2000 are so balanced in every position, that the telescope may be turned, with ease and certainty, in every direction towards the heavens.

The basis of the frame is formed of two cross beams, each nine feet seven inches long. The ends of these are seen in the figure at A, B, C, D. They are braced by four smaller bars forming a square, one of which is seen at E. This braced cross is fastened to the floor by eight screws, six of which are seen in the figure. A perpendicular post, about six feet high and seven inches square, is fixed over the centre of the cross, and is propped at the north, east, and west sides by three curved stays, denoted by G, G′, G″, which are fixed at their lower ends to the beams of the cross, and at the upper to the vertical post. An inclined beam H of the same thickness rests on the southern end of the meridian beam of the cross, and is attached to the vertical beam in a position parallel to the polar axis. This axis, shown in the figure at I, is a cylinder of steel 39 inches long, and proportionally thick. It turns in two collars, and its lower end, which is rounded and polished, rests on a steel plate attached to the bearing piece K, which is secured to the inclined beam H, and has therefore very little friction, the weight being supported by friction rollers near the common centre of gravity; and a counterpoise L is applied to support the axis in any position. There is a circle 13 inches in diameter, graduated to minutes of time, fixed to the lower end of the axis, and furnished with verniers. The axis of vertical motion of the telescope, which has nearly the dimensions of the polar axis, passes through a brass tube at right angles to the latter; the tube, which is seen at M, forms a part of the frame, and is fastened to the upper end of the polar axis by twelve screws. This axis carries the circle of declination, which is 19 inches in diameter, and is divided to every 10′, with a vernier reading 10″ or 5″ by estimation. The tube of the telescope is fixed to the frame-work nearer to the eye end than the middle, and has two counterpoises attached to levers, which balance the two ends, and prevent the natural tendency of the longer end to bend. The brass frame holding the two axes appears on the figure clamped to the tube by two strong rings, one at each end of the centre of motion. A bent lever, carrying the weight O, embraces by a double ring the near end of the axis of the declination circle. The axis itself carries another weight; and by this and the weight O it is counterpoised. The slow motion in altitude is given to the telescope by a Hooke's joint applied to the screw of the clamp, which has a spring urging it against a strong iron bar P, attached to the end of the cylinder M, that forms a stop to the circle; and a slow equatorial motion is given by a second Hooke's joint taking hold of an endless screw, acting with the racked edge of the hour circle, while a spring presses it into action uniformly, and a lever is employed to raise it out of the rack when necessary. The handles taking hold of these screws extend to the reach of the observer, who can thus point his telescope in right ascension and declination with the same certainty as the best meridian instrument.

A regular sidereal motion is communicated to the instrument by clock-work, which keeps a star apparently at rest in the centre of the field of view; and there is a contrivance by which the sidereal can be changed into a solar, also to a lunar angular motion.

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This almost invaluable instrument cost 10,500 florins (about 950 pounds sterling). The price, although it may appear considerable, yet barely covered the expense of the workmanship of its construction. This relinquishment of the profit of trade does great credit to the ingenious and liberal-minded artists, Fraunhofer, and Utzelmeider, the chief of the optical establishment at Munich.

3. *Lord Rosse's Reflecting Telescope.*

This celebrated telescope has two object-mirrors of 6 feet in diameter, and of 53 feet focal length. The preparations for the casting were commenced in 1842 and many experiments were necessary before the best proportions of tin and copper, of which the alloy for the mirrors was composed, were discovered. The respective weights of the specula are $3\frac{1}{2}$ and 4 tons, and the most refined precautions were necessary in the construction of the furnaces for fusing these immense masses of metal, in transferring it to the moulds prepared for the casting, and in cooling it with the requisite degree of slowness, to prevent flaws or cracks. The polishing process was performed by causing the polishers to make strokes backwards and forwards in imitation of the manner in which the hand would perform the same process by means of the action of a small steam-engine. This engine gave motion to a beam, which, by the intervention of a crank and connecting rods, gave motion to the polishers. A very ingenious system of levers was devised for the support of the mirror, so that it should remain in every required position without strain. Three similar systems of these levers rest on fulcra immediately under the centres of gravity of the three equal sectors into which the surface of the mirror may be supposed to be divided. Each system consists of one triangle with its point of support directly under its centre of gravity, on which it freely oscillates, and each triangle carries at its angles other three triangles similarly supported; and finally, at each angle of these last-named triangles, are placed three balls rotating freely, on which the mirror ultimately rests.

The tube of the telescope provided for the use of these enormous mirrors is of wood, fixed to a cube of 10 feet, which has in one of its sides folding doors for the admission of the specula. The specula themselves are placed on frames which run on railroads leading into this cube, these frames being the same on which they were cast and polished.

The telescope is placed between two immense piers 70 feet long and nearly 50 feet high, which serve as supports for the apparatus necessary for giving the requisite elevations of the tube, and for directing it to a given object, and also for the galleries which carry the observer near its upper end. It carries near its upper extremity the apparatus for the Newtonian small mirror, though provision has been made in the construction of the observing galleries for its use as a Herschelian telescope, without a second reflexion, for the purpose of avoiding loss of light.

The observations made with this wonderful instrument have been chiefly confined to nebulæ, in many of which some remarkable discoveries have been made. In the *Phil. Trans.* for 1850, are some beautiful drawings of some of these mysterious structures, amongst which the spiral forms of Messier 51 and Messier 99 deserve particular attention.

4. *Transit Instrument, Meridian Circle, and Astronomical Clock.*

The primary problem in geography is to determine the exact position of any proposed point on the earth's surface in respect of the equator and some assumed meridian, as that of Greenwich or Paris; that is, to find its latitude and

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longitude. The corresponding problem in astronomy is to determine the position of every fixed star, and in general of any celestial object. in respect to the equinoctial circle in the heavens (or else the pole) and a circle passing through the pole and the intersection of the equator and ecliptic; that is, to find its *declination* or polar distance, and its *right ascension* (chap. i. sect. i.) The former of these is found in great observatories by the *mural circle*, and the latter by the *transit instrument* or *transit circle*, and the clock.

The first transit instrument of which we have any account was that of Roemer, which he described in 1700. (*Miscel. Ber.* tom. iii.) Dr Halley placed a transit instrument in the Greenwich observatory in 1721. The axis was iron, and the telescope about five feet in length. This has been long laid aside, but is still preserved as a relic. Transit instruments of the present day are of two forms; one, the most common, is adapted to the determination of the right ascension only, the other to the determination of both right ascension and declination, either at once or by separate observations.

We have selected for description the transit instrument now in Sir James South's observatory at Kensington, which was constructed for him in 1820, by Troughton, with all the care that artist could bestow on it; and which, as far as the just proportions of its parts are concerned, he regarded as his happiest production. The instrument, with its various parts, is represented in Plate XCIII. Figures 1 and 3 represent two views of it. EO is an achromatic telescope, of which E is the end next the eye; AA′ is its axis of motion, with which the tubes are closely united at their junction, so as to form but one body. The extremities of the axis rest in notches formed on two cheeks of metal at AA′, which are firmly attached to the inner faces of two stone pillars PP′; and B, B′, B″, B‴, are four braces connecting the tubes and axis. These are the parts of the instrument which, on inspection, immediately meet the eye. When adjusted, the axis of motion of the instrument is truly horizontal and perpendicular to the plane of the meridian, and the optical axis of the telescope is in the plane of the meridian; the object of the whole construction is to keep it precisely in that plane, whatever position be given to the telescope by turning on its axis.

The object-glass of the telescope has four inches of clear aperture, and its focal length is seven feet two inches. The body of the telescope and the axis are formed of conical tubes firmly united in a spherical centre-piece, on which their wider ends rest, and cover two-thirds of its surface: thus the tube of the telescope is formed of two pieces, which taper towards its extremities, where their diameters are nearly the same as that of the object-glass. The axis in like manner tapers equally towards its extremities.

The centre-piece is perforated in the direction of the telescope, and also in that of the axis; the width of the first opening being a little more than the radius of the object-glass, and that of the second just enough to allow the light of a lamp placed near the end of the axis to pass uninterruptedly to the centre illuminator. The ends of all the four cones, where they join the sphere, are strengthened by circular pieces of cast brass, which extend full four inches into the cones, and are fixed by solder and pins. They are turned concave in front, so as to fit the surface of the sphere into which they are rabbeted, and serve to keep the opposite branches of the axis and telescope straight and perpendicular to one another; and to these pieces are attached rings for the reception of the screws which bind the whole together. The four branches of the axis and telescope are solely united by *tension bars*. These pass through the sphere, six in the direction of the axis and four in that of the telescope. They are arranged at equal distances between corresponding parts, but so as neither to obstruct the rays of the object-glass nor the light of the lamp that falls on the illuminator. They screw into the rings of the brass pieces which enter the cones. The tension bars serve a most important purpose in giving stiffness and permanence of form to the instrument; and he that would imitate it would do well to study Sir James South's description in the *Phil. Trans.* for 1826. Fig. 3 is a section through the axis, and exhibits the six bars which bind together the cones of the axis, and also the places of the four which are perpendicular to them, and which connect the tubes of the telescope. Fig. 4 is a section through the telescope; the bars of the telescope are shown lengthwise, whilst those of the axis are perpendicular. In both figures the illuminator within the telescope is shown, in one the polished surface, and in the other the back of the plate. The illuminator crosses the tube of the telescope at an angle of 45°. This position requires that the opening in it, through which the light coming through the object-glass passes, should be an ellipse. The braces B, B′, B″, B‴, extending from the cones of the axis to those of the telescope, are attached to the former about two inches from the pivots, and to the latter about ten inches from the centre-piece. They exert but a very slight pressure, and might have been omitted in this instrument. They were added in imitation of the Greenwich transit, to which they are essentially necessary.

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The apparatus for giving the telescope any required altitude is shown at the eye end in figures 1 and 2, but on a larger scale in fig. 5. It consists of two complete circles, six inches in diameter, firmly attached to the eye end of the telescope: each is provided with two opposite verniers, subdividing its divisions into minutes of a degree. The indexes have clamps and slow moving screws, and microscopes are attached to the verniers; a spirit level is also attached to the index of each circle. The apparatus is adjusted by setting the index to the place of the star, and then, the telescope being moved round till the bubble of the level stands in the middle of its range, the star will traverse the field between the two horizontal wires. If two stars differ but little in right ascension, as Capella and Rigel, so as not to allow time for changing the index which was set to the altitude of that which came first, then the index of the other circle may be set to the altitude of the following star, and both observed. When the same object is to be observed by direct vision, and also by reflexion, then one of the indexes may be set to point the telescope to the direct place of the star, and the other to its reflected image.

Figures 7 and 8 exhibit the plates or side-pieces, and Ys in which the pivots of the axis rest. The plates, which are semicircular, are imbedded in the stone piers, and are firmly screwed to them. Figure 7 represents the eastern plate, in which the contrivance for placing the axis truly level is contained. This adjustment is made by a piece of which the upper end is formed into a Y, and which may be moved vertically, but not laterally. To raise or depress it gradually, there is a piece having a short cylindrical part in the middle; also a fine screw at its upper end, which works in the moveable piece, and a coarse screw at its lower, which works in the fixed plates. The cylinder has holes by which it can be turned round by a capstan pin. By the ingenious contrivance of the two screws, the sliding piece is moved vertically, but slowly; for the space gone through is only the difference of the spaces through which it would have been pushed or drawn by each screw acting by itself. Fig. 8 shows the western plate. In this the Y piece admits only of a horizontal motion for the purpose of placing the instrument in the meridian. The adjustment is effected by two screws, which work in the opposite sides of the piece, and whose heads abut against the fixed plate. To produce motion one of them must be screwed and the other unscrewed by equal

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quantities while the observer's eye is at the telescope; and to effect this the screws are connected by pinion work put in motion by a handle hanging down close to the inside of the western pier. (See fig. 1.)

Fig. 9 is a bird's-eye view of the head of one of the piers. This is meant to show the apparatus for relieving the pivots of the axis and the Ys from a great part of the weight which would otherwise bear on them. Immediately behind the adjustable Y piece, but rather broader, is a plain piece of brass having a Y cut in its upper end: a lever also is seen, one extremity of which passes into a hole made in this Y piece, while the other end carries a weight. The bar of the lever is expanded into a circle whose centre is about one third of the lever's length distant from the pivot of the axis. The circle admits the illuminating lantern. Two steel screws, with blunted, hard, and polished points, are inserted in the diameter at right angles to the direction of the lever: these rest on hardened and polished planes, which are let into the stone pier, and together form the fulcrum, in the manner of a balance. The weight is a short cylinder hooked on the end of the lever: it is hollow to receive small shot, introduced, as a counterpoise, to relieve, more or less at pleasure, the instrumental portion of the pivot, and also the instrumental Y piece, of weight.

Fig. 6 is a perspective view of the eye end of the telescope. In it a micrometer is shown, which moves a plate contiguous to that in which the five transit wires are inserted: one wire is contained in the moveable plate, and is intended to facilitate the observation of the pole-star and others near it.

In fig. 1, on the eastern side of the telescope, a projecting finger-screw is seen. This gives motion to an apparatus within the tube of the telescope for regulating the quantity of light projected by the illuminator on the transit wires.

The Greenwich transit instrument, also the workmanship of Troughton, and one of his much admired productions, was placed in that observatory in 1816. In its construction it is nearly the same as Sir James South's, but of different dimensions. The object-glass of the telescope is 5 inches in clear aperture, and the focal length 10 feet: its horizontal axis, including the pivots, is 3 feet 10 inches. This instrument was dismounted in the year 1851, and its use was replaced by that of the great transit circle. For a more detailed account the reader may consult the volumes of the *Greenwich Observations*.

All transit instruments have a *meridian mark*, that is, a mark on some remote object, by which it may be ascertained at any time whether the instrument be truly in the meridian.

Transit or meridian circles are in their nature quite analogous to the instruments we have described; with, however, the important addition of a graduated circle of considerable dimensions as a principal part of their construction. The meridian circle which Troughton constructed for Mr Groombridge, but which afterwards passed into the hands of Sir James South, is a fine example of this kind of instrument. A figure and description of it may be seen in Dr Pearson's valuable work on Practical Astronomy. The largest and finest instrument at present is that which was erected at Greenwich in 1850.

A clock of the very best construction is an indispensable companion of the transit instrument. This may be regulated so as to show either mean solar or sidereal time, according to the principal objects in view, the one being always easily convertible into the other. The attention of ingenious men has been long directed to the construction of the astronomical clock; but on this subject we shall have occasion to treat fully elsewhere in our work.

The transit instruments here described are of the most expensive kind, and adapted to the higher efforts in the cultivation of astronomy; but there are also portable transits which travellers may use, and which may serve to determine true time. In all applications of the instrument, the axis must be placed truly horizontal by means of the level; the line of collimation, that is, a line between the centre of the object-glass and the centre of the cross wires, must move in a great circle, or, which is the same thing, it must be perpendicular to the axis; and the vertical circle which it describes must be the meridian: these are the three principal adjustments. The *Nautical Almanac* gives the exact time when the sun or certain considerable stars pass the meridian. The observer gives the telescope such a position that the star must appear in the field of view in its passage. When it is seen, he notes the exact time, by the beat of the clock, when it crosses each wire. Of these wires there are generally five or seven in the focus of the eye-piece, and all transits (whether perfect or imperfect) are always reduced to the time of passage over an imaginary line corresponding to the mean of these.

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5. *The Mural Circle.*

The Royal Observatory at Greenwich has two *mural quadrants*, each about eight feet radius; these are fixed on a massive structure of hewn stone in the form of a parallelopiped, one on each side, and hence their name. That whose telescope is directed towards the north is chiefly of iron, and was erected by Graham in 1725, for the lunar observations of Halley: it was, however, redivided by Bird in 1753. The other, for the southern part of the meridian, is of brass, and was constructed by Bird, and placed in its position in 1750: with this Bradley and Maskelyne successively made their observations for forty-six years.

Experience had shown, early in the present century, that entire circles have a great advantage over quadrants; accordingly, the use of the Greenwich quadrants was discontinued, and in their stead a *mural circle* six feet in diameter, constructed by Troughton, was placed in the observatory on 12th June 1812. A second *mural circle*, nearly a copy of the other, constructed by Thomas Jones (another eminent artist), was, in 1825, placed in the observatory, fronting the former, and at a distance of seven feet to the east; and with these two instruments simultaneous observations were, during the administration of Mr Pond, daily made of the zenith distances of stars, the zenith point being obtained by a combination of observations made by direct vision and by reflexion in a trough of mercury. Soon after the accession of Mr Airy, the use of Jones's circle was discontinued, as we have before had occasion to mention.

Figs. 1 and 2 of Plate XCIV. give two views of Troughton's mural circle. In fig. 1 the circle is seen obliquely on the front or eastern face of the wall, with the greater part of its apparatus. The breadth of the wall from north to south is seven feet, its thickness from east to west four feet, and its height ten feet. It is formed of four stones laid one on another. The third stone has in its under side a semicircular groove, cut in its middle from west to east, of six inches radius. The upper side of the second stone being worked level, forms the diameter of this semicircular *arch-hole*, and supports the axis-work of the instrument at about five feet above the floor. The real centre of the instrument is about five inches higher. The nucleus of the Greenwich circle is an octagon of eight inches diameter at the corners; its depth is three inches, and a circular perforation of six inches and a half is made through its whole depth. The outward faces of the octagon, which are each three inches square, support eight of the circle's conical radii, to which they are screwed and steady-pinned. The other eight radii are fitted in closely, each one between two of the former, so that their lower ends come down on the corners of the octagon. The limb of the circle consists of two rings, the interior one having its plane parallel, and the exterior perpendicular, to the plane of the circle, so that, when united, their section

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will be represented by the letter T. The interior or flat ring has in the engraving the appearance of passing through clefts in the middle of the outer ends of the sixteen radii, which are there solid. The perpendicular ring is fitted close on the exterior edge of the other, to which it is screwed, and also to the ends of the conical radii. The cones are bound together at half the distance from the double ring to the centre by a circle of interposed bracing bars. The circular aperture of the octagon is shut up by plates before and behind, which are fastened to the octagon by strong steel screws. The posterior plate has a large circular hole, and the anterior a smaller one, both truly wrought. Into these the axis of motion is fitted, and united to the octagon and circle by means of screws. The axis is a cone of brass nearly seven inches in diameter in front, but behind only half as much, and nearly four feet long; this works in a socket, which at each end receives it, and in which it fits with the greatest possible exactness. The two parts which fit the axis are soldered into a strong brass tube, larger than the tube of the axis, but nearly of the same shape. On the tube of the sockets in front is soldered a strong perforated plate or upright bearing-piece, at right angles to the axis, which nearly fills the semicylindrical aperture in the wall; and at the remote end is soldered a short cylinder, the use of which will be explained. It is there that the adjustments for placing the circle in the meridian, and for levelling the axis, are performed. Two strong horizontal plates are fastened on the lower surface (which is flat) of the perforation through the wall, one before and the other behind. The bearing piece of the socket in front only rests upon the plate, but behind the bearing cock and plate are screwed together. In front the plate and bearing piece are connected by a conical piece of hardened steel, which is fixed under the middle of this piece, and fits nicely into a hole in the plate, but so as to revolve. At this end of the axis these parts do not come quite in contact; for there are fixed under the bearing piece, at each extremity, about ten inches apart, two short props, like buttons of hardened steel, the spherical surfaces of which rest upon planes of hardened steel fixed in the plate. The central conical piece prevents the circle from sliding sideways when angular motion is given round this conical piece to bring the instrument into the plane of the meridian. It has been stated that a short cylinder was soldered on the remote end of the cone of the sockets. This passes into a perforation in the cock behind, which perforation is greater than that of the cylinder. Two fine-threaded screws at right angles to each other work in the cock, one vertically for levelling, and the other horizontally for meridian adjustment. The two screws only press with their points against the sides of the short cylinder; but opposite to them are the ends of two small cylinders standing in the same line, which are urged forward with spiral springs, and thus force the short cylinders into contact with the screws. The telescope is seen on the face of the instrument; its focal length is six feet two inches, which is the exact outer diameter of the circle; the aperture is four inches, and its common magnifying power about 150. The telescope is attached to the circle at the centre by a steel axis, which passes through the proper axis of motion from end to end, and was indeed the arbor on which the axis was turned. The weight of the telescope is supported on its own axis, and it may be fixed to the circle in any position by means of two clamps which keep hold of the border of the circle. The graduation of the instrument is on the convex cylindrical surface of the exterior ring, therefore the reading microscopes have their direction parallel to the plane of the instrument. The divisions on Troughton's circle are made on a narrow ring of white metal composed of four parts gold to one of palladium; and the figures which count the degrees are engraved on a like ring of platina. In Jones's circle the divisions are on gold. None of these metals tarnishes in the least degree. The divisions are by lines, and suited to wires which cross at an acute angle in the reading microscopes. The degrees are cut into 5′ spaces, and are numbered from the pole southward to the same pole again, viz. from 0° to 360°. The 5′ spaces are subdivided by the microscopes to single seconds; and a division representing this quantity on the micrometer head may be easily estimated to the tenth of a second. There are six reading microscopes; which, during Mr Airy's direction, were always used.

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In order that the circle may move easily round on its axis, there is an apparatus for counterpoising it, or for lifting the whole weight, without which the load would press altogether on the lower side of the front socket. This is effected by means of two large rollers, shown below the axis in fig. 1. The rollers, set in a double frame, act on the edge of the centre flanch, nearly in contact with the radial cones. Two perpendicular bars of steel, at about the height of the centre, are connected with the frame of the rollers by hook and eye; and these bars are in a similar manner suspended by two beams, each resembling a common balance, at the top of the wall. The part which appears in front is shown in fig. 1, and one of the beams, its fulcrum and counterpoising weight, near the top of the wall, in fig. 2. This apparatus produces a simple lift, without any tendency to affect the due motion of the circle's axis.

There is another flat, circular ring, somewhat larger than the graduated one, fastened at several places to the wall, and nearly touching it. On this ring the clamp and screw for slow motion slide, and may be clamped to it at any part of the ring.

The plumb-line of the mural circle, seen in fig. 2, is for placing the axis truly horizontal. The apparatus by which the plummet is suspended was applied by dovetail fittings occasionally to the wall near its top, see fig. 1. The apparatus itself is shown in fig. 2. In fig. 1 fixed microscopes are seen on the telescope, near its end, for viewing the plumb-line.

The wires of the telescope are illuminated by a diagonal reflecting plate in the middle of the tube, which receives the light by a circular aperture, seen in fig. 1, in a line with the centre of the circle. A lantern, at four or five feet distance, placed in the line of the axis, throws light on the field of view.

The instrument seen in a vertical position on the back of the wall is a zenith tube. It was erected to discover, if possible, the parallax of a star that passes very near the zenith; but was never used.

The mural circle has as an accompaniment a clock; and since all observations made with it require to be corrected for refraction, which depends on the state of the atmosphere (see table in page 148), every recorded observation must have annexed to it the height of the barometer and thermometer.

We have now described the instruments which constitute the principal furniture of an observatory, and which are all that the present state of the science absolutely requires. We proceed next to describe some others which are extremely convenient, and almost equally necessary in the science.

6. *Equatorial Instruments.*

An equatorial instrument is of great value to a practical astronomer, for by means of it he can direct his telescope at once to any object, however minute, whose right ascension and declination are known; and conversely, he can determine the right ascension and declination of any object to which it is directed, although out of the meridian.

Plates XCV. and XCVI. give a representation of Sir James South's five-foot equatorial instrument. The greater part of this instrument is composed of tinned iron plate; and

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its characteristics are lightness, steadiness, promptness in answering to its adjustments, and capability of retaining them. Fig. 1 of Plate XCV. represents the instrument as viewed at right angles to the declination circle. The polar axis is about 10½ feet long; the lower end is a pivot attached to a cone, which, reckoning upwards, is about a fourth of the whole length. The higher side of the cone is cut in a sloping direction, as seen in the figure, for the purpose of more conveniently observing the vicinity of the pole. From the upper end of the cone the polar axis branches into two parts, between which is room for the declination circle and the head of the observer. These two branches are again united at the top by an open frame of bell metal, represented in fig. 2, to which the upper pivot is attached. This frame, as well as the iron-work which composes it, is so contrived as to present the least possible surface to obstruct the telescope; for the same reason the pivot at the top of the telescope is made as small as possible, whilst that at the lower end is considerably larger. Both ends of the axis are supported on stones, the northern end rising within about four inches of the level of the declination circle, the rest of the support being of wrought iron. At the southern end the stone rises very little above the floor, but a cast-iron frame supports the pivot at the height of about two feet. The Y, or angle which supports the lower pivot, is placed upon the frame, and provided with two screw adjustments, one for giving the axis its due elevation, and the other for bringing the instrument to the meridian. The form of the iron-work will be understood by consulting the different figures. The two branches of the polar axis on their upper sides are formed of broad planes, making one continued plane. On these the axis and reading microscopes of the declination circle are fixed. The instrument is self-balanced by the position and figure of its parts, and the addition of a weight fixed to the conical part of the polar axis. The diameter of the declination circle is four feet, the length of the telescope five feet, and of the axis about thirty-two inches. In Plate XCV. fig. 1, the declination circle appears quite plain, like the head of a drum with the telescope directed towards the equator. In Plate XCVI. fig. 1, the polar axis is considerably fore-shortened, from the position of the draughtsman in making the drawing of the instrument. In this figure the edge of the declination circle is shown as a short cylinder, with the telescope protruding beyond it. In this figure, also, the shape of the declination axis, and the two principal microscopes for reading the declination, are shown. There is a third microscope, which indicates zenith distances. This is seen in Plate XCV. fig. 1, between the eye end of the telescope and the instrument's elevated pole. In the same figure is shown a narrow brass ring, whereon the graduation is made.

The hour-circle, two feet in diameter, is fastened to the lower end of the polar axis; its edge is seen in Plate XCV. fig. 1, and its under side in Plate XCVI. fig. 1 and fig. 3. One of the reading microscopes is well seen in fig. 1 of Plate XCV., and both of them less perfectly in the other two figures. The circle is of brass, and the divisions (fine lines) are on an inlaid ring of platina, corresponding to twenty seconds each; these are subdivided by the microscopes to tenths of seconds. The declination circle is divided to spaces of five minutes, which are subdivided by the micrometer screw of the microscopes to single seconds. The instrument is furnished with two ground levels. The divided side of the declination circle is quite flat; but the opposite face is articulated, showing how the parts are united. It is on this side that the levels would be seen; one of them is parallel to the telescope, and the other to the declination axis.

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The clamps and screws for slow motion are unusual, but remarkably good. Instead of the common mode of clamping the circle, in this instrument the clamp is made to grasp the axis. There is soldered on each axis a ring of brass, the outer edge of which is broad and cylindrical. On this fixed ring a moveable one is fitted, and afterwards cut into three equal parts: these are again united in two of the three sections by joints, like those which bind the different parts of a watch chain together. At the third juncture the clamping takes place, a projecting part of the ring having been there cut through, leaving one half on each side of the section. Here the ring gapes, but a screw passes through the projecting pieces or ears on each side of the disjunction, and in bringing them together, grasps the axis with a firm embrace. To the middle of the tripartite rings are attached long arms of tinned iron plate, at the extremities of which the slow-moving screws have their places. The fixed stud is in the lower screw, planted in the iron support; that of the upper one is in the polar axis. The long screw for slow motion in right ascension is acted on by a contrate wheel and a pinion at right angles to the plane of the circle, as shown in fig. 1, Plate XCV.; a long handle is attached to it, and shown leaning against the northern pier. A similar screw for declination, but without the contrate part, is seen in Plate XCVI. fig. 1.

The illumination of the wires of the telescope is made by a small lantern placed at one end of the declination axis; and there is a contrivance between the nozzle of the lantern and the end of the axis, by which the light is adapted to different observations.

The eye-piece of the telescope is represented in Plate XCVI. fig. 2, in which there is seen the edge of a graduated circle, the front of a quadrant, and two small spirit-levels. There is likewise shown, but partially, a double parallel line micrometer, which also measures angles of position.

This instrument, when first constructed, was designed to be placed where a meridian mark could not be obtained. A mark, however, could be placed and seen to the westward; and to take advantage of this, the axis of the declination circle was converted into a telescope with two object-glasses of equal focus, two sets of cross wires, and an eye-glass that might be placed in either end; a mark was then built up to the level of the axis, and in a line at right angles with the meridian, and this formed a substitute for a meridian mark. The instrument bears no maker's name, but the scheme of its fabric was devised by the late Captain Huddart, F.R.S. The brass-work, &c., was made by J. and E. Troughton, under his direction; and the object-glass for the telescope of 3¾ inches aperture by P. and J. Dollond. To preserve the tinned work from oxidation, it is well covered with white paint, and varnished; thus it has not only a neat appearance, but can be easily cleaned at any time.

With this instrument, and another equatorial of seven-feet focal length, the object-glass being made by Tulley, Sir James South and Sir John Herschel made observations on the apparent distances and positions of 380 double stars; a work of which we have had occasion previously to make mention. (W. W.) (T. H.) (R. M—N.)

Astruc || Asturias.

ASTRUC, JEAN, a celebrated physician, born in 1684 at Sauves, in Languedoc. His father, a Protestant clergyman, bestowed particular pains upon his early education; after which he studied at the university of Montpellier, where, having commenced the study of medicine, he took his degree as doctor of physic in 1703. He now applied to the study of medical authors, both ancient and modern, with uncommon assiduity, and in 1710 published a treatise on muscular motion, from which he acquired very high reputation. In that year he was appointed to the chair of anatomy at Toulouse. In 1717 he was appointed to teach medicine at Montpellier. Rising rapidly into fame, he was successively appointed superintendent of the mineral waters of Languedoc; first physician to the king of Poland; and, in 1731, regius professor of medicine at Paris. Here he taught the practice of physic with so great applause, as to draw students from other universities, and from foreign countries. He was not more celebrated as a professor than a practitioner. Even at an advanced age he prosecuted his studies with unwearied assiduity; and was thus enabled to transmit to posterity so many valuable monuments of his medical erudition. He died on the 5th of May 1766, in the 82d year of his age.

Of his numerous works, that on which his fame principally rests, is the treatise entitled *De Morbis Venereis, libri sex*, 1736. 4to; afterwards enlarged to 2 vols. 4to, and translated into French by Jault, 4 vols. 12mo. Besides these, he published some treatises not connected with medicine, one with the title of *Conjectures sur les Memoires originaux qui ont servi à Moise pour ecrire la Genèse*, Bruxelles (Paris), 1753, 12mo; and two dissertations on the Immateriality, Immortality, and Liberty of the Soul, Paris, 1755.

ASTURIAS, one of the ancient provinces of the Spanish monarchy, distinguished by the title of a principality, and under that name conferred on the heir apparent to the throne of Spain. By the new division of Spain, however, in 1833, the old province of Asturias took the name of Oviedo. It is bounded on the N. by the Bay of Biscay, on the S. by Leon, on the W. by Galicia, and on the E. by Santander. This part of Spain was known to the Romans by the name of the Ultramontane provinces, being bounded on every side but the N. by high mountains, which are passable with difficulty by horses, and nearly impassable by wheel-carriages. The principal road through the province is the *Camino real* or royal highway from Gijon and Leon to Madrid. This magnificent road, which cost so much that Charles IV. inquired if it were paved with silver, is carried by means of bridges and embankments over every impediment of a rugged and mountainous territory. In winter, however, it is in some places almost impassable. A railroad is now in progress from Aviles to Madrid, through Leon and Oviedo. Asturias contains 3460 square miles, and its population in 1849 amounted to 510,000. It is divided into 77 *audiencias*, which vary greatly as to their extent and productions. The face of the country is excessively irregular and mountainous; the higher elevations are not cultivated; and even in the valleys, which are irrigated by numberless streams, though there is abundant pasture for cattle, there is a great deficiency of corn. The flour of maize constitutes the principal food of all but the higher classes of inhabitants. Wheat is not much grown. The humidity weakens the plant; and though at first it appears to flourish, and looks well till it is in blossom, the crop frequently fails. Rye grows better, and constitutes part of the food, especially when mixed with maize. Chesnuts, as elsewhere in Spain, form an important part of the sustenance of the inhabitants. They are very abundant on the hills, and the nuts as well as the wood are very valuable products. Other kinds of timber well calculated for shipbuilding are found in the mountains; and several medicinal plants, such as hellebore, valerian, angelica, and others, which form trifling branches of commerce. Cows and horses are reared in this province, and considerable numbers of them are sent to Galicia, Leon, and the two Castiles. Vines, for want of due attention, do not flourish. Very little wine is made, and that little of bad quality; but to compensate for this deficiency, there is abundance of apples, and cider forms the common drink of the people. In some parts of the province there are very valuable mines of coal, some of which is transported to Cadiz, Carthagena, and other ports in the Mediterranean. The quantity yielded in 1847 was 472,000 quintals, being three times the amount in 1835. In the lower parts of the country, especially on the sea-coast, at a distance from coal-mines and forests, the inhabitants use turf or peat for firing. In the vicinity of the river Aviles, some mines of copper and iron are worked. The other mineral productions are gold, lead, zinc, magnesia, arsenic, cobalt, lapis-lazuli, alum, antimony, jet, marble, and rock-crystal. Fuel being plentiful, several manufactories of copper utensils have been established, which supply some parts of Leon and Castile with braziers' kettles, pots, and other similar articles. Besides these, there is a royal manufactory near Oviedo, where, in blast-furnaces, cannon-balls, grenades, bombs, and cannon of all calibres are cast. Some coarse cloths are made, but not sufficient to supply the inhabitants. Asturias.

The province is generally mountainous, especially in the S., where it is intersected by numerous ramifications of the Pyrenees. These gradually decline in height as they approach the ocean, along the border of which is a narrow stripe of the best and most populous portion of the principality. From the narrowness of this tract, it must be seen that the courses of all the rivers are necessarily short and rapid, and that they are very apt to overflow the country when the rains descend on the mountains. The Nalon, its principal river, passes the city of Oviedo, before which it receives the river Caudal, formed by the junction of two others, namely the Pola de Leon and the Aller. After passing Oviedo, the rivers Trubia and Narcea contribute their streams, when, after a course of 62 miles, it falls into the ocean. Along the whole extent of the coast of Asturias, a distance of 130 miles, there is not one good port. In that of Ribadesella, a large frigate may anchor; but it is difficult of access. Gijon will admit a vessel drawing 16 or 17 feet water, but the entrance here is also very narrow and dangerous. The principal city of the province is Oviedo. (See OVIEDO.) At a league from the city are the warm baths of Caldas. The spring issues from a calcareous rock of secondary formation: it is much resorted to, being found highly beneficial in many diseases. Gijon is honoured by having been the native place of Jovellanos, one of the wisest and best men that Spain has recently produced. He founded here the Asturian Institution, destined for the instruction of youth in mathematics, mineralogy, and navigation, which continues to flourish, though the building is still unfinished. He also projected the road for wheel-carriages from Gijon to Leon. The cabildo of Oviedo has done honour to his memory by erecting at the gate of their city, through which this road passes, a stone with an inscription to perpetuate the obligations which his country owes to him. At 10 leagues to the E.S.E. of Oviedo stands the collegial church and sanctuary of Covadonga, famous in the history of the period when the remains of the Goths were collected in the mountains of Asturias, and commenced that struggle against the Moors which continued during seven centuries, till the last of that wonderful people were finally driven out of the peninsula. The sea-coasts, as well as the small rapid streams, abound with fish of various kinds, the latter especially with salmon and lampreys, which are sent to supply the markets of Madrid. The Asturians are principally employed in agriculture. Their character is marked by the qualities which generally distinguish the inhabitants of mountainous regions; and they have been called the Swiss of Spain. They are robust, patient, and hardy; unenterprising but laborious; hospitable to strangers, and enthusiastic lovers of their country. Naturally prone to meditation, their imaginative spirit delights to dwell on

Astyages || Asymmetry.

the romantic traditions of the past, which their mountain-homes on every side call to remembrance. Among all the inhabitants of Spain they hold the first place in the comparative scale of morals, as is shown by the fact that in the province of Oviedo the proportion of crimes to the number of inhabitants is as 1 to 898, while in Madrid it is as 1 to 137. Their idiomatic dialect, called *Bable*, has suffered little changes since the days of Alonso X.; preserving more of the primitive type than the other dialects derived from the Latin. The important events of the early history of this principality will be found under the article SPAIN.—*Historia Natural de Asturias*, por Don Mariano Lagasca; *Viage de Ponz; Geografia de España*, por Antillon; Madoz, *Diccionario Geographico de España;* Ford's *Handbook of Spain.*

ASTYAGES, son of Cyaxares, and the last king of Media, began to reign in the year 594 B.C., and was dethroned by his grandson Cyrus, B.C. 559. Herodotus and Xenophon differ materially in the relation of this story: according to the latter, Cyrus peaceably succeeded to the throne on the death of Cyaxares II., the son of Astyages. See CYRUS.

ASTYANAX or SCAMANDRIUS, was the only son of Hector and Andromache. After the taking of Troy he was thrown headlong from a tower by order of Ulysses.

ASTYNOMI (ἀστυνόμοι), in *Grecian Antiquity*, magistrates in Athens, corresponding to the ædiles of the Romans. They were ten in number.

ASYLUM, a sanctuary or place of refuge where criminals shelter themselves from the hands of justice. The word is compounded of the privative particle α, and σύλη, *violence;* because no person could be taken out of an asylum without sacrilege. The asyla of altars and temples were very ancient, and likewise those of tombs, statues, and other monuments of distinguished personages. Thus, the temple of Diana at Ephesus was a refuge for debtors, the Theseium at Athens for slaves. At Rome a celebrated asylum was opened by Romulus between the mounts Palatine and Capitoline, for all sorts of persons indiscriminately, fugitive slaves, debtors, and criminals of every kind, in order to people the city. The Jews had their asyla, the most remarkable of which were the six cities of refuge, the temple, and the altar of burnt-offerings. It was customary among the heathens to allow refuge and impunity even to the vilest and most flagrant offenders; some out of superstition, and others for the sake of peopling their cities. We even read of asylums at Lyons and Vienne among the ancient Gauls; and there are some cities in Germany which still preserve the ancient right of asylum. Hence, on the medals of several ancient cities, particularly in Syria, we meet with the inscription ΑΣΥΛΟΙ, to which is added ΕΡΑΙ. This quality of asylum was given them, according to M. Spanheim, in regard to their temples, and to the gods revered by them. The Emperors Honorius and Theodosius granting the like immunities to churches, the bishops and monks laid hold of a certain tract or territory, without which they fixed the bounds of the secular jurisdiction; and so well did they manage their privileges, that convents in a little time became the next thing to fortresses, where the most notorious villains braved in safety the power of the magistrate. These privileges were extended not only to the churches and churchyards, but also to the bishops' houses, whence the criminal could not be removed without a legal assurance of life, and an entire remission of the crime. The reason of the extension was, that they might not be obliged to live altogether in the churches, &c., where several of the occasions of life could not be decently performed. But at length these asyla or sanctuaries were also stripped of most of their immunities, because they served to make guilt and libertinism more bold and daring. In England, particularly, they were entirely abolished. See SANCTUARY.

ASYMMETRY, the want of proportion between the parts of anything; being the contrary of *symmetry*. Or, it is the relation of two quantities which have no common measure, as 1 and $\sqrt{2}$, or the side and diagonal of a square.

Asymptote || Ath.

ASYMPTOTE, in *Geometry*, a line which continually approaches nearer to some curve, but which, though continued infinitely, would never meet it. This property belongs to the hyperbolic curve and its asymptotes, which are in relation to each other as a repeating decimal fraction and unity. The term is derived from the Greek ἀσύμπτωτος (from α, priv., σύν and πίπτω), "not falling together."

ASYNDETON (α and συνδέω, to *bind*), in *Grammar*, a figure which omits the conjunctions in a sentence; as in *veni, vidi, vici*, where ET is left out; or in that of Cicero concerning Catiline, *abiit, excessit, evasit, erupit.*

ATACAMA, a division of Bolivia in South America, remarkable for a vast desert tract along the Pacific.

ATACAMITE, a mineral found in that desert in some quantity. It is an oxychloride of copper, of a rich green colour, massive, or pulverulent.

ATAHUALPA, the last of the Incas. See PERU.

ATALANTA, in *Grecian Fable*, the most swift-footed of mortals, promised her hand in marriage to him who should outstrip her in the race, on the condition, however, that the unsuccessful competitor should suffer the penalty of death. Milanion at length succeeded in obtaining her for his wife, by the stratagem of dropping during the race three golden apples, whose beauty so charmed Atalanta that she stopped to gather them, and thus suffered herself to be defeated. After their nuptials they were metamorphosed into lions for profaning a sanctuary by their embraces.

ATAMELIK, a learned native of Khorassan, who was a prefect of Baghdad under Hulaku, and author of a history of the Moguls, said to exist in MS. in the National Library at Paris. He was born in 1226. The period of his death is uncertain.—See *Mines de l'Orient*, vol. i.

ATCHAFALYA, a river of Louisiana, in North America, or more properly a secondary channel of the Mississippi, by which a portion of its waters flows off from the main trunk into the Mexican Gulf. Its mouth is 100 miles W. of the principal embouchure of the Mississippi.

ATE, in *Pagan Mythology*, the goddess of mischief. When Jupiter was deceived by Juno, after he had sworn to her that the next descendant of Perseus should reign over that race, his vengeance fell upon his daughter Ate, on the supposition that it was through her interference that Hercules was deprived of his heritage by the earlier birth of Eurystheus; whereupon she was hurled from Olympus, and banished for ever from the abodes of the celestials. In the tragic writers the character of Ate resembles that of Nemesis and Erinnys.

ATELLANÆ FABULÆ, in *Roman Antiquity*, a species of low comedy, invented by the people of Campania, and adopted by the Romans. They seem to have consisted of metrical effusions, in burlesque imitation of the manner and dialect of the peasantry, with satirical humour.

ATERGATIS, in *Mythology*, a goddess of the Syrians, supposed to be Derceto, the mother of Semiramis. She was represented with the face and breasts of a woman, but the rest of her body resembled a fish. It has been conjectured that she is perhaps the female counterpart to the *Dagon* of the Philistines.—See Lucian, *De Dea Syria.* xiv.; Diodorus, ii.

ATESTE, a town in Austrian Lombardy, now Este.

ATH, or AETH, a city of Belgium, province of Hainaut, situated on the river Dender. It is well built, and was strongly fortified by Vauban; has an arsenal, with several bomb-proof magazines; a church dedicated to St Julian, a town-house, college, school of design, orphan asylum, theatre, &c. It contained in 1850, exclusive of the garrison, 8437 inhabitants, chiefly employed in refining sugar and salt, in making soap, beer, and gin, and in the cotton and linen manufactures. It is 25 miles from Brussels. Long. 3. 46. 32. E. Lat. 50. 42. 17. N

Athabasca || Athanasius.

ATHABASCA, or ATHAPESCOW, a river in the north-western territory of British North America, which flows into a lake of the same name. It rises in the Rocky Mountains, and has a long and tortuous course in a north-eastern direction, during which it receives the Lesser Slave River, the Red Deer, and several others. The lake is about 230 miles in length, with a breadth varying from 30 to 14 miles, lying in a direction almost E. and W., in Lat. 59. N. Long. 110 W.

ATHALIAH, the daughter of Ahab and wife of Jehoram king of Judæa, who, after the death of King Ahaziah, her son, butchered all the seed-royal of the house of Judah, that she might usurp the throne. Among the victims were her own grandchildren, except the youngest, whom the affectionate pity of his aunt Jehosheba concealed in the Temple, where he was protected by the high priest Jehoiada for six years. At the end of that time the priest showed their infant king to the nobles, and exhorted them to put this infamous woman to death; which was promptly done, as soon as she was without the precincts of the Holy Place. The story of Athaliah forms the subject of one of Racine's best tragedies.

ATHANASIAN CREED, a formulary or confession of faith, long supposed to have been drawn up by Athanasius, bishop of Alexandria in the fourth century, to justify himself against the calumnies of his Arian enemies: but it is now generally admitted among the learned that he was not the author. Dr Waterland, in his *Critical History of the Athanasian Creed*, ascribes it to Hilary, bishop of Arles, for the following among other reasons:—1. Because Honoratus of Marseilles, the writer of his life, tells us that he composed an *Exposition of the Creed*—a more proper title for the *Athanasian* than that of *Creed* simply, which it now bears. 2. Hilary was a great admirer and follower of St Austin; and the whole composition of this creed is in a manner upon St Austin's plan, both with respect to the Trinity and incarnation. 3. It is agreeable to the style of Hilary, as far as we can judge from the little that is left of his works. Upon the whole, he concludes that Hilary, bishop of Arles, about the year 430, composed the *Exposition of Faith* which now bears the name of the *Athanasian Creed*, for the use of the Gallican clergy, and particularly those of the diocese of Arles; that about the year 570, it became famous enough to be commented upon; but that all this while, and for several years longer, it had not yet acquired the name of *Athanasian*, but was simply styled *The Catholic Faith*; that before 679 Athanasius's admired name came in to recommend it, being in itself an excellent system of the Athanasian principles of the Trinity and incarnation, in opposition chiefly to the Arians, Macedonians, and Apollinarians. This creed was received in France in the time of Hincmar, or about 850; in Spain and Germany about 100 years later. We have clear proofs of its having been sung alternately in our churches in the tenth century. It was in common use in some parts of Italy, particularly in the diocese of Verona, about the year 960, and was received at Rome about the year 1014. It has been questioned whether any of the Greek and oriental churches ever received this creed at all, though some writers of authority are of a contrary opinion. It appears, then, that the reception of this creed has been both general and ancient, and that it may vie with any in that respect, except the Nicene or Constantinopolitan, the only general creed common to all the churches. As to its matter, it is given as a summary of the true orthodox faith, and a condemnation of all heresies, ancient and modern. Unhappily, however, it has proved a fruitful source of unprofitable controversy and unchristian animosity.

ATHANASIUS, ST., bishop of Alexandria, and one of the greatest defenders of the faith against the Arians, was born at Alexandria in Egypt, about the year 296. He followed St Alexander to the Council of Nice in 325, where he disputed against Arius, and the following year was made bishop of Alexandria. In 335 he was deposed by the council of Tyre; when, having recourse to the Emperor Constantine, the Arian deputies accused him of having hindered the exportation of corn from Alexandria to Constantinople; on which the emperor, without suffering him to make his defence, banished him to Treves. The emperor, two years after, gave orders that he should be restored to his bishopric; but, on his return to Alexandria, his enemies brought fresh accusations against him, and chose Gregory of Cappadocia to his see, which obliged Athanasius to go to Rome to reclaim it of Pope Julius. He was there declared innocent, in a council held in 342, and in that of Sardica in 347, and two years after was restored to his see by order of the Emperor Constans; but after the death of that prince he was again banished by the Emperor Constantius, which obliged him to retire into the deserts. The Arians then elected in his stead one George, who was killed in a popular sedition under Julian in 360. St Athanasius then returned to Alexandria, but was again banished under Julian. His successor Jovian, however, being a Christian, restored him to his see. To that emperor he addressed a letter, in which he proposed that the Nicene creed should be the standard of the orthodox faith, and condemned those who denied the divinity of the Holy Ghost. He was afterwards banished by Valens in 367, but again returned from what has been termed his fifth exile. He died in 373. His works principally contain a defence of the mysteries of the Trinity, and of the incarnation and divinity of the Word and Holy Spirit. There are three editions of them which are esteemed: that of Commelin, printed in 1600; that of Peter Nannius, in 1627; and that of Father Montfaucon. The most complete edition, however, is that published at Padua in 1777, in four vols. folio. As to the creed which bears the name of Athanasius, see the preceding article.

Athanati || Athelingey.

ATHANATI, (*ἀθάνατοι, immortals*), in *Persian Antiquity*, a body of cavalry, consisting of 10,000 men, always complete. They were called *athanati*, because when one of them happened to die another was immediately appointed to succeed him.

ATHANERIK, a valiant leader of the Visigoths, who, though defeated once by the generals of the Emperor Valens in 369, was afterwards raised to the head of his nation, and when he died in 381, left behind him a reputation for fortitude and sagacity.—*Ammianus; Gibbon.*

ATHEIST (from *α*, priv., and Θεὸς, God), one who denies or disbelieves the existence of a Deity. Many, both ancient and modern, have pretended to atheism, or have been reckoned atheists by the world; but it may justly be questioned whether any man ever seriously adopted such a principle. Vulgar prejudice and bigotry also, from the time of Socrates downwards, have frequently fastened the charge of atheism where it was least of all appropriate. Among us, the greatest philosophers have been the principal advocates for the existence of a Deity. So true is the saying of Lord Bacon, that though a smattering of philosophy may lead a man into atheism, a deep draught will certainly bring him back again to the belief of a God and providence.—See Reimann's *Historia Atheismi*, &c., 8vo, Hildesh. 1725; and Sylvain Maréchal's *Dictionnaire des Athées*, 8vo, Paris, 1799.

ATHELING, ADELING, EDELING, ETHLING, or ETHELING, among the Anglo-Saxons, was a title of honour, properly belonging to the heir-apparent or presumptive to the crown. It was first conferred by King Edward the Confessor on Edgar, to whom he was great uncle, when, having no issue of his own, he intended to make him his heir.

ATHELINGEY, or NOBLES' ISLAND, a fastness in Somersetshire, in which King Alfred concealed himself when the Danes overran his country. It is now a gentle eminence in a cultivated district; it was then a jungle of about 100 acres, surrounded by a deep morass, from which he issued in many successful assaults on his astonished enemies.

Athelstan ‖ Athens.

It is commonly called Athelney, and is now occupied by a single farm-house.

ATHELSTAN, a Saxon king of England, natural son of Edward the Elder, and grandson of the great Alfred. He succeeded to the crown in 925, and reigned 16 years. A remarkable law passed by this prince, shows his just sentiments of the advantages of commerce, as well as the early attention to it in this country: it declared that any merchant who made three voyages on his own account beyond the British channel or narrow seas should be entitled to the privilege of a thane or gentleman.

ATHENÆUM (*Ἀθήναιον*), in *Antiquity*, a public place in which the professors of the liberal arts held their assemblies and gave instruction, the rhetoricians declaimed, and the poets rehearsed their performances. The three most celebrated Athenæa were those at Athens, at Rome, and at Lyons; the second of which was built by the Emperor Hadrian, and continued in high repute till the fifth century. The name Athenæum is frequently applied in modern times to establishments connected with literature and art, to public libraries, and the like.

ATHENÆUS, a mechanician of Magna Græcia, who dedicated to Marcellus, the conqueror of Syracuse, a work termed Περὶ Μηχανημάτων, "On Warlike Engines." It is extant in Thevenot's *Mathematici Veteres*. He must have flourished about the year 214 B.C.

ATHENÆUS, a physician of Attalia in Asia Minor, the founder of the *Pneumatic* sect, in the first century. Some of his opinions are preserved in Aetius, Oribasius, and Galen, from which it would appear that he attributed the movements of the heart and the pulse to a *fifth element*, Πνεῦμα; and therefore it would seem that he held the doctrine of a *vital principle*.—Le Clerc, *Hist. de la Medicine*.

ATHENÆUS, a Greek grammarian of great erudition, was a native of Naucratis in Egypt, and lived about A.D. 230, first at Alexandria, and afterwards at Rome. The only one of his works extant is that entitled *Deipnosophistæ* (Δειπνοσοφισταί), or *Banquet of the Learned*, in 15 books, of which the first two, and parts of the 3d, 11th, and 15th, exist only in epitome. This work is an almost inexhaustible store of anecdotes, facts, quotations, criticisms, and discussions, on subjects of the most diversified kind; and it is valuable for the light it throws on many curious circumstances regarding the ancients. Editions: by Aldus, Venice, 1514; Casaubon, Geneva, 1597; Schweighaüser, Strasbourg, 14 vols. 8vo, 1801–7; W. Dindorf, 3 vols. 8vo, Lips. 1827, which is the best. There is also a French translation in 5 vols. 4to, by M. Lefevre de Villbrune.

Athenagoras ‖ Athens.

ATHENAGORAS, an Athenian philosopher who flourished about the middle of the second century. Originally a disciple of Plato, he embraced Christianity, and distinguished himself by the zeal and learning which he brought to its defence. Two of his works are extant—an *Apology for Christianity*, addressed to the Emperors Marcus Aurelius Antoninus and Lucius Commodus, and a *Treatise on the Resurrection*. The best edition of his works is that of the Benedictines, published at Paris in 1742, together with the writings of Justin Martyr, Theophilus of Antioch, and Hermias, in one vol. folio. There is also an English translation by Humphreys, London, 1714.

ATHENODORUS, surnamed CANANITES or SANDONUS, a Stoic philosopher, was born at Tarsus, and went to the court of Augustus, who made him tutor to Tiberius. Augustus esteemed him greatly, having proved by experience his virtue and probity. He used to speak very freely to the emperor, and warned him, whenever he found himself giving way to anger, to rehearse the twenty-four letters of the alphabet before he resolved to say or do anything. He died at the age of 82. None of his works have survived. There was another Stoic of this name, surnamed *Cordylion*, also of Tarsus, who was keeper of the library at Pergamus, and died at Rome in the house of Cato the Younger. There were likewise two sculptors named Athenodorus, one of whom assisted Agesander in the group of the Laocoon.

ATHENRY, a decayed town of Ireland, county of Galway, and province of Connaught, 14 miles E. of Galway. It is a place of antiquity, and traces of its walls, castle, and an old Dominican friary, are still visible. From the time of Richard II. till the Union it returned two members to parliament. Pop. in 1851, 1487.

ATHENS.[1]

ATHENS (Ἀθῆναι, *Athenæ*), "the eye of Greece" (to use Byron's phrase), the capital of Attica, and the birthplace of the most distinguished poets, orators, philosophers, statesmen, historians, and artists of antiquity, is situated in Long. 23. 44. E. Lat. 37. 58. N., in the central plain of Attica, about four miles from the coast. See ATTICA. The city of Athens consisted of three distinct parts: 1. The town on the rock, or the Acropolis, also simply called ἡ πόλις; 2. The city of Athens below and around the Acropolis, generally called τὸ ἄστυ; and sometimes ἡ κάτω πόλις, or lower city; and 3. The port towns, including Peiræus, Munychia, and Phalerum.

By whom founded.

The origin of Athens, like that of most other ancient and renowned cities, is involved in the obscurity of fable. Its reputed founder was Cecrops, an Egyptian, who brought from Sais the worship of the goddess Neith, called by the Athenians Ἀθήνη, and who, in the opinion of the learned, was contemporary with Moses. The new city was built on the rock of the Acropolis, which originally contained all the habitations of the Athenians, and received from Cecrops the name of Cecropia. But in the time of Erechtheus, called by later writers Erichthonius, the second of the early kings in succession from Cecrops, and the person who is said to have instituted the festivals called *Athenæa*, in honour of Ἀθήνη or Minerva, it lost the name which it had derived from its founder, and acquired that of Ἀθῆναι, *Athens*, from the goddess to whose worship it was principally dedicated.

Ancient state.

We have received little or no information respecting the size or dimensions of Athens under its earliest kings. It is generally supposed, however, that even as late as the time

[1] The principal works on the Topography of Athens, which has been discussed at length, and with great accuracy and research, by modern antiquaries and travellers, are Stuart's *Antiquities of Athens*; Dodwell's *Classical Tour*, vol. i.; Mr Hawkins' *Dissertation on the Topography of Athens* in Walpole's *Memoirs*, vol. i. p. 480; Colonel Leake's *Topography of Athens, with some Remarks on its Antiquities*; P. W. Forchhammer's *Topographie von Athen*, Kiel, 1841, 8vo; Wordsworth's *Athens and Attica*, London, 1836; and Mr Cramer's *Geographical and Historical Description of Ancient Greece*, vol. ii. p. 309. These writers, with the exception of Mr Cramer, have in general followed Pausanias, who, having himself visited Athens, describes, in his first book, its antiquities and most remarkable edifices. But as it is admitted on all hands that Pausanias has neglected to notice several important buildings pointed out by other authors, and that his description is, besides, defective in several particulars, we have availed ourselves of the additional information supplied by Meursius in his *Athenæ Atticæ*, and by succeeding antiquaries, in order that we might be enabled to form as accurate a list as possible of the principal edifices and monuments of this celebrated city.

Athens.

ot Theseus the town was almost entirely confined to the Acropolis and the adjoining hill of Ares or Mars. But during the six or seven centuries which elapsed between the Trojan war and the reign of Peisistratus, it appears to have increased considerably both in extent and population;[1] while the adminstration of that enlightened and patriotic usurper, so far from proving an impediment to the prosperity of the city, operated in aid of its improvement; as has often happened when power chances to fall into the hands of a person of taste and munificence. By establishing a public library, and by editing the works of Homer, Peisistratus and his sons fixed the Muses at Athens. Nor in the midst of all this attention to the cultivation of the arts and the embellishment of the city, had the means of defence against external aggression been neglected. For, since Athens was able to withstand a siege by the Lacedæmonians, during the reign of Hippias, one of the sons of Peisistratus, we may conclude that it already possessed walls and fortifications of sufficient height and strength to ensure its safety.

Effects of the Persian invasion.

But the invasion of Xerxes, and the subsequent irruption of Mardonius, effected the entire destruction of the ancient city, and reduced it to a heap of ruins; with the exception only of such temples and buildings as, from the solidity of their structure, were enabled to resist the action of fire and the work of demolition. During their temporary ascendancy in Greece, the Persians displayed the same iconoclastic fury which had marked their career of conquest in Egypt with havoc and desolation. But when the battles of Marathon, Salamis, Platæa, and Mycale, had dissipated the forces of the invader, and liberated Greece from the danger of subjugation to a foreign power, Athens, restored to peace and security, soon rose out of its ruins with increased splendour; and having been provided by Themistocles with the military works necessary for its defence, it attained, under the subsequent administrations of Cimon and Pericles, to the highest pitch of beauty, strength, and magnificence. The former, indeed, is known to have erected the temple of Theseus, the Dionysiac Theatre, the Stoæ, and the Gymnasium, and also to have embellished the Academy, the Agora, and other parts of the city, at his own expense;[2] while the latter completed the fortifications which had been left in an unfinished state by Themistocles and Cimon—rebuilt several edifices which the Persians had destroyed—and, above all, immortalized himself by the construction of the temple of Eleusis, the Parthenon, and the Propylæa, edifices unrivalled alike for classical purity of design and perfection of execution.

Age of Pericles; population.

It was, indeed, under the administration of Pericles that Athens attained to that eminence in art which has excited the wonder and admiration of all succeeding ages: it was to this illustrious man that the city was principally indebted for the splendour of its architectural decorations, and the republic for its prosperity and its power. At the period in question the whole of Athens, with its three ports of Peiræus, Munychia, and Phalerum, connected by means of the celebrated Long Walls, formed one great city, inclosed within a vast peribolos of massive fortifications, extending to not less than 174 stadia, of which the circuit of the city amounted to 43, the long walls taken together to 75, and the circumference of the three harbours to 56.[3] There is some difficulty in ascertaining the amount of the population of Athens at this period. Xenophon informs us that it contained more than 10,000 houses, which, at the rate of ten persons to a house, would give 100,000 souls for the whole population of the city. By a census of Pericles, mentioned by Plutarch in his life of that statesman, it, however, appears that the number of Athenians entitled to exercise the rights of citizenship was confined to 14,040; and at no subsequent period does this number appear to have much exceeded 20,000, which indeed may be taken as the average amount of the free adult male population of Athens, enjoying the rights of citizenship. See ATTICA.

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Dimensions of the walls.

From the researches of Colonel Leake and others, it appears that the ancient city considerably exceeded in extent the modern town; for, although the scanty remains of the old fortifications are insufficient to enable us to judge of their circumference, it is nevertheless evident, from the measurement furnished by Thucydides, that they inclosed a much larger space than that contained within the present line of wall, particularly towards the north. It is probable, indeed, that, on this side, the extremity of the city reached as far as the foot of Mount Lycabettus; and that, to the westward, its walls followed the course of the small brook which terminates in the marshy ground of the Academy, until they met the point where some of the ancient foundations are still to be seen near the Dipylum; while, to the eastward, they approached close to the Ilissus, a little below the present church of the Mologitades or Confessors. The entire peribolos of the fortifications, including the walls of the city, the longimural inclosure, and the defences of the ports, cannot therefore have been less than 19 miles; but from the extreme irregularity of the space inclosed, it is impossible to form any accurate estimate of its dimensions. Ancient writers inform us, however, that Athens was nearly equal in extent to Rome within the walls of Servius; and Plutarch compares it in point of size to Syracuse, which Strabo estimates at 180 stadia, or upwards of 22 miles in circumference.

Gates, Dipylum, &c.

The number of gates in the fortifications of ancient Athens is uncertain; but the names of nine have been preserved by the classical writers. These are Dipylum (otherwise called Ceramicæ), Diomeiæ, Diocharis, Melitides, Peiraicæ, Acharnicæ, Itoniæ, Hippades, and Heriææ. The Dipylum was situated in that part of the wall which separated the inner from the outer Ceramicus, and formed the communication between them; from which circumstance it was sometimes called the gate of Ceramicus. A little to the south of the Dipylum was the Sacred Gate, from its leading into the Sacred Way; also called the Thriasian gate, or gate of Thria, from its conducting to or forming the outlet in the direction of Eleusis and Megara. On the north-west side of the Acropolis, in a hollow adjoining a small church built on a rock and dedicated to St Athanasius, there still remain some appearances of the foundations of a gate; and here, accordingly, Colonel Leake and others have fixed the site of Dipylum. The Diomeiæ, probably so called from Diomeia, one of the Attic demi, which itself received its name from the hero Diomus, was nearly opposite the entrance of the suburban gymnasium called Cynosarges, a place dedicated to Hercules, and situated to the north-east of Athens. The gate of Diocharis fronted the entrance of the Lyceum, near to the fountain of Panops; while that called Melitides was situated in the southern part of the wall, towards the sea and Phalerum; and the Peiraicæ, as its name sufficiently implies, led to the harbour of the Peiræus. Traces still exist of the Melitides and Peiraicæ, as well as of the Dipylum.

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[1] This must have been true even in the time of Homer, who applies to it the epithets of *εὐκτιμένη* and *εὐρυάγυια*, which seem to indicate a place of some consideration.

[2] Plutarch, *in Vit. Cimon.*

[3] Taking the itinerary stadium at 575 English feet, or the length resulting from the equation of 19 English miles with 174·5 stadia, it would of course follow that the peribolos of fortifications was just the same number of miles in extent. But it has been ascertained that the Greek stadium in the time of the Roman emperors exceeded the itinerary stadium by 30 feet, or, in other words, was equal to 605 English feet; which, taken as the true value of the measure, would consequently give 605×174÷5280=19·9375 miles as the entire circumference. (Leake's *Topography*, p. 369.)

Athens. There can be little doubt that the gate called Acharnicæ was so named from its leading to the demus of Acharnæ, the situation of which was probably at or near the modern village of Menidhi, close by the spot where the present road to that village intersects the line of the ancient walls. The site of the Itonian gate, mentioned in the dialogue of Axiochus, is placed by Colonel Leake about half-way between the Ilissus and the foot of the hill of Museum, where the road leading direct to Phalerum from the modern Inté-kapesi or Albanian gate cuts the line of the ancient walls. Of the Hippades we only know that it was the gate on the outside of which was the sepulchre of the family of the orator Hyperides. It seems to have derived its name from some equestrian statues erected near it; and it is not improbable that the Hippades may have been the gate between Dipylum and the Peiraic, of which some vestiges still exist on the north side of the Hill of Nymphs, commonly, but erroneously, called Mount Lycabettus. Lastly, the Heriæ or Heriææ was so called from its being the gate through which corpses were usually conveyed to the burying-ground, but its precise site cannot now be discovered. Athens, in fact, was surrounded on every side with an immense cemetery. On the north-west and north, from the northern long wall to Mount Lycabettus, generally but falsely called Anchesmus, there was a continued succession of sepulchres; and the excavations made in search of sepulchral antiquities have proved that there were similar burying-grounds on the outside of the southern long wall.[1]

Pompeium and temple of Ceres. Pausanias commences his description of Athens apparently from the Peiraic gate. We shall imitate his example, and follow nearly the same course; supplying his omissions as we go along, and conjoining with our accounts of ancient edifices and monuments notices of their existing state and condition where any traces or vestiges of them still remain. On entering the city, the first building remarked by Pausanias was the Pompeium. This was so called from its being the depository of the sacred vessels (*πομπεῖα*) used in certain processions, which, being of great value, had a separate building appropriated for their safe custody. In the Pompeium there was also a statue of Socrates by Lysippus, together with several portraits of eminent individuals, amongst which that of Isocrates has been particularly mentioned. Near this edifice stood a temple of Demeter (Ceres), containing statues of that goddess, of her daughter Persephone, and of Iacchus, executed by Praxiteles; and beyond it were several porticoes leading from the city gates to the outer Ceramicus; while the intervening space was occupied by some temples, the Gymnasium of Hermes, and the house of Polytion, where some Athenians of distinction (probably Alcibiades and his companions) are said to have celebrated mysteries similar to those of Eleusis.[2]

Ceramicus. There were two places in Athens known by the name of Ceramicus;[3] one without the walls, forming part of the suburbs; and the other within, including a considerable and very important section of the city. The outer Ceramicus was covered with the sepulchres of the Athenians who had been slain in battle, and buried at the public expense, with the exception of those who fell at Marathon, and who were interred on the spot where they had died so gloriously; and it appears to have communicated with the inner Ceramicus by means of the gate Dipylum, which is understood to be the Ceramic entrance alluded to by Philostratus. The Ceramicus *intra muros* probably included the Agora, the Stoa Basileios, and the Poecile, besides various other temples and public buildings. Antiquaries, it is true, are not decided as to the general extent and direction of this portion of the ancient city; but, from the researches and observations of Colonel Leake, it seems pretty certain that it lay entirely on the south side of the Acropolis,[4] where it was of course bounded by the city walls, which ran close to the fountain Callirrhoe, or Enneacrunus; and that, consequently, its breadth could not have exceeded one-half of its length.[5] We shall now give some account of the edifices in this part of the ancient city, reserving what we have to say of the outer Ceramicus until we come to describe the suburbs. Athens.

Ceramic edifices. The first building mentioned by Pausanias is the Stoa Basileios, so called because the archon basileus held his court there, and which probably stood at the western extremity of the Areiopagus. Its roof was adorned with statues of baked clay; and adjoining it were statues of Cimon, and Evagoras, king of Cyprus. Behind this portico was another, containing paintings of the twelve gods, and of Theseus and "the fierce democracy,"—thus implying that he was the first to establish equal rights among the citizens of Athens; together with a picture by Euphranor, representing the achievements of the Athenian auxiliary cavalry at the battle of Mantineia. The temple of Apollo Patrous was situated in the vicinity of the latter portico, and was dedicated to that god in his capacity of *Alexicacus*, that is, the averter of evil, such as the plague and other epidemics. The Metroum, a temple consecrated to the mother of the gods, was the grand depository of the archives of the state, and served also as a tribunal for the archon eponymus. Adjacent to the Metroum was the senate-house (*βουλευτήριον*), containing statues of Zeus the Counsellor, of Apollo, and of the Athenian demos; and close to the council-wall stood the Tholus, where the Prytanes usually held their feasts and sacrifices; while somewhat higher up were the statues of the eponymi, or heroes, who gave names to the Athenian tribes, with those of Amphiaraus, Lycurgus the orator, and Demosthenes. Near the latter stood a temple of Ares (Mars), having several statues within, and around it those of Hercules, Theseus, and Pindar, who was thus honoured for the praise he had bestowed upon the Athenians; close to which were the figures of Harmodius and Aristogeiton. All the statues here mentioned were carried away by Xerxes when he plundered Athens, but were afterwards restored by Antiochus, as we learn both from Pausanias and from Arrian. Above the Stoa Basileios was a temple of Hephæstus (Vulcan), and also one dedicated to Aphrodite (Venus) Urania, containing a statue of the goddess in Parian marble, executed by the chisel of Phidias; both of which edifices were situated near the western extremity of the hill or ridge of Areiopagus.[6]

Stoa Poecile. One of the most important of the Ceramic edifices was the Stoa Poecile, so called from the celebrated paintings with which it was adorned, although its more ancient name appears to have been Peisianactios. The paintings were almost exclusively devoted to the representation of national subjects, as the contest of Theseus with the Amazons, the battle of Marathon, and other achievements of the Athenians; and were mostly executed by Polygnotus, Micon, and Pamphilus, the most celebrated amongst the early Grecian artists. Here were also suspended the shields of the Scionæans of Thrace, together with those of the Lacedæmonians taken in the island of Sphacteria; and it was in this

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[1] Leake's *Topography of Athens*, p. 374, 375.

[2] Demosthenes *in Phorm.*; Diogenes Laertius *in Vit. Socrat.*; Plutarch *in Vit. Alcibiad.*; and Thucydides, vi. 27.

[3] So called either from the hero Ceramus, or from potteries which were formerly situated in the neighbourhood. Herod. v. 88; Suid. *v.* Κεραμεῖς.

[4] Leake's *Topography of Athens*, p. 101.

[5] Schol. Aristoph. *Equit.* 772; Plutarch, *Syll.*; Hesychius, *v.* Κεραμεικός.

[6] Pausanias, *Attic.* 3; Plutarch, *de Glor. Athen.*; Pliny, xxxv. 11; Harpocrates, *v.* Μήτρωον; Suidas, *v.* Ἀρχῶν and Θίλος; Pausan. *Attic.* 8; Arrian. *de Exped. Alex.* iii. 16.

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portico that Zeno first opened that celebrated school, which thence received the appellation of Stoic, and was destined to exercise a most powerful influence both on the philosophy and legislation of succeeding times. The Poecile is also memorable as the scene where no less than 1500 citizens of Athens are said to have been destroyed by the Thirty Tyrants. Some ancient walls which are still extant near the church of Panagia Fanaromeni, Colonel Leake supposes, with some probability, to be the remains of this once celebrated portico. Near the Stoa Poecile was a statue of Hermes Agoræus, which, from its position close to a small gate, was sometimes termed Ἑρμῆς πρὸς τῇ πολίδι.[1]

Ceramic Agora.

The epithet Agoræus naturally leads us to conclude that this brazen figure of the god, described by the Roman satirist as *furum aviumque maxima formido*, stood in the Agora or market-place, by much the largest portion of which was in the quarter of Ceramicus. Xenophon also informs us, that at certain festivals it was customary for the knights to make the circuit of the Agora on horseback, beginning at the statue of Hermes just mentioned, and paying homage as they passed along to the statues and temples around it.[2] There is sufficient reason to believe, however, that the Agora never extended to the southward and eastward of the ascent to the Acropolis; but it seems to have included a very large space to the west and north-west of the Propylæa; which is accounted for upon the supposition, which a number of circumstances conspire to render probable, that the market-place, or at least its most frequented parts, had shifted their position at different periods of the republic. In the more remote ages, when Acropolis or Cecropia was almost the only inhabited part of the site of Athens, it is natural to believe that the Agora resorted to from the neighbouring country must have been situated a little below the entrance of Cecropia, free admission to which could scarcely have been permitted to strangers in those barbarous ages. But when the principal sacred edifices were erected on the south side of the Acropolis, and the city began to spread over the valleys to the south and west of the citadel, the Agora may have extended into the western side of the same space, with that most ancient place of popular assembly, the Pnyx, above the middle of it. It has been supposed by Colonel Leake and others, that about the time of Augustus, when the city had been considerably extended in the north of the Acropolis, and when the Agora had been polluted by the massacre of the Athenians in the time of Sulla, a new Agora was built in the north of the Acropolis; and a portal still existing in that neighbourhood has been generally regarded as a remnant of this new Agora. But the style of this portal, as well as the inscriptions on it, show that it was not a gate, but a portion of a building erected out of the donations of Julius Cæsar and Augustus in honour of Athena Archegetis. As for the population of that part of the city, we know that in the time of Thucydides and Xenophon it was not occupied by houses, but consisted of gardens.[3] There is accordingly no ground for supposing that Athens ever had more than one Agora.[4]

Its sections or divisions.

Our detailed description of the Agora must necessarily be brief. It contained a street lined with Hermæ, and forming the communication between the Stoa Basileios and the Poecile. The Macra Stoa was a range of porticoes extending from the Peiraic gate to the Poecile, behind which rose the hill called Colonus Agoræus, where Meton erected a table for astronomical purposes. The Leocorium stood also in the Ceramicus, which, as classical readers know, is often used synonymously with Agora. Pausanias makes no mention of this monument, which was erected in honour of the daughters of Leos, who had devoted themselves for their country, and near which the tyrant Hipparchus was slain by Harmodius and Aristogeiton. The Ceramicus also contained the Agrippeium or theatre of Agrippa, the Palæstra of Taureas, and the Stoæ of the Thracians and of Attalus. The portion strictly appropriated as a market-place was divided into sections, distinguished from one another by appellatives descriptive of the various articles exhibited for sale. Thus we read of the γυναικεία ἀγορά, where women's apparel was usually sold; of the ἰχθυόπωλις ἀγορά, or fish-market; of the ἱματιόπωλις ἀγορά, or clothes-market; and of the ἀγορά Ἀργείων, Θεῶν, Κεράμων, where, among other things, stolen goods were, it seems, publicly disposed of. The quarter denominated Cyclus from its form, was the slave and provision-market. A peculiar stand was allotted to each vender, who, when he had once chosen his station, was not allowed afterwards to change it.[5] The common-hall of the Athenian mechanics was situated in the Ceramicus, which seems to have been the great resort of the lower orders, including courtesans, who, according to Lucian and the scholiast on Aristophanes, principally frequented this part of the city. In the north of the Acropolis, or the district commonly called that of the new Agora, there was an altar to Pity, and two gymnasia; one founded by Ptolemy the son of Juba the Libyan, the other supposed to have been established by Ptolemy Philadelphus, and each denominated Ptolemeium. To the northward of Fanaromeni there was found among the ruins,[6] many years ago, an inscribed pedestal, which had supported a statue of Ptolemy the son of Juba; and Juba is said by Pausanias to have been honoured with a statue in the Gymnasium of Ptolemy.[7] So much for the Ceramic edifices.

Theseum.

The next structure which demands our attention is the Theseium or temple of Theseus, which stood, and happily still stands, at no great distance from the site of the monuments last mentioned. The circumstances which led to the erection of this noble edifice are deserving of commemoration. About eight centuries after the death of Theseus, the Athenians suddenly became ashamed of the ingratitude of their ancestors towards their great benefactor, in driving him out of Athens to die by violence in a foreign country. This tardy fit of remorse is said to have been occasioned by a rumour, which readily gained belief, that the spectre of the patriot hero had been seen fighting against the Persian host at Marathon. The Pythia was consulted in reference to the supposed apparition, which of course was duly authenticated; and generously directed the Athenians to remove his remains to the city, which even his spirit had defended, and to honour him as a demigod. His bones, with a brazen helmet and a sword lying beside them, were discovered in the island of Scyrus, by Cimon, son of Miltiades. They were received at Athens with processions and sacrifices. Games and festivals were instituted in his honour; a heroum was erected to him on the Colonus Hippius, and a temple, the Theseium, in the city. This building was equalled in sanctity only by the Parthenon and Eleusinium; its sacred inclosure was so large as occasionally to serve as a place of military assembly. It was built about 465 years before the Christian era, and about 30 years anterior to the erection of the Parthenon.[8] The Theseium is a peripteral hexastyle, with 13 columns on the sides, and it faces the east.

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[1] Diogenes Laertius *in Vit. Zenonis*; Plutarch *in Vit. Cimonis*; Pausan. *Attic.* 15; Ælian. *Hist. An.* vii. 28; Æschines *de Fals. Leg.*; *Topography of Athens*, 118; *Description of Ancient Greece*, ii. 319.

[2] Xenophon, *Hipparch.* c. 3.

[3] Thucyd. ii. 17; Xenoph. *De Vectig.* ii. 6.

[4] Forchhammer, *Topogr.* p. 54. fol.

[5] Pausanias, *Attic.* 2 and 16; Herodot. vi. 108; Thucyd. vi. 54, i. 20; Julius Pollux, vii. 18; Plato *de Leg.* xi.; Cicero *de Fin.* v. 1.

[6] Stuart's *Antiquities of Athens*, vol. iii. c. 1.

[7] Leake's *Topography of Athens*, p 119.

[8] Plutarch *in Thes. et Cimon.*; Diodor. Sicul. l. iv. c. 62; Pausan. *Attic.* 17, 30; Plutarch *de Exil.*; Thucydides, l. vi. c. 61; Diodor. Sic. *ubi supra*; Plut. *Paral. in Thes.*; Hesych. *vv.* Θήσειον et Θησειεγίψ; *Topography of Athens* (additional note), p. 292.

Athens. The cella within measures 40 feet in length and 20 feet in breadth. It has a pronaos and a posticum, each of which is formed by a prolongation of the side walls of the cella, having two columns between the antæ; but the depth of the pronaos is greater than that of the posticum, and the depth of the portico of the pronaos is greater than that of the portico at the back of the temple. The side porticoes are only 6 feet in breadth; but the 34 columns of the peristyle are nearly 3 feet 4 inches in diameter at the base, and about 19 feet in height, with an intercolumniation of 5 feet 4 inches, except at the angles, where the interval is smaller. The stylobate is formed of only two steps; and the height of the temple, from the bottom of the stylobate to the summit of the pediment, is 33·5 feet. The eastern or chief front only of the temple was adorned with sculptures; and, accordingly, the ten metopes of that front, with the four adjoining metopes of either flank, are those in which the labours of Hercules and Theseus are represented in alto-relievo, while the other metopes are plain.[1] The roof of the cella of the Theseium is modern; the greater part of the beams and lacunaria of the porticoes are wanting; and the sculptures have been purposely defaced by the Turks. When the temple was converted into a Christian church, the two columns of the pronaos were removed to make room for the altar; and a door was at the same time pierced in the western wall. But when Athens was taken by the Turks, who were in the habit of riding into the churches on horseback, this door was shut up, and a smaller one made in the southern wall. In other respects, however, the temple is complete. It is formed entirely of Pentelic marble, and stands upon an artificial foundation constructed of large quadrangular blocks of ordinary limestone. At the north-western angle of the temple, where the hill upon which it stands is precipitous, six courses of the foundation now appear above ground, and are gradually receiving so much injury from the effect of the periodical rains as to threaten the safety of this part of the building. The sculptures of the Theseium are upon the 18 metopes already mentioned, upon a frieze over the entrance of the pronaos, and upon another over that of the posticum. All the metopes in the front of the temple which can be deciphered relate to the labours of Hercules, the kinsman, friend, and companion of Theseus; whilst those on the two flanks relate exclusively to the achievements of the hero to whom the edifice was more immediately dedicated. The subject of the frieze over the columns and antæ of the posticum or back vestibule was the most celebrated event in the life of Theseus, his contest with the Centaurs; and, from the analogy of the front and flank metopes, it may reasonably be presumed that the panel over the pronaos, which has been completely defaced, related to the exploits of Hercules. The interior of the Theseium, as we learn from Pausanias, was anciently decorated with paintings, representing the achievements of Theseus, particularly his battle with the Amazons, and the fight of the Centaurs and Lapithæ, where his prowess was most remarkably signalized.[2] The stucco upon which they were painted is still apparent, and shows that each painting covered the entire wall from the roof to within 2 feet 9 inches of the pavement. Athens.

Some difficulty exists as to the relative sites of the Anaceium and Aglaurium, which Pausanias next proceeds to describe. We know, however, that the Anaceium stood *below* the Aglaurium; and from comparing the statements of Herodotus, Pausanias, and Euripides in reference to the latter, Colonel Leake has made it pretty evident that the position of this ancient sanctuary of the Athenians was near the northern foot of the Acropolis, in some part of the precipices which are situated to the eastward of the Grotto of Apollo and Pan. These precipices were called the long rocks (μακραὶ πέτραι); and here it appears to have been that the Persians under Xerxes ascended the steepest part of the hill, near the temple of Aglauros, in order to scale the ramparts of the citadel; an enterprise in which they were completely successful. The Aglaurium was rather a sanctuary or sacred inclosure (ἱερὸν τέμενος) than a temple, and some traces of its existence are still discoverable near the centre of the north side of the Acropolis. The Anaceium,[3] or temple of the Dioscuri, a building of great antiquity, stood immediately below the Aglaurium, close to the rock of the Acropolis, and near the gate which now leads into an exterior inclosure of the citadel, forming the modern approach from the town to the Propylæa. It is said to have contained several paintings by Polygnotus and Micon. Near to the Aglaurium was the Prytaneium, where the written laws of Solon were deposited. It stood above the level of the main body of the city, and formed the commencement of a street called Tripodes, leading to the sacred inclosure of Bacchus, near the theatre; a circumstance which seems to fix its site at the north-eastern angle of the Acropolis, one of the very finest situations in Athens, commanding a view of the sea, as well as of all the northern part of the city and its plain. Not far from the supposed site of the Prytaneium is a church of Panagia Vlastiki, where are still seen the remains of some important building, probably the temple of Serapis, which is the first edifice mentioned by Pausanias upon descending from the Prytaneium into the lower parts of the city. "The ruins at the church of Vlastiki," says Colonel Leake, "are in a line between the new Agora and the arch of Hadrian: the building therefore to which they belonged probably stood in the street leading from the Agora to the Olympeium and Hadrianopolis, of which the arch of Hadrian formed the termination."[4] The numerous buildings erected by Hadrian in this part of the city were denominated Hadrianopolis, as we learn from an inscription on the remains of the triumphal arch just mentioned.[5] Aglaurium, &c.

The Olympeium, Olympieium, or Olympium, one of the most ancient temples in Athens, was supposed to have been originally founded by Deucalion. But it seems to have fallen into decay at a very early period; for about the year 530 before the Christian era, Peisistratus commenced a new and more magnificent structure upon the site of the old building. The ancient Athens, however, was not the only place Olympeium.

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[1] Leake's *Topography of Athens*, p. 38 and 392.

[2] For an account of the subjects of the sculpture in high relief which adorn the metopes of the front and two flanks of the temple, and the friezes over the posticum and pronaos, see Stuart's *Antiquities of Athens*, vol. iii., and especially Colonel Leake's additional note on the Theseium in his *Topography of Athens*, p. 392, to which we have been almost exclusively indebted for the above particulars.

[3] This building was named Ἀνάκειον because the Dioscuri (Castor and Pollux) were commonly called *οἱ ἄνακτες* by the Athenians. Plutarch, *Vit. Thes.*; Ælian, *Hist.* iv. 5; Harpocr.

[4] *Topography of Athens*, p. 134.

[5] Above the north-west side of the arch there is inscribed ΑΙΔΕΙΣΑΘΗΝΑΙΘΗΣΕΩΣ ΗΠΡΙΝΠΟΛΙΣ, that is, *αἵδε εἰσι Ἀθῆναι Θησέως ἡ πρὶν πόλις, This is Athens, formerly the city of Theseus*; and, on the opposite side, are the following characters: ΑΙΔΕΙΣΑΔΡΙΑΝΟΥΚΑΙΟΥΧΙΘΗΣΕΩΣΠΟΛΙΣ, *αἵδε εἰσι Ἀδριανοῦ καὶ οὐχὶ Θησέως πόλις, This is the city of Hadrian, not of Theseus.* Dr Chandler has supposed that the first words of the former inscription should be read *ἃ Τδεις Ἀθῆναι*, instead of *αἵδε εἰσι Ἀθῆναι*, or rather *αἵδ' εἰσ' Ἀθῆναι*; but Spon and Wheler, Stuart, and a multitude of others, including Kavasila (Cabasilas), a modern Greek, have all declared in favour of the former interpretation; and where the same contracted form of expression occurs in other inscriptions, Gruter, Crusius, and Meursius invariably resolve it as we have done. In both cases, however, the meaning is the same. That side of the arch which fronted the ancient city pointed it out, whilst the portion of the monument which looked towards the erections of Hadrian in like manner marked them out to the readers of the legend.

Athens.

in the world where it was found easier to begin than to finish a temple. The expensive wars in which the Athenians were not long afterwards engaged put a stop to the progress of the building; and nearly four centuries elapsed, including the most flourishing periods of the republic, before any attempt was made to complete it. At length, however, Antiochus Epiphanes, king of Syria, about the year 174 B.C., undertook this task, and a magnificent edifice of the Corinthian order was begun by Cossutius, a Roman architect. But upon the death of Antiochus in 164 B.C. the work was again interrupted; and on the capture of Athens by Sulla, 78 years afterwards, the columns prepared for the building were carried away by order of the conqueror, and erected as part of the temple of Jupiter Capitolinus at Rome. The Olympeium was in this imperfect and mutilated condition when the kings and states in alliance with or in subjection to Augustus undertook the completion of the edifice at their joint expense. But, from various causes, the work was once more interrupted; and the honour of completing and dedicating the temple, as well as of erecting the statue of the divinity, formed (if we may believe Pausanias) of ivory and gold, was reserved for Hadrian, six centuries and a half after its foundation by Peisistratus.[1] There can be little doubt that the cluster of magnificent columns of Pentelic marble at the south-east extremity of the city of Athens, near the Ilissus, belonged to the celebrated temple of the Olympian Zeus. They are of the Corinthian order, sixteen in number,[2] six feet and a half in diameter, and above sixty feet in height, standing upon an artificial platform, supported by a wall, the remains of which show that the entire peribolos or circuit must have been about 2300 feet, or little short of half a mile. From the existing remains, it appears that the temple consisted of a cella, surrounded by a peristyle, which had ten columns in front and twenty on the sides; that the peristyle, being double on the sides and quadruple at the posticum and pronaos, consisted altogether of 120 columns; and that the whole length of the building was 354 feet, and its breadth 71. "Such vast dimensions," says Colonel Leake, "would alone be sufficient to prove these columns to have belonged to that temple, which was the largest ever built in honour of the supreme pagan deity, and one of the four most magnificent ever erected by the ancients, even if Thucydides had not pointed out this side of the city as the position of the Olympeium, or if Vitruvius had not left us a description of this edifice exactly conformable with the existing ruins."[3]

Temples of Hera and Zeus Panhellenius, &c.

To the taste and munificence of Hadrian Athens was also indebted for a temple of Hera (Juno), another dedicated to Zeus (Jupiter) Panhellenius, and a temple common to all the gods, or Pantheon. But the most remarkable edifice next to the Olympeium, erected by this emperor, was that which has been denominated the Stoa or Gymnasium of Hadrian. When complete, it was a quadrangle of 376 feet by 252, adorned at the western end with a portal and colonnade of Corinthian columns, 120 in number, and each three feet in diameter; but of these, which were formed of Phrygian marble, only ten are at present standing. In the centre are the ruins of a building which now forms part of the church of Megali Panagia, and consist, on one side of the remains of an arch, and on the other of an architrave, supported by a pilaster, and three Doric columns, each one foot nine inches in diameter, and of a declining period of the arts: round the inside of the inclosure, at a distance of twenty-three feet from the wall, are also vestiges of a colonnade; and in the northern wall, which still exists, there is one large quadrangular niche thirty-four feet in length, and two circular niches equal to it in diameter. The general form and distribution of this building, which Pausanias notices as the most magnificent of Hadrian's works, are those of a stoa, or place of resort for walking, conversation, and reading; and the apartments projecting from the wall of the peribolos accord precisely with the *οἰκήματα* mentioned by Pausanias, which were resplendent with alabaster and gilding, and adorned with pictures and statues. The building at the church of the great Panagia in the centre answers, Colonel Leake thinks, to the library with which we know from several ancient authors[4] besides Pausanias, that this magnificent stoa was provided.[5]

Athens.

Tripodes, Lenæum, Dionysiac Theatre, &c.

Besides the street leading from the Prytaneium to the Olympeium, there was another which branched off from the same place towards the Lenæum or sacred inclosure of Bacchus, adjacent to the theatre, which was called the Tripodes, from the tripods there dedicated by the leaders of the chori victorious in the scenic contests decided in the Dionysiac theatre. Several of these tripods were placed upon temples dedicated to Bacchus and other deities, and erected either in the quarter of the Tripodes or within the inclosure of the Lenæum; others, again, stood upon columns and rocks near the theatre, as the remains of the monuments still indicate. Of the former description was the beautiful little choragic monument of Lysicrates, vulgarly called the Lantern of Demosthenes, the apex of which proves beyond a doubt that it once supported a tripod, while its closed construction shows that the victorious choragus who built this gem of art (*νεὼς ὑποκείμενος τῷ τρίποδι*) preferred bestowing all the expense on external decorations.[6] From the inscription on this monument it appears to have been erected in the archonship of Evænetus, in the year 335 B.C.;[7] and it is consequently the oldest known specimen of the Corinthian order, although considerably posterior to the epoch of its invention.[8] Colonel Leake thinks that the street of Tripodes passed at the foot of the rocks under the east end of the Acropolis; and that, after reaching the south-eastern angle of the rocks, it had one branch leading into the Lenæum, and another into the theatre of Bacchus. The Lenæum, situated on the western side of the theatre, was a most ancient sanctuary of Bacchus; having within its peribolos or inclosure two other temples similarly dedicated, with a couple of statues, one of which was surnamed Eleuthereus,—and containing several pictures representing different events in which the rosy god

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[1] Thucyd. l. ii. c. 15; Pausan. *Attic.* 23; Plutarch, *Solon;* Vitruv. *Procem.* in l. vii.; Liv. xli. c. 20; Sueton. *August.* 60; Spartian. *Vit. Hadrian.*

[2] There was a seventeenth column belonging to the western front standing until the year 1760, when it was taken down by order of the governor of Athens, to build a new mosque in the Bazaar. (Stuart's *Antiq. of Athens*, vol. iii. p. 15; Chandler's *Travels in Greece*, c. 15.)

[3] *Topography of Athens*, 43. See also note, p. 401. The other three temples alluded to in this extract were that of Artemis (Diana) at Ephesus, that of Apollo near Miletus, and the Doric temple sacred to Demeter and Persephone at Eleusis. The first was 425 feet long by 220 broad, the second 368 by 165 feet, and the third 216 by 178 feet.

[4] Eusebius, *Chron. Can.;* Cassiodorus, *Chron. in Hadrian.;* Syncellus, *Chron.* p. 349.

[5] *Topography of Athens*, 120. Spon and Wheler conceived this building to be the temple of Jupiter Olympius, in which they were certainly mistaken; and Stuart thought it the Poecile, which is incompatible with the fact he himself admits, that the columns were the work of Roman times.

[6] Stuart's *Antiq. of Athens*, vol. i. c. 4; Leake's *Topography*, 155.

[7] The inscription, which is upon the architrave, testifies that Lysicrates, son of Lysitheides, led the chorus when the boys of Acamantis gained the victory, when Theon played the flute, when Lysiades wrote the piece, and when Evænetus was archon.

[8] This order was first employed in the construction of the temple of Athena Alea at Tegea about the year 385 B.C., or half a century prior to the period in question. (Pausan. *Arcad.* c. 45.)

Athens. was believed to have participated. This is the temple to which Thucydides alludes as that of Dionysus in Limnis, or Bacchus in the marshes.[1] The Dionysiac Theatre was situated near the south-eastern angle of the Acropolis, where vestiges of it are still to be seen. Like most of the other theatres of Greece, its extremities were supported by piers of solid masonry, while the middle of it was excavated in the side of the hill. From the existing ruins, however, it is difficult to form any correct estimate of the dimensions of this theatre; but if we are to credit Plato's statement, that it was capable of containing more than 30,000 spectators,[2] it must have descended much lower down into the plain than has been generally imagined, or than the actual remains would lead us to suppose. The Hierum of Epidaurus, which could not have contained more than 15,000 spectators, allowing only eighteen inches for each person, was 366 feet in diameter; and the theatres at Argos and Sparta, as well as that near Dramatzus in Epirus, were about 500 feet in diameter, yet could not have admitted more than 30,000 spectators, allowing for each the width of seat or room just mentioned. If Plato's statement be correct, it seems therefore to follow, that the diameter of the Dionysiac theatre must have been not less than from 450 to 500 feet, and consequently that it must have extended quite close to the foot of the hill, where, indeed, the level space necessary for the orchestra and the scene could alone have been found.[3] This celebrated theatre contained statues of all the great tragic and comic poets, the most conspicuous of which were naturally those of Æschylus, Sophocles, and Euripides, among the former, and that of Menander among the latter; and Dicæarchus informs us that it was accounted the most beautiful structure of the kind in existence. A little to the east ward stood the Odeium of Pericles, with a roof formed out of the masts and yards of the Persian ships captured at Salamis, and rising to a point like the pavilion of Xerxes, which the whole structure indeed was intended to represent. It was richly decorated with columns; and during the dominion of the Thirty Tyrants, was generally occupied by their satellites. During the siege of Athens by Sulla, Aristion, general of Mithridates, who was intrusted with the defence of the city, set fire to this monument of Athenian glory, lest the enemy should make use of the timber for the purpose of assaulting the Acropolis; and although Vitruvius informs us that it was afterwards restored at the expense of Ariobarzanes, king of Cappadocia, not a vestige or trace of the edifice remains. In the immediate vicinity of the citadel were a temple of Æsculapius, with a fountain; the temples of Themis, Aphrodite Pandemos, and Persuasion; the monument of Hippolytus; besides the temple of Demeter Chloe, some remains of which are supposed to exist at the foot of the Acropolis, near the ascent which formerly led to the citadel.[4]

Acropolis. The ancient city of Cecrops is now a fortress or citadel, with a thick irregular wall inclosing a large area about twice as long as it is broad, and standing on the outer ledges of an elevated rock abruptly terminating in precipices on every side, except the front, which is towards the Peiræus or west, and by which alone it is accessible. Some portions of the ancient wall may still be seen on the outside, particularly at the two extreme angles; and in many places it is patched with fragments of columns and marbles taken from the ruins. Athens. The physical character of this remarkable rock continues nearly the same as in the days of the most remote antiquity; and notwithstanding all the devastations which war, time, and fanatical barbarism have committed, it still contains a large portion of the remaining antiquities of Athens, and consequently demands a corresponding share of the researches both of the artist and topographer. Anciently the Acropolis was filled with monuments of Athenian glory, and exhibited an amazing concentration of all that was most perfect in art and most magnificent in architectural decoration. It appeared, so to speak, as one entire offering to the divinity, surpassing in excellence, and unrivalled in richness and splendour. It was the peerless gem of Greece, the glory and the pride of art, the wonder and envy of the world. Heliodorus, surnamed Periegetes or the Guide, employed no less than fifteen books in describing it; the curiosities of various kinds, with the pictures, statues, and pieces of sculpture, supplied Polemo Periegetes with matter for four volumes; and Strabo seems to think that as many more would have been required for a minute description. The number of statues, in particular, was prodigious. Tiberius Nero, who had a remarkable taste for appropriating works of art which the genius and means of others had executed, plundered the Acropolis, as well as Delphi and Olympia; yet notwithstanding this spoliation, Athens, in the time of Pliny, had no fewer than three thousand remaining, of which the most valuable portion was in the Cecropian city on the rock. Even Pausanias seems to be distressed by the multiplicity of objects which here engaged his attention, and uncertain where to commence his description. Such *was* the Acropolis. What it *is*, Stuart and Revett, and Cockerell and Leake, and other writers, have told us; and to their learned and accurate researches we are indebted for the correct knowledge, which we have at length attained, of those magnificent buildings which adorned the citadel of Athens. We do not say that many curious discoveries connected with the monuments of the Acropolis may not still be made, when its platform shall have been cleared of the wretched buildings which now cover its surface and disfigure its appearance; but in regard to the three great edifices, namely, the Propylæa, the Parthenon, and the Erechtheium, it is probable, from what has been already discovered, that but little remains to be done.

Propylæa. The western side of the Acropolis, which, as we have already said, furnished, and still furnishes, the only access to the summit of the hill, was about 168 feet in breadth; an opening so narrow that, to the artists of Pericles, it appeared practicable to fill up the space with a single building, which, in serving the main purpose of a gateway, should contribute to adorn as well as to fortify the citadel. This work, the greatest production of civil architecture in Athens,[5] which rivalled the Parthenon in felicity of execution, and surpassed it in boldness and originality of design, was begun in the archonship of Euthymenes, in the year 437 B.C., and completed in five years, under the directions of the architect Mnesicles, at the enormous cost, if we may believe Heliodorus, of two thousand and twelve talents.[6] Of the space which formed the natural entrance to the Acropolis, 58 feet near the centre were left for the great artificial entrance, and the

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[1] Thucydides, ii. 15.

[2] Plato, *Conviv.* iii. 173, 175, ed. Serran.

[3] *Topography of Athens*, 60.

[4] *Ibid.* 162.

[5] Philostratus, in his *Life of Apollonius Tyanæus*, says, Περικλεῖ μὲν Προπύλαια πρὸς φιλοτιμίαν ἤρκει καὶ Παρθενών, l. ii. c. 5; and Demosthenes, in his oration against Androtion, gives a similar indication of the Propylæa having been considered upon a level with the Parthenon in point of architectural skill and decoration: οἱ τὰ Προπύλαια καὶ τὸν Παρθενῶνα οἰκοδομήσαντες ἐκεῖνοι καὶ τἄλλα πάντα ἀπὸ τῶν βαρβάρων ἱερὰ κομήσαντες, κ. τ. λ. p. 597, ed. Reiske.

[6] This is incredible for many reasons. In particular, it appears, from Thucydides, that the expense of *all* the works of Pericles, including the Odeium, the mystic temple at Eleusis, the Parthenon, and one of the long walls, as well as the Propylæa, did not amount to three thousand talents; and it is therefore inconceivable that the last-mentioned edifice, one of five of which the Parthenon was the chief, should have cost two-thirds of this sum. See a very learned note on this subject by Colonel Leake. (*Topography of Athens*, p. 406.)

Athens. remainder on either side was closed by wings projecting 32 feet in front of the grand central colonnade. The entire building received the name of Propylæa from its forming the vestibule to the five gates or doors, still in existence, by which the citadel was entered.[1] The wall in which these doors were pierced was thrown back about 50 feet from the front of the artificial opening of the hill; and the whole may, therefore, be said to have resembled a modern fortification, the Propylæum properly so called representing the curtain, and each of the two wings presenting a face and flank or gorge like two adjoining bastions. This incomparable edifice was constructed entirely of Pentelic marble. The Propylæum or great vestibule in the centre consisted of a front of six fluted Doric columns, mounted upon four steps which supported a pediment, and measuring five feet in diameter and near 29 in height, with an intercolumniation of 7 feet, except between the two central columns, which were 13 feet apart in order to furnish space for a carriage-way. Behind the Doric colonnade was a vestibule 43 feet in depth, the roof of which was sustained by six Ionic columns in a double row, so as to divide the vestibule into three aisles or compartments; and these columns, although only three feet and a half in diameter at the base, were, including the capitals, nearly 34 feet in height, their architraves being on the same level with the frieze of the Doric colonnade. The ceiling was laid upon marble beams, resting upon the lateral walls and the architraves of the two rows of Ionic columns; those covering the side aisles being 22 feet in length, and those covering the central aisle 17 feet, with a proportional breadth and thickness. Enormous masses like these, raised to the roof of a building, standing upon a steep hill, and covered with a ceiling which all the resources of art had been exhausted to beautify, might well excite the admiration of even a plain matter-of-fact topographer like Pausanias, and at once account for and justify the enthusiasm with which he expresses himself when speaking of the roof of the Propylæa.[2] Of the five doors at the extremity of the vestibule, the width of the central and largest was equal to the space between the two central columns of the Doric portico in front, which was the same as that between the two rows of Ionic columns in the vestibule; but the doors on either side of the principal one were of diminished height and breadth, and the two beyond these again were still smaller in both dimensions. These five gates or doors led from the vestibule into a back portico 18 feet in depth, which was fronted with a Doric colonnade and pediment of the same dimensions as those of the western or outer portico, but placed upon a higher level, there being five steps of ascent from the level of the latter to that of the former. From the eastern or inner portico there was a descent of one step into the adjacent part of the platform of the Acropolis.

Wings. The wings of the Propylæa were nearly symmetrical in front, each presenting on this side a wall adorned only with a frieze of triglyphs, and with antæ at the extremities. The extreme simplicity of the wings in this direction was characteristic of the work of defence of which they formed so important a part; while the flanks of the bastions (if we may be allowed the expression) were also uniform in their construction, each presenting a Doric front of three columns in antis, each three feet in diameter, supporting pediments, the summits of which were on a level with the frieze of the Propylæum properly so called. Besides, the inner or southernmost column of each wing stood in a line with the great Doric columns of the Propylæum; and as both these columns and those of the wings were upon the same level, the three porticoes were all connected together, and the four steps which ascended to the Propylæum were continued also along the porticoes of the two wings. But here the symmetry of the building ended; for, in regard to interior size and distribution of parts, the wings were exceedingly dissimilar. In the northern or left wing, a porch of twelve feet in depth conducted by three doors into a chamber of 34 feet by 26, the porch and chamber thus occupying the entire space behind the western wall of that wing; whereas the southern or right wing consisted only of a porch or gallery of 26 feet by 16, which, on the south and east sides, was formed by a wall connected with and of the same thickness as the lateral wall of the Propylæum, and, on the west side, had its roof supported by a narrow pilaster, standing between the north-west column of the wing and an anta, which terminated its southern wall. In front of the southern or right wing there stood, so late as the year 1676, a small Ionic temple, dedicated to Niké Apteros (Wingless Victory). Wheler informs us that it was built of white marble, and about fifteen feet in length by eight or nine in breadth; and we learn from Spon that it was then used by the Turks as a powder-magazine.[3] The left wing of the Propylæa was decorated with paintings by Polygnotus, representing a series of events connected with the siege of Troy; and the structure was ornamented with equestrian statues. After the ruin of Athens, the Propylæa ceased to be the entrance of the Acropolis. The passage between the columns of the centre was walled up almost to their capitals, and above was a battery of cannon. The way wound before the front of the ancient structure; and turning to the left among rubbish and wretched walls irregularly huddled together, the stranger proceeded to the back of the vestibule and the five door-ways, without almost suspecting that he was in the midst of that celebrated structure which formed the external glory and defence of the rock of Cecrops.[4]

Athens.

Parthenon. The Parthenon, or temple of the Virgin Goddess, was placed upon the highest platform of the Acropolis, which was so far elevated above its western entrance that the pavement of the peristyle of this renowned edifice was upon the same level as the capitals of the columns of the eastern portico of the Propylæa. It was also called Hecatompedon (from its being a hundred feet broad), and was constructed entirely of white marble from the quarries of Mount Pentelicus. It consisted of a cella, surrounded with a peristyle, having eight Doric columns in the two fronts, and seventeen in the sides, or forty-six in all; each column six feet six inches in diameter at the base, and thirty-four feet in height, standing upon a pavement or platform, to which there was an ascent of three steps. The total height of the temple above its platform was about 68 feet, its length 228, and its breadth 102 feet English. Within the peristyle, at both ends, there was an interior range of six columns, five feet and a half in diameter, standing before the end of the cella, and forming a vestibule to its door, two steps above the pavement of the peristyle. The cella, which was 63 feet in breadth within, was divided into two unequal chambers, of which the western was about 43½ feet in length, and the eastern 98 feet. The ceiling of the former was supported by four columns of about four feet in diameter, and that of the latter by sixteen columns of about three feet.

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[1] Heliod. *apud Harpocrat.* v. Προπύλαια.

[2] Τὰ δὲ Προπύλαια λίθου λευκοῦ τὴν ὀροφὴν ἔχει, καὶ κόσμῳ καὶ μεγέθει τῶν λίθων μεχρί γε ἐμοῦ πρεσβύς. (*Attic.* c. 22.)

[3] This little gem of ancient architecture has lately been almost completely restored; for during the excavations made in 1835, nearly all the stones of which it had originally consisted were recovered, and under the superintendence of very competent persons it has been rebuilt with the original materials and on its original site, where it has the appearance of an entirely new building.

[4] In the year 1853 M. Beulé, at the expense of the French government, removed the rubbish of the two Turkish batteries that covered up the true entrance to the Athenian Acropolis, and discovered below the unseemly mass the two towers that formed the defences of the gate, and between them a marble curtain, with remains of a Doric entablature over a Doric doorway of a simple but beautiful style. Within this the fine marble stairs that formed the ascent to the Propylæa are still entire.

Athens.

Since the time of Stuart and Leake, the Greek government has removed the whole of the ruins that encumbered the existing remains, and the Turkish tower and mosque, and the ground plan of the Parthenon has been more accurately ascertained. The accurate measurements were made by Mr Pennethorne in 1837, confirmed in 1838 by two German artists, M. Hofer and M. Schubart, and the plans laid down by Geo. Knowles in 1850. The singular discoveries that have been thus brought to light are not unimportant to architecture. It is discovered that the lines formerly supposed to be straight lines, are regularly formed segmental curves of a long radius. Thus the lines of the pediment and of the surface of the pavement are found to be parabolic segments of large radius.[1] The platform is found to be just 233 feet by 108 feet. The exterior dimensions of the cella = 158 feet 6 inches by 72 feet 6 inches. The cella was divided by a wall of 4 feet in thickness into the Parthenon proper, the interior of which is 97 feet 6 inches by 64 feet, and an opisthodomos of 44 feet 6 inches, by 64 feet. Thickness of the end walls of the cella, 7·75 feet; of the side walls, 4 feet. The diameter of the base of the columns is 6 feet 6 inches. The intercolumniations are 8 feet, except at the angles of the peristyle on the sides, where these are only one diameter of the columns. The principal division of the cella had two interior rows of columns of ten in each row, with three additional at the west end. They were 11 feet from the side walls of the cella and the septum. The space between the rows is 23 feet. The statue of the goddess is now ascertained to have stood within the columns, 70 feet from the porch of the eastern portico, and 34 feet from the septum dividing the Parthenon from the opisthodomos. The opisthodomos had 4 interior Doric columns of the same diameter as the columns of the peristyle, placed 17 feet from the side walls of the cella, and 11 feet from the septum. In the eastern chamber of the Parthenon, the smallness of the diameter of the columns leaves little doubt that there was an upper range, as in the temples of Pæstum and Ægina. But it is to be lamented that no remains of any of them have been found, as these might have presented new proofs of the taste and invention of the architects of the age of Pericles. Such, then, was the simple construction of this magnificent temple, which, by its united excellencies of materials,[2] design, and decoration, internal as well as external, has been universally considered the most perfect which human genius and skill ever planned and executed. Its dimensions were sufficiently large to produce an impression of grandeur and sublimity, which was not disturbed by any obtrusive subdivision of parts; and, whether viewed at a small or a great distance, there was nothing to divert the mind of the spectator from contemplating the unity as well as majesty of mass and outline; circumstances which form the first and most remarkable characteristic of every Greek temple erected during the purer ages of Grecian taste and genius. Nor was it until the eye had become satiated with the contemplation of the entire edifice that the spectator could be tempted to examine the decorations with which this building was so profusely adorned; for the statues of the pediments, the only decoration which was very conspicuous from its magnitude and position, being inclosed within frames, which formed an essential part of the design of either front, had no more obtrusive effect than an ornamented capital to a single column.[3]

Athens.

Decorations.

It is not our intention, in this place, to attempt any detailed or minute description of an edifice which would require a volume for its complete illustration. We may observe, generally, that as it was one of the great objects of Pericles to furnish employment in every branch of art to the ingenious and skilful artists with whom Athens at that period abounded, so he had contrived that the temple should be of a design the best adapted to the decorations of sculpture, and that it should be adorned with every species of it which was most esteemed among the Greeks. Within the cella was a specimen of chryselephantine sculpture, having but one rival in Greece, and that by the same master; under the colonnade, and in other parts of the temple, stood numerous statues in bronze; in the reti or pediments were two compositions near eighty feet in length, each consisting of about twenty entire statues of colossal size; under the exterior cornice, in harmony with the projecting features of that part of the building, were ninety-two groups, raised in high relief, from tablets about four feet three inches square; and, lastly, along the outside of the cell and vestibules ran a frieze of about three feet four inches in breadth and 520 in length, to which a relief, slightly raised above the surface of the naked wall

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[1] This has been found to hold particularly in the Parthenon, Theseium, and also in the Corinthian temple of Jupiter Olympius, but especially in all the Doric remains.

The curves are so gentle as to be not perceptible to one standing directly in front, unless the eye be practised in such observations; but if the spectator be placed at one end, and look along the course, it will be seen.

This explains an obscure passage in Vitruvius, in which the words *scamilli impares* had formerly puzzled the commentators, but which has been correctly translated by Wilkins.

The following table is given by Mr Penrose in his *Investigation of the Principles of Athenian Architecture*:—

	Feet in Length.	Actual Rise.	Rise in 100 Feet.
1. Temple of Jupiter Olympius.			
Flank	354·2	·25 nearly.	·07
2. Surbase of Parthenon, or first temple,			
Front	104·2	·150	·145
Flank	221·	·233	·105
3. Stylobate of Parthenon.			
Front	101·3	·228 = flank × $\frac{1}{1000}$	·225 = $\frac{8}{9}$ ·145 } very
Flank	228·1	·355	·156 = $\frac{8}{9}$ ·105 } nearly.
Entablature in front	100·2	·171 = $\frac{3}{4}$ ·228	·171
Ditto on flanks restored	227·	·307	·135
4. Theseum.			
Front	45·	·063	·140
Flank	104·2	·101	·100
5. Propylæa.			
Entablature from E. portico	68·1	·119	·175

It thus appears, that in the Theseium and the first Parthenon the agreement is remarkable; but it will be seen that the curvature of the lines in the Parthenon of Pericles is greater by one-half. "The effect of the curvature in the temple of Theseus may have shown the architect that an increase of curvature would be attended with advantage." This introduction of gently curved lines no doubt adds to that peculiarly harmonious blending of the parts of the architecture so observable in all genuine Grecian buildings.

[2] The beautiful white marble with which nature furnished the Athenians was undoubtedly one of the great concurring causes of their unrivalled pre-eminence in architecture and statuary. Admitting as fine a surface, and presenting as beautiful a colour, as ivory, with a still sharper edge, it was admirably calculated to encourage the successive efforts of artists studious to excel their predecessors in the effects produced. (*Topography of Athens*, 211, 212.)

[3] *Topography of Athens*, p. 209, *et seq.*; Stuart's *Antiq. of Athens*, vol. ii. p. 57.

Athens. which it crowned, was peculiarly applicable. This frieze represented the procession to the Parthenon on the grand quinquennial festival of the Panathenæa. No part of the work is now attached to the temple, but a tolerably correct idea of it may be formed from the drawings of Carrey, taken before the explosion which ruined the building, added to the designs of Stuart, and the fragments of the original which have been disinterred from the ruins and are now deposited in the British Museum. The procession is represented as advancing in two parallel columns from west to east; one proceeding along the northern, and the other along the southern side of the temple, part facing inwards after turning the angle of the eastern front, and part meeting towards the centre of that front. Of the metopes on the frieze of the peristyle, ninety-two in all, viz., fourteen on either front and thirty-two on either flank of the temple, the greater part on the northern side and the two fronts have perished by wanton violence or by casual destruction; whilst of those which belonged to the southern side, where the progress of dilapidation had been less ruinous, fifteen are now in the British Museum and one in Paris. From these fragments, together with the drawings of Carrey and Stuart, it has been conjectured, with much probability, that the metopes of the northern side related to the war of the Amazons, whilst those on the opposite side of the temple related principally to the other great fabulous Athenian contest with the Centaurs. The two pediments of the temple were decorated with magnificent compositions of statuary, one representing the birth of Athena (Minerva), and the other the contest between that goddess and Poseidon (Neptune) for the possession of Attica; the birth being delineated on the western and the contest on the eastern pediment. The statue of the virgin goddess stood in the eastern chamber of the cella, and consisted of ivory and gold. On the summit or apex of the helmet was placed a sphinx, with griffins on either side. The figure of the goddess was represented in an erect martial attitude, and clothed in a robe reaching to the feet. On the breast was a head of Medusa wrought in ivory, and a figure of Victory about four cubits in height. The goddess held a spear in her hand, and an ægis lay at her feet; while on her right, and near the spear, was a figure of a serpent, believed to represent that of Erichthonius. According to Pliny, the entire height of the figure was twenty-six cubits; and the artist Phidias had ingeniously contrived that the gold with which the statue was encrusted might be removed at pleasure. The battle of the Centaurs and Lapithæ was carved on the sandals; the gigantomachia and the battle of the Amazons were represented on the ægis which lay at her feet; and on the pedestal was sculptured the birth of Pandora. Pausanias also notices statues of Iphicrates, Pericles, his father Xantippus, Anacreon, and a brazen Apollo by Phidias. A portion of the southern wall was adorned with the battle of the giants; and here also were represented the conflict of the Athenians and Amazons, the battle of Marathon, and, lastly, the defeat of the Gauls in Mysia, sculptured at the expense of Attalus. The statue of Zeus Polieus stood between the Propylæa and the Parthenon; and the brazen colossus of Athena by Phidias, dedicated from the tenth of the spoils of Marathon, and commonly called Athena Promachos, appears to have occupied some part of the space between the Erechtheium and Propylæa, near the Pelasgic or northern wall. The architect of the Parthenon was Ictinus, who appears to have designed as well as executed the building; while Phidias had the control of the whole sculptural decorations, and with his own unrivalled hand executed those prodigies of art with which this great temple was adorned.[1]

Erechtheium, &c. The Erechtheium, or Temple of Erechtheus, so called from its reputed founder Erechtheus, otherwise named Erichthonius, stood on the northern side of the Acropolis, and was one of the most ancient structures of Athens, being alluded to by Homer in the second book of his *Iliad*. There is, however, some confusion respecting this edifice, which seems to have been of a double construction, or divided into two parts, from the circumstance of the entire building being often called the temple of Athena Polias as well as the Erechtheium; a practice which, as Colonel Leake remarks, is not at all surprising, considering that the temple of Athena Polias was the most important part of the building, and that the statue of the goddess here worshipped was the most sacred in Attica, not even excepting that of the Parthenon. The truth, however, seems to be, that the Erechtheium contained two subdivisions; the eastern or more important forming the temple of Athena Polias, the peculiar protectress of the citadel; and the western, that of Pandrosos. The former had a hexastyle front; before the colonnade was an altar of Zeus, and under it were altars of Poseidon and Hephæstus; on the wall of the portico were the pictures of the Butadæ; and within the cella were the Erechtheian salt-well, the wooden statue of Athena, with the lamp and brazen palm-tree before it, the altar of oblivion, the sacred serpent, the wooden statue of Hermes, the chair of Dædalus, and the Persian spoils. The Pandrosium, or chapel sacred to Pandrosos, one of the daughters of Cecrops, consisted of two chambers, of which the western was narrow, and opened into the portico at either end. The northern portico consisted of six Ionic columns, four in the front, with one on either flank; and it stood not far from the edge of the precipice, at the foot of which was the *temenos* of Aglauros. The southern portico was smaller than the northern, and its roof was supported by six caryatides, standing upon a podium, and disposed like the columns of the northern portico, four in front and two on the flanks. In the western or narrow chamber of this chapel grew the tree of Athena, and the crooked Pancyphus, which was held in such high veneration by the Athenians, and which the Persians, during their invasion, had burned but not destroyed. As to the eastern or interior chamber, which was contiguous to the cella of Athena Polias, Colonel Leake thinks with Stuart that it formed the Cecropium, and quotes an inscription which countenances that opinion. "That Cecrops," says he, "was buried in this edifice appears to have been the common belief; and upon an inscribed marble (brought to England by Dr Chandler, and presented by the Society of Dilettanti to the British Museum), wherein different parts of this building are specified, we find the Cecropium mentioned in a manner which leaves no doubt of its having been an integral part of the building." The number of statues in the Acropolis was prodigious; and there were likewise several hiera or sanctuaries, such as that of Zeus Polieus, Artemis (Diana) Brauronia, and the genius of good men. The whole of the Acropolis was surrounded by walls built on the natural rock of which the entire hill is composed. But the most ancient part of these defences was constructed by the Tyrrhenian Pelasgi, who, in the course of their multifarious migrations, settled in Attica, and were employed by the Athenians of that early period in the erection of those ramparts which are often mentioned in the history of Athens under the name of Pelasgicum. Before the Persian war, however, they had fallen into decay; for on that occasion it was found necessary to erect palisades and other temporary defences. At a subsequent period the hill was re-fortified by Cimon and Themistocles; and it is probable that the greater part of the existing wall, although disfigured by the reparations of various ages, consists of the original Hellenic work hastily raised by these celebrated men, before the alarm occasioned by the Persian invasion had entirely subsided. "A part of the southern wall," says Colonel Leake, "where the profile is not less than 60 feet in height,

[1] *Topography of Athens, ubi supra;* Pliny, l. xxxvi. c. 5; Pausan. *Attic.* 25.

appears in particular to consist almost entirely of the ancient Cimonian work; and the centre of the northern side still bears the strongest evidence of the haste with which Thucydides describes the fortifications of Athens to have been restored after the Persian war, when the Athenians returned to the city upon the departure of the barbarians, and found nothing left but a small part of the walls, and some of the houses which had been occupied by the Persian grandees."[1]

Grotto of Pan, Areiopagus.

In his descent from the Propylæa, in the direction of the outer Ceramicus and Academy, Pausanias describes the Cave or Grotto of Pan and the Areiopagus, both of which lay nearly in his route, and were the only objects of importance which had not yet been noticed by him. The grotto sacred to Apollo and Pan he describes as a cavern converted into a temple, and as situated under the Propylæa, near to a spring of water. Now, under the wall of the northern wing of the Propylæa, near the road which forms the present access to the citadel from the centre of the town are both the cavern and the spring; the former containing two excavated ledges for the altars and statues of the two deities, together with several niches for votive offerings; and the latter supplying water to an artificial fountain a little way down the hill, whence the streamlet is conveyed by means of an aqueduct to the principal mosque, near the Bazaar.[2] The Areiopagus, or hill of Ares, so called, it is said, in consequence of that god having been the first person tried there for the crime of murder, was beyond all doubt the rocky height which is separated from the western end of the Acropolis by a hollow forming a communication between the northern and southern divisions of the city. It appears, however, that the court of Areiopagus, and the temple of the Semnæ occupied only the eastern or highest summit of the hill, which agrees with the authorities indicating that other buildings were situated on the more western parts of the ridge. This court consisted originally of an open space, in which were an altar dedicated to Athena Areia, and two rude seats of stone for the plaintiff and defendant, or the accuser and accused, as the case might be. But we learn from Vitruvius, that at a later period this space was inclosed and roofed in with tiles, and the ancient mode of administering justice in the open air altogether abandoned. The Persians occupied a position on the Areiopagus at the time when they made their attack on the western end of the Acropolis. Near to the spot on which the court stood was the temple of the Furies, as well as the building on which the sacred ship of the great Panathenaic festival was deposited.[3]

Pnyx, Museium, &c.

In ancient times, a place at the foot of the Pnyx was the most common place of public assembly, especially during elections; but latterly it was less frequented for that purpose than the Dionysiac theatre, which has been already described. It appears to have been situated over against the Areiopagus, in view of the Propylæa, and not very far from the city walls; and it was constructed for the meetings of the people, not with the magnificence of a regular theatre, but with a simplicity characteristic of the earlier and severer age of Grecian liberty. The orators addressed the people, not from rostra splendidly decorated, but from a Βῆμα, or plain pulpit of stone, which looked to the sea. Some traces of this ancient structure still exist on a height or eminence, the situation and bearings of which, to the N. of the Museium, and the W. of the Areiopagus, accord perfectly with the position of the Pnyx, as determined by the statements of the Greek writers.[4] The whole range of hills which rises to the S.W. of the citadel, and above the ancient place of the popular assembly, bore the name of Pnyx. Plato informs us that it was opposite the Pnyx, and Antigonus Carystius relates a fabulous story, which would lead us to imagine that anciently it approximated more closely to the Acropolis than is at present the case. The Museium was another elevation S. of the Pnyx, and, like the Pnyx, it was within the peribolus or circumference of the ancient walls. It derived its name from the poet Musæus, who was believed to be interred there. At a later period a monument was erected on this eminence by Philopappus, a descendant of the kings of Commagene in Syria, who, having been consul in the reign of Trajan, retired to Athens (as we learn from the inscription) to spend the remainder of his days "from toils and cares remote," in the bosom of that renowned city. Among the inferior courts of judicature mentioned by Pausanias, after describing the Areiopagus, were the Parabystum, where petty causes were tried; the Trigonum, so called from its shape; and the Batrachium and Phœnicium, which probably received their names from some peculiarities of colour in the edifices where they were held. The Palladium was a court where persons accused of murder were commonly tried. Those, however, who confessed to the act of slaying, but set up a justification of the deed—as, for example, that it had been done in self-defence—were sent to be judged in the Delphinium, a tribunal which probably derived its name from being situated near the temple of Apollo Delphinius.[5]

This completes our survey of the principal buildings, monuments, and localities, within the city, which we have described as fully as the limits to which the present article is confined would possibly admit; omitting nothing which we considered of material importance, either for conveying a just notion of the ancient splendour and magnificence of Athens, as contrasted with its actual state of decay and ruin, or for enabling the reader to understand and appreciate the innumerable allusions, references, and descriptions, with which the Greek writers, whether poets, historians, philosophers, or orators, abound.

Cœle, Melite, Colyttus.

The whole of the north-western part of the city, comprising the hills Museium, the Pnyx, and the hill of the Nymphs, appears to have borne the name of Melite; but it was subdivided into quarters. The valley between the Museium and Pnyx was called Colyttus or Collytus,[6] and the district north of the Pnyx and south of the hill of the Nymphs bore the name of Scambonidæ. The whole of this part of the city appears to have been densely peopled, and many of the illustrious persons in Athenian history are said to have dwelt there.[7] On the south of the Museium the city extended a little way beyond the river Ilissus, and the south-western part of the city bore the name of Cœle, that is, hollow or low ground; it appears to have been mainly used as a burying-ground.

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[1] Stuart's *Antiq. of Athens*, vol. ii.; Leake's *Topography*, p. 257 and 264.

[2] The position of the cave of Apollo and Pan is exactly represented on a coin of Athens, which has been published by Stuart (*Antiquities of Athens*, vol. ii. p. 37) and Barthelemy (*Récueil des Cartes, &c., relatifs au Voyage du Jeune Anacharsis*, No. 27). It presents a view of the north-western side of the Acropolis, with the Propylæa to the right, the Parthenon to the left, and the colossal statue of Athena Promachos between them; whilst the grotto of Pan is represented a little to the left of the stairs which formed an ascent for foot passengers from the north side of the city to the Propylæa. (*Topography of Athens*, p. 62, 63.)

[3] Jul. Poll. viii. 10; Æschyl. *Eumenid.* 680; Herod. viii. 52.

[4] Jul. Poll. viii. 10; Harpocr. *v.* Πρυτάνεια; Aristoph. *Pac.* 659, *ubi et Schol.*; Plutarch, *Themist.*; Plato *in Crit.*

[5] Galen *in Harpocr. Epidem.* iii. 3; Demosth. *in Aristocrat.* p. 643; *Cf.* J. Poll. viii. 10.

[6] Plutarch *in Them.*; Tzetz. *Chil.* viii. *Hist.* 192, v. 326; Philostr. *Sophist.* ii.: Tertull. *de Anim.* cap. 20; Xenoph. *Hell.* v. i. 23; Æsch. *Epist. ad Ctes.* Harpocr. *v.* Ἰσχανδρεῖς.

[7] *Topography of Athens*, 116; Dodwell, vol. i. p. 401. From an inscription cited by Spon we learn that Cœle belonged to the tribe Hippothoontis, *Itin.* tom. ii. p. 426.

Ilissus and Enneacrunos.

The far-famed Ilissus, from which Athens was principally supplied with water, and which Plato in a well-known passage of his *Phædrus* has described as a perennial stream, is now almost always dry, its waters being drawn off, either to irrigate the neighbouring gardens or to supply the artificial fountains of the modern city. It rises to the N.E. of the town, and after a course of a few miles, loses itself in the southern marshes. Not far from the supposed site of the Lyceium, and close to the walls of Athens, it is joined by another stream, or rather water-course, which is believed to be the Eridanus of Pausanias. The fountain of Callirrhoe or Enneacrunos supplied the only spring water used by the Athenians, that of the other wells being either salt or brackish. According to Thucydides, it was situated on the S. side of the city, close to the temples of Bacchus and Zeus Olympius; but other authors affirm that it rose near the stream of the Ilissus; and here, in fact, Spon and Wheler observed a fountain, a little below the south-eastern angle of the Olympeium, to which the natives still applied the name of Kalliroi. Colonel Leake says that it now forms a pool, which in the drought of summer becomes muddy and scanty, but which is still resorted to as the only place in the neighbourhood furnishing sweet water.[1]

Odeium, Eleusinium, &c.

Near the fountain of Callirrhoe or Enneacrunos stood an Odeium (which the reader will be careful to distinguish from that of Pericles, formerly mentioned), adorned with various statues of the Egyptian Ptolemies, as well as of Philip, Alexander, Lysimachus, and Pyrrhus, and probably erected by some prince of the Macedonian dynasty. This seems to have been a sort of minor theatre, intended for recitation and music without action. In Agræ, a south-eastern suburb of Athens, and on the left bank of the Ilissus, a little above Enneacrunos, was the Eleusinium, or temple of Demeter and Persephone, set apart for the celebration of the lesser Eleusinian mysteries. It is conjectured to have stood on the southern bank of the Ilissus, opposite the western point of the little island of the Ilissus, where the foundations of an ancient building are still observable. Plutarch informs us that the Stadium was erected by Lycurgus the son of Lycophron for the celebration of games during the great Panathenaic festival. Pausanias describes it as an astonishing structure, rising in the shape of an amphitheatre above the Ilissus, and extending to the banks of that stream. It was originally constructed about the year 350 B.C. for the purpose just mentioned; and about five centuries afterwards it was covered with seats of Pentelic marble by Herodes Atticus, who is said to have been interred within its walls. The marble seats have all disappeared, but the entire cavea remains, together with the masses of masonry by which the semicircular end on the south was formed out of the torrent-bed of the Ilissus; and similar ruins are also observable at the opposite end, with the piers of a bridge over the Ilissus, and the site of a building on the summit of either hill. The temple of Triptolemus, which Pausanias also places above Enneacrunos, was probably the beautiful little Ionic building which the drawings of Stuart have preserved from oblivion. It formed in his time the church of Panagia on the Rock, but has now almost entirely disappeared. Travellers have sometimes taken this building for the Eleusinium; but it is scarcely credible that the edifice where the sacred mysteries of Ceres were celebrated should have been of so small dimensions.[2]

Lyceium.

Higher up the river was Agræ, containing the temple of Artemis Agrotera, an altar dedicated to Boreas, and another sacred to the Musæ Ilissiades. In the vicinity, too, were some gardens, and a temple of Aphrodite celebrated for a statue of the goddess, executed by Alcamenes, a pupil of Phidias. But the most interesting spot in this quarter, on the outside of the walls of the city, was the Lyceium, a sacred inclosure dedicated to Apollo Lycius, where the polemarch originally held his court. It was decorated with fountains, plantations, and ornamental edifices by Peisistratus, Pericles, and Lycurgus, and became the usual place of exercise for such of the Athenian youth as devoted themselves to military pursuits. Nor was it less frequented by philosophers and others fond of retirement and study. The Lyceium is indissolubly associated with the immortal name of Aristotle, who delivered his prelections, esoteric as well as exoteric, while walking within its sacred inclosure, and whose followers, thence called Peripatetics, have added to the celebrity of the spot which formed the favourite resort of the greatest philosopher of the ancient world. The position commonly assigned to the Lyceium is on the right bank of the Ilissus, nearly opposite to the church of Petros Stauromenos, which is supposed to correspond with the temple of Artemis Agrotera, on the other side of the river.[3] We shall now proceed briefly to notice some of the remarkable places or suburbs connected with Athens.

Cynosarges.

Cynosarges was a spot consecrated to Hercules, and possessed a gymnasium, with groves frequented by the philosophers, as well as a sort of consistorial tribunal for deciding in all questions of legitimacy. After the battle of Marathon, when the city was threatened by the Persian fleet, which had doubled the promontory of Sunium (Cape Colonna), the Athenian army took up a position at Cynosarges, in order to cover the capital from attack, and to give battle to the enemy should they venture to land, which, however, they did not. Philip, the son of Demetrius, is said to have encamped on the same spot with a very different intention, and to have destroyed the groves and buildings around it, as well as those of the Lyceium. Cynosarges is supposed to have been situated at the foot of Mount Lycabettus, now the hill of St George, and to the southward of the place called Asomato.[4]

Outer Ceramicus.

On the opposite side in the west, and outside the city walls, was the exterior Ceramicus, of which we have already spoken incidentally. Here were interred Pericles, Phormio, Thrasybulus, and Chabrias; in this vast cemetery the bravest and the best men, who had proved themselves the ornaments of their country and the benefactors of their species, lay as it were in state beside that celebrated capital which their valour had defended or their genius illustrated; and, as far as the Academy, the road was lined on either side with the sepulchres of those Athenians who had fallen in battle. Over each tomb was placed a *stele* or pillar, whereon were commemorated the names and tribes of the deceased. Among the several monuments enumerated by Pausanias we may notice those of the soldiers who fought at Tanagra before the Peloponnesian war, on the Eurymedon under Cimon, at Potidæa under Callias, and at Amphipolis and Delium. One column commemorated the names of those who had fallen in Sicily; that of Nicias, however, was excepted, in consequence of his having surrendered to the enemy; while, on the other hand, Demosthenes was adjudged worthy of having his name inscribed, because, although he had capitulated for his army, he refused to be included individually in the treaty, and made an attempt on his own life. Here, also, were the cenotaphs of those who fell in the naval combat on the Hellespont, at the battle of Chæroneia, and in the course of the Lamian war; here rose the tombs of Cleisthenes, who increased the number of the Attic tribes, of Tolmides, of Conon and Timotheus, whose

[1] Plat. *Phædr.* p. 229; Leake's *Topogr.* p. 49; Wheler's *Travels*, p. 366; Spon, tom. ii. p. 122.
[2] Pausan. *Attic.* 14 and 19; Philostr. *Vit. Herod.*; Stuart, *Antiq. of Athens*, iii. 5; Leake, 116.
[3] Diog. Laert. *Vit. Antisthen.*; Steph.; Leake, p. 150.
[4] Pausan. *Attic.* 29; Plutarch, *Vit. Lycurg. in Dec. Rhet.*; Leake, p. 150.

Athens. exploits were only surpassed by those of Miltiades and Cimon: and here rested from their labours, in honoured repose, Zeno and Chrysippus, Harmodius and Aristogeiton, Ephialtes and Lycurgus, besides many others whom it would be tedious to enumerate. The games called Lampadephoria were celebrated in the outer Ceramicus.[1]

Academy. The Academy (of which we have already spoken under that head) was situated at the extremity of this cemetery, about six stadia from the gate Dipylum. It was originally a deserted and unhealthy spot; but it was afterwards surrounded with a wall built at a great expense by Hipparchus, and was planted, divided into walks, and supplied with fountains of water, by Cimon. Before the entrance was an altar of Love; within was a *temenos* of Athena, containing a temple of Prometheus, with an altar in the vestibule, whereon were figured in relief Hephæstus and Prometheus, and whence also the race of the Lampadephoria usually commenced. Here likewise was a sanctuary of the Muses, built by Xenophon, containing statues of the Graces, dedicated by his disciple Speusippus, and a statue of Plato by Silanion, dedicated by Mithridates, a Persian. The Academy had likewise altars of Hermes, of Hercules, and of Zeus Catæbates, also surnamed Morius, from the sacred olives called *moriæ*, which grew near the sanctuary of Athena; and contained the garden of Attalus, where the sophist Lacydes had his school, besides a βόθρος or tank, and some magnificent plane-trees of unusual height and size, which the Roman barbarian Sulla caused to be cut down during the siege of Athens. The modern name of Ahathymia leads the traveller directly to this once favourite haunt of philosophers and poets; where the divine spirit of Plato poured forth its lofty fancies and sublime speculations in a stream of eloquence which the gods themselves might envy; where genius was married to science, and poetry to philosophy; and where the foundations were laid of a school which was destined to exert a powerful and (we may add) perennial influence on the opinions of mankind. But the name is the only memorial that remains of the Academy. "It is now," says Mr Hawkins, "an open piece of ground, not exceeding five acres, and presents nothing remarkable in its appearance. A few scattered olives grow on it; and some paces farther west we saw a number of gardens and vineyards, which contained fruit trees of a more exuberant growth than in any other part of the plain."[2]

Lycabettus Another suburb was situated on the lofty height overhanging the city in the N.E., and now called the hill of St George. This hill used to be identified with one mentioned by Pausanias under the name of Anchesmus, but Mr Wordsworth in his work on Attica has very happily made out that the hill is no other than the Lycabettus, which is so often mentioned by ancient authors as in the immediate vicinity of Athens.

Long Walls. We have already had occasion to allude generally to the fortifications of Athens, including the celebrated Long Walls which connected the city with its several ports. The latter were first planned and commenced by Themistocles, after the termination of the Persian war; evidently with the intention of preventing any future invader from intercepting the communication between the City and the Peiræus, and thus starving the former into submission. But the hero of Salamis did not live to execute this great undertaking, which was continued after his death by Cimon, and finally completed by Pericles. These walls, which were deservedly considered by the ancients as one of the greatest objects of curiosity at Athens, were flanked at intervals with towers, some traces of which are still to be seen, and, together with a portion of the walls of the City and of the Peiræus at either end, formed an inclosure, which constituted one of the three great garrisons into which Athens was divided, and which, in this light, was sometimes denominated the long fortress (τὸ μακρὸν τεῖχος). From an expression of Plato, quoted by Harpocration (διαμέσου τεῖχος), as well as from the description of the Athenian fortifications given by Thucydides (ii. 13), it is perfectly evident that the City of Athens was connected with the port-towns by three walls, viz., the Phaleric, 35 stadia long, and the two long walls, each of which was 40 stadia in length. The northern long wall and the Phaleric were built first, and the intermediate one was built at the suggestion of Pericles, for the purpose of rendering the communication between Athens and Peiræus more secure. The long walls remained entire for about 54 years after their completion; that is, until the capture of Athens by the Peloponnesian forces, when they were dismantled and much injured; but 11 years subsequent to this disaster they were rebuilt by Conon, with the assistance of Pharnabazus, and the interior as well as the exterior rampart was guarded at intervals by towers and other defences. In the siege of Athens by Sulla, however, they were again broken down, and almost entirely destroyed. With regard to the existing remains, "they are chiefly remarkable," says Colonel Leake, "towards the lower end, where they were connected with the fortifications of Peiræus and Phalerum. The modern road from Athens to the port Drako, at something less than 2 miles short of the latter, comes upon the foundations of the northern long wall, which are formed of vast masses of squared stones, and are about 12 feet in thickness. Precisely parallel to it, at the distance of 550 feet, are seen the foundations of the southern long wall; the two thus forming a wide street running from the centre of the Phaleric hill, exactly in the direction of the entrance of the Acropolis."[3]

Athens.

Maritime Athens. Maritime Athens was divided into three districts and as many havens or ports; namely, Peiræus, Munychia, and Phalerum. From the earliest times Peiræus was a demus; but it did not become a harbour for ships until the administration of Themistocles; for hitherto Phalerum had been the usual port, as there the sea was nearest the city. The harbour of Peiræus was subdivided into three lesser havens, named Cantharus, Aphrodisium, and Zea. The first was appropriated as a dock-yard for the construction and repair of ships of war; the second seems to have been the middle or principal port; and the third, which was the outermost, appears from its name to have contained the granaries in which the Athenians deposited the corn imported from the countries on the Euxine and other places for the supply of the capital. The most remarkable edifices and sites in the Peiræus were the maritime bazaar or emporium called Macra Stoa, consisting of five porticoes, so connected together as to form in fact only one grand or long portico; the market-place, called Hippodameia; the Deigma or exchange: the Serangium or public bath; the Phreattys or court of criminal justice, with a sort of admiralty jurisdiction; a theatre, of which some remains are still to be seen; and, lastly, the tomb of Themistocles. The Peiræus is now known by the name of Port Drako or Leone, from a colossal figure of a lion which once stood upon the beach, but was removed by the Venetians in the year 1687. The port of Munychia, so called, it is said, from Munychus, an Orchomenian, was situated at the outer extremity of a promontory or narrow neck of land, at no great distance from the Peiræus. Strong by nature, Munychia, when inclosed within fortified lines connecting it with the other harbours, became a most important position, from the security it afforded to the maritime dependencies of Athens; and accordingly we find it always mentioned as the point which was most particularly guarded when any attack was apprehended on the seaward side. This port, which is nearly circular, is known to the

[1] Leake, *Topography of Athens*, 290.

[2] *Topography of Athens*, in Walpole's *Mem.* vol. i. p. 488, note.

[3] Leake's *Topography of Athens*, p 351. See also p. 354 and 357.

Athens. Greeks of the present day by the name of Stratioki. Phalerum, the most ancient of the Athenian ports, ceased to be of any importance in a maritime point of view after the erection of the docks in the Peiræus; but it was nevertheless inclosed within the fortifications of Themistocles, and, as we have already seen, gave its name to one of the long walls, by means of which it was connected with Athens. Its modern name is Porto Fanari.[1]

Ever since the year 1833, excavations and investigations of every kind have been carried on at Athens, partly by private enterprise and partly by the government of Greece; and the topographical discoveries which have been made within the period that has elapsed since, are very considerable; but far more numerous are the discoveries of works of art, inscriptions, and architectural remains. It would lead us too far here to give an account of all these matters, but in order to enable the reader to pursue the study of Athenian topography more in detail, we shall subjoin a list of the more important works on the subject:—1. Wordsworth, *Athens and Attica*, London, 1836; Müller, *De Munimentis Athenarum*, Göttingen, 1836; A. Westermann, in the *Neue Jahrbücher für Philologie und Paedagogik*, vol. xli., p. 230, fol. The dissertations upon the particular buildings and localities are almost countless.

Having thus completed the description of Athens, with its suburbs and dependencies, all that now remains to be done is to notice a few of the most remarkable epochs in its history, and to conclude with some account of the modern town, collected from the most recent authorities.

History of the city. The history of Athens, from the death of Alexander to the present time, may be compressed within comparatively narrow limits. Soon after the premature decease of the Macedonian hero, the citizens revolted; but they were defeated by Antipater, who garrisoned Munychia. Another insurrection followed with no better success. The garrison and oligarchy were reinstated; Demetrius, surnamed the Phalerean, was appointed governor of the city; and no less than 300 statues were erected in honour of this man, by the degenerate descendants of those Athenians who had thought a place in the foreground of a picture, painted at the public expense, an adequate reward for the victory of Marathon. But Demetrius, surnamed Poliorcetes, "the shame of Greece in peace, her thunderbolt in war," withdrew the garrison, and restored the democracy; a service for which he was deified by the Athenians, who assigned him a residence in the opisthodomos of the Parthenon, as a guest worthy of being entertained by Athena herself, and afterwards placed the Peiræus, with Munychia, at his disposal. As usual, however, they soon became weary of their idol, expelled his garrison, and regained their independence; chiefly, as is said, by the intercession of Craterus the philosopher, who persuaded Demetrius to leave them in possession of their liberty. Antigonus Gonatas, the next king of Macedonia, proved less scrupulous than "the Taker of Cities," and again seized upon Athens, where he established a garrison. But, on the death of Demetrius, son of Gonatas, the people, aided by Aratus, recovered their liberty; and the Peiræus, Munychia, Salamis, and Sunium, were restored to them, on payment of a considerable sum of money by way of equivalent. Disregarding this arrangement, however, Philip, the son of Demetrius, invaded Attica, and, encamping near the city, burned and destroyed the sepulchres and temples of the villages, slaughtered the inhabitants, and laid waste the greater part of the country.

Driven to despair by these barbarous proceedings, the Athenians were forced to solicit the protection of the Romans, which was readily granted, and to receive a garrison into the citadel, which it continued to occupy until the war with Mithridates, king of Pontus. But, taking advantage of the embarrassments of Rome, occasioned by one of the most arduous contests in which she had yet engaged, the Athenians, at the instigation of Aristion, general of the royal linguist, rose upon their protectors and expelled the garrison. This act of ingratitude met with an exemplary punishment. War was immediately declared; and Sulla soon afterwards appeared in Attica at the head of a powerful army. Unable to withstand the fury of the Romans, Archelaus, the Athenian general, relinquished the defence of the long walls, and retired into the Peiræus and Munychia. Sulla, on the other hand, immediately laid siege to the Peiræus, as well as to the city itself where Aristion commanded; and having received information that some persons had been overheard conversing in the Ceramicus, and blaming Aristion for his neglect of the avenues near the Heptachalcos, where the wall was accessible, he instantly resolved to assault the town in that quarter. Accordingly, about midnight he entered the city by the gate Dipylum, which he forced, and, having overcome every obstacle between it and the Peiraïc gate, was soon master of Athens. Aristion fled to the Acropolis; but being at length compelled to surrender from want of water, the supply of which had been cut of, he was dragged from the sanctuary of Athena, where he had sought refuge, and instantly put to death. This event took place in the year of Rome 668, or about 86 years before the Christian era. Sulla raged against the unfortunate city with the fury of a barbarian; burning the Peiræus and Munychia, defacing the monuments in the town and suburbs, and not even sparing the sepulchres of the dead in the Ceramicus.

In the civil war between Cæsar and Pompey, the Athenians declared for the champion of liberty. But although the battle of Pharsalia placed them at the mercy of Cæsar, that great and generous conqueror, "whose brow was girt with laurels more than hair," scorned to sully the lustre of his renown by any act of vengeance, and, with a magnanimity native to his character, dismissed the envoys who had been sent to propitiate him, with this fine observation: "I am content to spare the living for the sake of the dead." The same lingering affection for liberty which had led the Athenians to side with Pompey, also induced them to take part with Brutus and Cassius, in the wars of the second triumvirate; and they had even the spirit to erect statues to the two Roman patriots, beside those of their own deliverers, Harmodius and Aristogeiton. But at Philippi, as at Pharsalia, the gods declared against liberty,[2] and the Athenians were again on the losing side. Nor were they more fortunate in the contest which ensued between Octavianus and Antony; for, having joined the latter, who gave them Ægina, Cea, and other islands, they incurred the resentment of Augustus, now become master of the Roman world, who treated them with the utmost harshness and severity. Under Tiberius the city declined, but it still continued to enjoy a considerable share of freedom, and was regarded as an ally of the Romans. Germanicus conferred upon it the privilege of having a lictor to precede the magistrates; but he was censured for this act of condescension, as "the race of noble bloods" was now believed to be extinct, and the Athenian people a mixture of all nations. Nerva also proved rather indulgent to Athens; and under his successor, Trajan, Pliny exhorted Maximus, when intrusted with the government, to be mindful of the ancient glory of that classic land, and to

[1] For a full and accurate account of the present state of the Peiræus and its adjoining ports see Colonel Leake's work, p. 312, 325, and 326.

[2] The fine, though somewhat irreverent, sentiment expressed in the following line of Lucan, is not altogether inapplicable here:—
"Victrix causa diis placuit, sed victa Catoni."

Athens. rule Greece as if it had still been composed of free cities.[1] Hadrian, prouder of the archonship of Athens than of his imperial dignity, gave the city a digest of laws compiled from the codes of Draco, Solon, and other legislators, and testified his affection for it by unbounded munificence. Antoninus Pius, who succeeded Hadrian, and Antoninus the philosopher, also proved themselves benefactors of Athens, though on a less magnificent scale than their predecessor.

In the reign of Valerian, the northern barbarians first appeared in the north of Greece, where they laid siege to Thessalonica. This extraordinary apparition having alarmed all Greece, the Athenians restored their city wall, which Sulla had dismantled, and otherwise placed the town in a state of defence sufficient to secure it against a *coup-de-main*. But under Gallienus, the next emperor, Athens was besieged, and the archonship abolished; upon which the strategos or general, who had previously acted as inspector of the Agora, became the chief magistrate. Under Claudius the city was taken, but recovered soon afterwards. Constantine the Great gloried in the title of General of Athens, which had been conferred upon him, and expressed high satisfaction on obtaining from the people the honour of a statue with an inscription; a distinction which he acknowledged by sending to the city a yearly gratuity of grain. He also conferred on the governor of Attica and Athens the title of Μέγας Δοῦξ, or Grand Duke, which soon became hereditary; and his son Constans bestowed several islands on the city, in order to supply it with corn. In the time of Theodosius I., that is, towards the end of the fourth century, the Goths laid waste Thessaly and Epirus; but Theodorus, general of the Greeks, acted with so much prudence that he saved the Greek cities from pillage and the inhabitants from captivity; a service which was most gratefully acknowledged. But this deliverance proved only temporary. The fatal period was now fast approaching; and, in a real barbarian, Athens was doomed to experience a conqueror yet more savage and remorseless than Sulla. This was Alaric, king of the Goths, who, under the Emperors Arcadius and Honorius, overran both Italy and Greece; sacking, pillaging, and destroying. Never indeed did the fury even of barbarian conquest discharge itself in a fiercer or more desolating tempest. The Peloponnesian cities were overturned; Arcadia and Lacedæmon were both laid waste; the gulfs of Lepanto and Ægina were illuminated with the flames of Corinth; and the Athenian matrons were dragged in chains to satisfy the brutal desires of these rampant barbarians. The invaluable treasures of antiquity were removed; stately and magnificent structures were reduced to heaps of ruin; and Athens, stripped of the monuments of her ancient splendour, was compared by Synesius, a writer of that age, to a victim of which the body had been consumed, and the skin only remained.

After this dreadful visitation Athens sank into insignificance, and became as obscure as it had once been illustrious. We are indeed informed that the cities of Hellas were put in a state of defence by Justinian, who repaired the walls of Corinth, which had been overturned by an earthquake, and those of Athens, which had fallen into decay through age. But from the time of this emperor a chasm of nearly seven centuries ensues in its history; except that, about the year 1130, it furnished Roger, the first king of Sicily, with a number of artificers, who there introduced the culture of silk, which afterwards passed into Italy. The worms, it seems, had been brought from India to Constantinople in the reign of Justinian.

Doomed apparently to become the prey of every spoiler, Athens again emerges from oblivion in the thirteenth century, under Baldwin and his crusaders, at a time when it was besieged by a general of Theodorus Lascaris, the Greek emperor. In 1427 it was taken by Sultan Murad; but some time afterwards it was recovered from the infidels by another body of crusaders, under the Marquis of Montferrat, a powerful baron of the West, who bestowed it, along with Thebes, on Otho de la Roche, one of his principal followers. For a considerable time both cities were governed by Otho and his descendants, with the title of dukes; but being unable to maintain themselves in their Greek principality, they were at length succeeded by Walter of Brienne, who, soon after his succession, was expelled by his new subjects, aided by the Spaniards of Catalonia. The next rulers of Athens were the Acciaioli, an opulent family of Florence, in whose possession it remained until 1455, when it was taken by Omar, a general of Mahomet II., and thus fell a second time into the hands of the barbarians. The victorious sultan settled a Mahometan colony in his new conquest, which he incorporated with the Ottoman empire; and Athens, as well as Greece, continued to form an integral part of the Turkish dominions, until the treaty of Adrianople in 1829, following up the provisions and stipulations of the treaty of London, 7th July 1827, established within certain limits the new state of Greece, of which ancient Athens is now the capital.

Athens.

From the period of the Ottoman conquest to the commencement of the insurrection in 1821, Athens was only known in history by two attempts, on the part of the Venetians, to expel the Turks and make themselves masters of the city. The first of these took place in 1464, only nine years after its capture by the Osmanlis, and proved an entire failure. But the second, which was undertaken in 1687, more than two centuries later, was crowned with a temporary and fatal success. In the month of September of that year, Count Konigsmarck, a Swede in the service of Venice, having disembarked at the Peiræus a force of 8000 foot and 870 horse, forming part of the armament under Francesco Morosini, afterwards doge, marched to Athens; and having summoned the citadel without effect, he erected a battery of heavy ordnance on the hill of the Pnyx, and placing two mortars near the Latin convent at the western foot of the Acropolis, bombarded it for several days. The fire of the cannon was chiefly directed against the Propylæa, and the modern defences below that edifice; whilst the mortars continued, without intermission, to throw shells into the citadel. The consequence was, that the beautiful little temple of Nikê Apteros, the frieze of which is now in the British Museum, was completely destroyed by the breaching battery; and the Parthenon, besides being greatly injured by the bursting of the shells, was, towards the close of the attack, almost rent in pieces by the explosion of a powder magazine, which reduced the middle of the temple to a heap of ruins, threw down the whole of the wall at the eastern extremity, and precipitated to the ground every statue on the eastern pediment. The western extremity was fortunately less injured, and a part of the opisthodomos was still left standing, together with some of the lateral columns of the peristyle adjoining to the cell. But the shock was nevertheless abundantly disastrous; and when the Turks afterwards regained possession of the citadel (from which, on this occasion, they were expelled), they did all in their power to complete the destruction which the Venetians had so vigorously begun, by defacing, mutilating, or burning for lime every fragment of the edifice within their reach.[2]

Sieges.

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1 "You will revere the gods and heroes their founders," said he; "you will respect their pristine glory, and even their age; you will honour them for the famous deeds which are truly, and even for those which are fabulously, recorded of them: remember it is Athens you approach."

2 It has been often remarked of the Turks that they are encamped rather than settled in Europe. Far from improving the countries they govern, they scathe everything that comes within their reach: they destroy monuments, but build none; and when at length

Athens || Atherston.

In the course of the late revolutionary war, Athens sustained three sieges. The first was laid by the Greeks in 1822. Having carried the town by storm, and driven the Turks into the citadel, they established a strict blockade of the fortress, which was continued until the advance of the pasha at the head of 4000 men induced them to abandon their enterprise, and fly, with the Athenians, to Salamis and Ægina. Two months afterwards, the pasha having left Athens to the defence of 1500 men, the Greeks again ventured to attack the town, and succeeded in obliging the Turks to seek refuge in the citadel, which they forthwith determined to besiege; but, from ignorance and want of means, no progress whatever was made in the operation until they obtained possession of the well which supplied the garrison with water, when the Turks agreed to capitulate upon condition of being immediately embarked with their families, and sent to Asia Minor. On various pretences, however, the embarkation was delayed from time to time; and when intelligence at length arrived that a large Turkish force was advancing upon Athens, the Palicari, instead of manning the walls and preparing for a vigorous defence, rushed in a body to the houses where the prisoners were confined, and commenced an indiscriminate massacre, in which the young and beautiful inmates of the harem, the aged and infirm, and the brave but defenceless spahis and janissaries, fell alike beneath the merciless yataghan. This atrocity, for which no possible palliation can be alleged, and which, in every circumstance of cruelty, exceeded that previously perpetrated at Trippolizza, reflects indelible dishonour on the Greek character, and proves that they inherit the faithlessness of their ancestors, with the innate ferocity of their former masters. The third siege was laid by the Turks in 1826. The Greeks had left a strong garrison in the Acropolis, with provisions for several months; and a spring of water having been discovered in the cave of Pan, and inclosed by Odysseus within the defences of the citadel, there was no danger of its being starved into a surrender. But the Turks having established batteries near the Pnyx and on the hill of the Museium, and having drawn a line of trenches round the citadel, with the view of intercepting all communication between the besieged and the Greek army, the garrison was hard pressed; and although Colonel Fabvier succeeded in forcing his way through the Turkish lines with 500 men and a supply of ammunition, and thus affording immediate relief, yet the total defeat of the Greek army under General Church, at the battle of Athens, fought in the hope of raising the siege, led soon afterwards to the surrender of the Acropolis, which remained in the hands of the Turks until the termination of the revolutionary war.

In 1812 Athens could boast of a population of 12,000 souls, but during the war the greater part of the city was laid in ruins, and most of the inhabitants were dispersed. In 1834, it was declared the capital of the new kingdom of Greece. Great exertions have been made to restore the city; streets have been opened, levelled, and widened, though most of them are still narrow, winding, and irregular; the ancient sewers have been cleaned and repaired; and the marshes of the Cephissus, the exhalations of which were extremely noxious, are in the course of being drained. The ancient buildings have also been cleared of their rubbish, and some important discoveries have been made. The small temple of Victory has already been spoken of. The other marble fragments of buildings discovered have been placed in the temple of Theseus. The royal palace is a large building of Pentelic marble, situated in the east part of the city, on the highest part of the gentle eminence which rises from the level of the Ilissus and Cephissus towards Lycabettus. A theatre, a barrack, a military hospital, the royal stables, and many large private buildings, have all been raised since 1834. The houses, built in the modern German style, are generally supplied with jalousies and balconies; and have shops and coffeehouses on the ground floor. A university was established here in 1837, and has an anatomical theatre, a considerable library, and 34 professors and teachers, with (in 1845) 195 students. The gymnasium, a preparatory school to the university, is attended by about 800 regular students, besides many more attending particular lectures. It has eight professors, divided into three classes:—1. Ancient Greek, Latin, Geometry, Algebra, Logic, and Moral Science; 2. Ancient Greek, Geometry, Algebra, Psychology, History; 3. Ancient Greek, Latin, Algebra, Geography, History, and the French and English Languages. There are also a military and an ecclesiastical academy, a normal, Lancasterian, infant, and other schools, especially one established by the American missionaries, now in a very flourishing condition, and a splendid establishment for the education of young ladies, founded by the munificence of a benevolent lady, and called the Αρσακεῖον. The population of the city in 1845 amounted to 27,800. Porto Leone (the ancient Peiræus) contained at the same date 1000 houses. A good road has been made between it and the city, a distance of five miles, and a constant communication is kept up by means of fiacres; a large customhouse, a quay, and a lazaretto, have been erected; and the port presents rather a bustling appearance. The harbour is deep and secure, but has a very narrow entrance. The government is constructing a pier, which will afford accommodation to several hundred merchant vessels. Outside, about two miles to the westward, there is a great roadstead, with nearly eighteen fathoms of water. (J. B—E.)

Athens || Atherton.

ATHENS, the name of several towns and villages in the United States of America. The principal are, 1. the capital of a county of the same name in the S.E. of the state of Ohio, finely situated on the Hockhocking River, 40 miles from its mouth. It is the seat of the Ohio university and of an academy. Pop. 1593. 2. A town in the county of Clark, state of Georgia, on the W. bank of Oconee River. Pop. 3000. It contains the university of Georgia.

ATHEROMA (*ἀθήρωμα*), in *Surgery*, an encysted tumour, containing a soft substance resembling pap (*ἀθήρη*), intermixed with hard particles.

ATHERSTON, a market-town of Warwickshire, hundred of Hemlingford, 23 miles N. of Warwick. It consists chiefly of one street, is well paved and lighted with gas; and its sanitary condition has lately been much improved by sewers, &c. It has a market-house; a parochial chapel, once part of a convent; a Roman Catholic chapel; Independent and Methodist meeting-houses; a free grammar-school; a free school for boys, and another for girls; an infant school; a literary institution; subscription library; savings bank; and a dispensary. The staple manufacture is that of hats. The Coventry canal, which passes close by the town, adds considerably to its trading facilities. Pop. in 1851, 3819.

ATHERTON, or CHOWBENT, a township in the parish of Leigh and hundred of West Derby, in Lancashire, 200 miles from London. It is one of those places which have grown to wealth and populousness since the extension of the cotton trade. Pop. in 1851, 4655.

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they are driven out by the chances of war or revolution, the only traces they leave of their sway are to be found in the desolation with which they everywhere encompass themselves.

ATHIAS, Joseph, a celebrated rabbi and printer at Amsterdam, who printed a great number of Bibles in Hebrew, more correct than any that had previously been edited. He was a learned Hebraist as well as a skilful typographer, although it is said that there are occasional errors in the *points*, especially in the edition of 1661, many of which, however, were corrected in that of 1667. He also printed many Bibles in the corrupted Hebrew spoken by the Jews of Spain, Germany, Poland, and England. He died in 1700.

ATHLETÆ, in *Antiquity*, persons of strength and agility, disciplined to perform in the public games. The word is originally Greek, ἀθλητής, formed from ἆθλος, *certamen*, combat; whence also, ἆθλον, the prize or reward adjudged to the victor. Under athletæ were comprehended wrestlers, boxers, runners, leapers, throwers of the disk, and those practised in other exercises exhibited in the Olympic, Pythian, and other solemn games. Athletæ were first introduced at Rome by M. Fulvius in the year B.C. 186, and enjoyed under the emperors many privileges. Some curious particulars relative to their mode of training are given by several writers, which show that very different ideas were entertained, at different periods, of the diet most suitable for athletæ.—See Paus. vi.; Diog. Laërt. vi. viii.; Galen, *de Val. Tuend.* iii. *Athen.* ix. x.

ATHLONE, a market-town and parliamentary borough of Ireland, lying partly in West Meath and partly in Roscommon, 76 miles W. of Dublin. The River Shannon divides the town into two portions, which are connected by a handsome new bridge, opened in 1844. The rapids of the Shannon at this point have been obviated by means of a canal about a mile long, which renders the river navigation practicable for 71 miles above the town. In the war of 1688, the possession of Athlone was considered of the greatest importance; and it consequently sustained two sieges, the first by William III. in person, which failed; and the second by General Ginkell, who, in the face of the Irish, forded the river, and took possession of the town with the loss of only fifty men. During the late war with France, it was strongly fortified on the Roscommon side, the works covering 15 acres, and containing two magazines, an ordnance store, an armoury with 15,000 stand of arms, and barracks for 1500 men. There are two parish churches, two Roman Catholic parochial chapels, a Franciscan and Augustinian chapel, Presbyterian, Baptist, and Methodist meeting-houses, a sessions court-house, bridewell, a union workhouse, and two branch banks. It has a distillery, a brewery, and a tannery; and an active trade is carried on with Shannon harbour and Limerick by steamers, and with Dublin by the grand and royal canals. Market-days, Tuesday and Saturday. The borough returns one member to parliament. Pop. in 1851, 6218; constituency, 181.—Thom's *Irish Almanac* for 1853.

ATHOL, a district of Scotland, in the north of Perthshire, comprising an area of about 450 square miles. It is bounded on the N., the N.W., and W. by Badenoch and Lochaber in Inverness-shire, on the S. by Breadalbane and Strathmore, E. by Forfarshire, and N.E. by Mar in Aberdeenshire. This district is rough and mountainous, interspersed with woods and valleys, but withal beautiful and romantic. In Blair, amidst a wilderness of old trees, stands Blair Castle, the principal seat of the Duke of Athol. In the same neighbourhood is situated the pass of Killicrankie, memorable as being the scene of action between the troops of William III. under General M'Kay, and the Highland adherents of James II. under the celebrated Viscount Dundee. Glentilt, in this district, has lately acquired notoriety from the attempts made to deprive the public of the right of way.

ATHOS, a celebrated mountain of Chalcidice in Macedonia, situated in Long. 24. 20. E. and Lat. 40. 10. N. The ancients entertained extravagant notions concerning its height. On many accounts it was famous amongst them, but it is no less so among the moderns. The Greeks, struck with its singular situation, and the venerable appearance of its towering ascent, rising as it does in the form of an isolated pyramid, erected so many churches, monasteries, hermitages, &c., upon it, that it became in a manner inhabited by devotees, and from thence received the name of the *Holy Mountain*, which it still retains, though many of those consecrated abodes are now decayed. This mountain stands at the extremity of a peninsula of about 40 miles in length, and an average breadth of four miles. It is 6349 feet in height, about 30 miles in circumference, and may be seen 90 miles off. It abounds with many different kinds of plants and trees, particularly the pine and fir. The appearance of the mountain at present is exceedingly interesting. Upon its sides there is scattered a profusion of convents, chapels, villages, cells, and grots, inhabited by a number of monks of various countries, who never marry, and subsist on the most penitential fare. They are very industrious, cultivating the vine and the olive in the field, and practising various mechanical arts in their secluded abodes. The libraries of some of the convents appear to contain valuable remains of ancient literature; for, some years ago, a copy of the Greek fabulist Babrius was discovered there by a Greek, and editions of this collection of metrical fables have since been published in France, England, and Germany. Through this mountain, or rather through the isthmus behind it, Xerxes, king of Persia, is said to have cut a passage for his fleet when about to invade Greece. In this work he spent three whole years, employing all the forces on board his fleet. The truth of this relation was long denied, but has at length been proved. The remains, partly filled with water, were distinctly seen by Dr Sibthorp.—See Walpole's *Memoirs relating to Turkey*, 1817: *Mount Athos and its Monasteries*, 1837; and Curzon's *Monasteries of the Levant*, 1848, 2d ed.

ATHY, a market-town of Ireland, county of Kildare, 34 miles S.W. of Dublin. The town is intersected by the river Barrow, which is here crossed by a bridge of five arches. It has a church, a Roman Catholic chapel, a Presbyterian and Methodist meeting-house, court-house, jail, two banks, hospital, dispensary, barracks, &c. Adjoining the town is a small chapel, an ancient cemetery, and a small Dominican monastery. Previous to the Union it returned two members to the Irish parliament. The principal trade is in corn. Pop. in 1851, 5110.

ATIENZA, a town of Spain, in the province of Guadalajara, 21 leagues from Madrid. It stands on the declivity of a hill, contains five churches, a monastery, and about 2000 inhabitants, who are chiefly employed in agriculture and the rearing of cattle.

ATILIUS, M., an early Roman comic poet, of whose works there are no remains except a line quoted by Cicero (*ad Att.* xvi. ii.), and a few words in Varro.

ATIMIA (ἀτιμία), from α, priv. and τιμή, honour, in *Grecian Antiquity*, was an act or decree by which an offender was disgraced, and deprived of the rights of citizenship. Its rigour, however, was variously modified.

ATINA, a town of Naples, province of Terra di Lavoro, near the Melfa, and 12 miles S.E. of Sora. It has a cathedral, convent, and hospital, with about 5000 inhabitants; but it is chiefly remarkable for its remains of Cyclopean architecture.

ATKINS, or Atkyns, Sir Robert, lord chief baron of the Exchequer, was born in 1621, and educated at the university of Oxford, from whence he removed to the inns of court, and became eminent in the law. He was made knight of the bath at the coronation of King Charles II. In 1672 he was appointed one of the judges of common pleas, in which office he continued till 1679, when, foreseeing the troubles that soon afterwards ensued, he resigned his office and retired into the country. In 1689 he was made lord

Atkins || Atlantic Ocean.

chief baron of the Exchequer by King William; and about the same time held the office of speaker to the House of Lords, which had previously been refused by the Marquis of Halifax. He distinguished himself by an unshaken zeal for the laws and liberties of his country. He wrote several pieces, which have been collected into an octavo volume under the title of *Parliamentary and Political Tracts*, which afford much sound information on the true constitution of the country, and on the grounds and reasons of the Revolution. He died in 1709.

ATKINS, SIR ROBERT, son of the preceding, was born in 1646, and died in 1711. He wrote *The Ancient and Present State of Gloucestershire*, a work much esteemed.

ATKYNS, RICHARD, was born of a good family at Tuffleigh in Gloucestershire, in the year 1615. He was educated at Oxford, from whence he removed to Lincoln's Inn. During the civil wars he distinguished himself by his loyalty to King Charles I., and after the Restoration was a constant supporter of the government. Being committed to the Marshalsea prison for debt, he died there on the 14th of September 1677. He wrote a treatise *On the Original and Growth of Printing*, and several other pieces.

ATLANTES, in *Architecture*, also called Caryatides, are figures employed instead of columns to support an entablature. In general, male figures have the former, female statues the latter designation.

ATLANTIC OCEAN, one of the five great hydrographical divisions of the globe, lying between America on the W., and Europe and Africa on the E., and extending from the Arctic circle on the N., to the Antarctic circle on the S. Meridian lines from Cape Horn in South America, and from Cape Agulhas in Africa, prolonged to the Antarctic circle, complete its boundaries on the E. and W. It extends 8600 miles from N. to S., and its breadth varies from 1800 to 5400 miles, the estimated area being 25,000,000 square miles. It contains Iceland, the British Isles, the Azores, Madeira, the Canary Islands, the islands in the Gulf of Guinea, and those of the Gulf of St Lawrence, the Antilles, and Newfoundland. The principal gulfs and bays are the Bay of Biscay, and the Gulfs of Guinea, Mexico, and St Lawrence.

This ocean, according to Humboldt, presents all the indications of a valley, as if a flow of eddying waters had been directed first towards the N.E., then towards the N.W., and back again to the N.E. The parallelism of the coast north of 10° S. latitude, the projecting and receding angles, the convexity of Brazil opposite to the Gulf of Guinea, that of Africa under the same parallel with the Gulf of the Antilles, all favour this apparently speculative view. In this Atlantic valley, as is almost everywhere the case in the configuration of large continental masses, coasts deeply indented and rich in islands are situated opposite to those possessing a different character. The depth of this ocean is extremely various; and is enormous, both to the N. and S. of the equator. Thus, Captain Sir Edward Belcher, R.N., in Lat. 0. 4. N. Long. 10. 6. W., *sounded* to the depth of 3065 fathoms = 18,390 feet; Captain Barnett, R.N., in Lat. 41. 2. N. Long. 44. 3. W., sounded to the depth of 3700 fathoms, or 22,200 feet; Captain Sir James Ross, R.N., in 1840, to 2677 fathoms, or 16,062 feet; and afterwards in Lat. 33. 3. S. Long. 9. 1. E. to 4600 fathoms, or 27,600 feet; and Captain H. M. Denham, H.M.S. Herald, has obtained soundings at the vast depth of 7706 fathoms = 46,236 feet, or about 8¾ English miles. This, which is the deepest sounding ever yet taken, occurred on 30th October 1852, in Lat. 36. 49. S. Long. 37. 6. W. Two American captains have also obtained soundings at the depth of 3100 and 3500 fathoms.

The intertropical part of the Atlantic is under the influence of the trade-winds, which frequently extend to the 32d degree of N. or S. latitude. The winds blow almost invariably in the same direction, from E. to W., occasionally varying a few points to the N. or S., on the N. and S. sides of the equator. A region of calms, varying from 3 to 10 degrees of latitude, according to the season of the year, separates the two trade-winds. It is, however, daily agitated by a squall, which begins about two o'clock in the afternoon, and continues about an hour. This region does not always occupy the same part, but its central line may be placed about the 5th degree of N. latitude. In some tracts the influence of the trade-winds extends to the shores; but in general it does not come within 200 miles of the coasts.

Atlantic Ocean.

The current of this ocean first known to mariners, is called the equinoctial, and is within the tropics, especially flowing from the coast of Senegal to the Caribbean Sea. Its direction is constantly from E. to W., with a mean rapidity of 9 or 10 miles in 24 hours. This current is attributed to the impulse which is given to the surface of the sea by the trade-winds. "In the channel," says Humboldt, "which the Atlantic has dug between Guiana and Guinea on the meridian of 20 or 23 degrees, and from the 8th or 9th to the 2d or 3d degrees of N. latitude, where the trade-winds are often interrupted by winds blowing from the S. or S.S.W., the equinoctial current is more inconstant in its direction. The equinoctial current is felt, though feebly, even beyond the tropic of Cancer, in the 26th and 28th degrees of latitude. In the vast basin of the Atlantic, at 600 or 700 leagues from the coasts of Africa, vessels from Europe bound to the West Indies find their sailing accelerated before they reach the torrid zone." In the Caribbean Sea, the motion of this current is much accelerated by the action of another current. The Mozambique current, flowing from N. to S. between Madagascar and the eastern coast of Africa, bends to the north of the Lagullas bank, round the southern point of Africa, and advances with much violence along its western coast beyond the equator to the island of St Thomas. It gives a north-westerly direction to a portion of the waters of the South Atlantic, causing them to strike Cape St Augustin, and to follow the shores of Guiana beyond the mouth of the Orinoco, the Boca del Drago, and the coast of Paria. The coast of America presenting a barrier to the equinoctial current; its waters are driven with velocity through the strait formed by Cape Catoche and Cape St Antonio, into the Gulf of Mexico; and after following the bendings of the coast, force their way back into the open sea N. of the Straits of Bahama, where it forms a warm rapid current, known as the Gulf Stream. At first its rapidity is sometimes as great as five miles an hour, but it decreases as it proceeds towards the north, at the same time that its breadth increases and its waters become cool. Between Cayo Biscaino and the bank of Bahama the breadth is only 15 leagues, while in the latitude of 28½ degrees it is 17; and in the parallel of Charlestown, opposite Cape Henlopen, from 40 to 50 leagues. "The waters of the Mexican Gulf forcibly drawn to N.E. preserve their warm temperature to such a point, that in 40 and 41 degrees of latitude I found them at 22·5° cent. (= 72·4° Fahr.) when out of the current; the heat of the ocean at its surface was scarcely 17·5° (= 63·5° Fahr.) In the parallel of New York and Oporto, the temperature of the Gulf Stream is consequently equal to that of the seas of the tropics in the 18th degree of latitude, as, for instance, in the parallel of Porto Rico and the islands of Cape Verd."—(*Humboldt.*) In Lat. 41. 25. and Long. 67., where it is nearly 80 leagues broad, it turns suddenly to the E., and almost touches the southern edge of the Great Newfoundland Bank, from whence it continues its course E. and E.S.E. to the Azores. On the meridian of Corvo and Flores, the most westerly islands of the Azores group, the breadth of the current is 180 leagues. From the Azores it turns towards the Straits of Gibraltar, the island of Madeira, and the Canary group. There are several other minor currents in this vast ocean, as the branch

sent off by the Gulf Stream before reaching the Western Azores, which at certain seasons of the year flows towards Ireland and Norway. The experiments of Sir James Ross and Captain Denham show that, after the depth of 200 or 300 fathoms, the temperature of the Atlantic waters is stationary at 40° Fahr., whatever be the temperature at the surface. This uniformity of temperature in the waters of great oceans renders them the means of mitigating the extremes of tropical and polar regions.—See Rennell's *Investigation of the Currents of the Atlantic Ocean;* Humboldt's *Cosmos, Personal Narrative, &c.*

ATLANTIDES, in *Astronomy*, a denomination given to the Pleiades, or seven stars, sometimes also called *Vergiliæ*. They are thus called, as being supposed by the poets to have been the daughters either of Atlas or his brother Hesperus, who were translated into heaven.

ATLANTIS, Atalantis, or Atlantica, an island mentioned by Plato and some others of the ancients, concerning the real existence of which many disputes have been raised. Homer, Horace, and the other poets make two Atlanticas, calling them *Hesperides* and *Elysian Fields*, and representing them as the habitations of the blessed. The most distinct account of this island we have is in Plato's *Timæus*, of which Mr Chambers gives the following abridgment:—"The Atlantis was a large island in the Western Ocean, situated before or opposite to the Straits of Gades. Out of this island there was an easy passage into some others, which lay near a large continent, exceeding in size all Europe and Asia. Neptune settled in this island (from whose son Atlas its name was derived), and divided it amongst his ten sons. To the youngest fell the extremity of the island, called *Gadir*, which, in the language of the country, signifies *fertile*, or *abundant in sheep*. The descendants of Neptune reigned here, from father to son for a great number of generations, in the order of primogeniture, during the space of 9000 years. They also possessed several other islands; and passing into Europe and Africa, they subdued all Libya as far as Egypt, and all Europe to Asia Minor. At length the island sunk under water; and for a long time afterwards the sea thereabouts was full of rocks and shelves." Many of the moderns also are of opinion that the existence of the Atlantis is not to be looked upon as entirely fabulous. Some take it to have been America; and on this supposition, as well as from a passage in Seneca's *Medea*, and other obscure hints, they imagine that the new world was not unknown to the ancients. But allowing this to be the case, the abovementioned continent, which was said to lie beyond Atlantis, would seem rather to have been the continent of America than Atlantis itself. The learned Rudbeck, professor in the university of Upsal, in a work entitled *Atlantica sive Manheim*, endeavours to prove that Sweden and Norway are the Atlantis of the ancients; but the situation assigned to it renders this notion untenable. Kircher supposes it to have been an island extending from the Canaries quite to the Azores; adding, that it was really swallowed up by the ocean, as Plato asserts, and that these small islands are the shattered remains of it which were left standing.

The New Atlantis is the title of the interesting fragment in which Lord Bacon has sketched an ideal or scientific commonwealth.

ATLAS, king of Mauritania, is supposed to have been contemporary with Moses. From his taking observations of the stars on a mountain top, the poets represented him as turned into the mountain which bore his name, and sustaining the heavens on his shoulders. Being an excellent astronomer, and the first who taught the doctrine of the sphere, they tell us that his daughters were turned into stars; seven of them forming the Pleiades, and other seven the Hyades. A good account of Atlas, under his different aspects, may be found in Smith's *Dictionary of Greek and Roman Biography and Mythology*, vol. i.

Atlas, a celebrated but little known mountain chain of Northern Africa, between the great desert of Sahara and the Mediterranean. Geographers differ as to the extent of this range, some considering it to extend from Cape Ghir on the Atlantic to Cape Bon, the north-east point of Tunis; while others, under that name, include the whole mountain system between Cape Nun and the greater Syrtis. In this latter sense it forms the mountain-land of the countries of Marocco, Algeria, Tunis, and Tripoli. It is composed of ranges and groups of mountains, inclosing well-watered and fertile valleys and plains, and having a general direction from W. to E. The highest peaks are supposed to attain an elevation of nearly 15,000 feet; and although none of them reach the height of perpetual snow, some of their loftiest summits are covered with snow during the greatest part of the year. Mount Miltsin, 27 miles S.E. of the city of Marocco, was ascertained by Captain Washington to be 11,400 feet high. The greatest heights are in Marocco, from which point they appear to diminish in elevation as they extend towards the E. These mountains, except the loftier summits, are, for the most part, covered with thick forests of pine, oak, cork, white poplar, wild olive, and other trees. The inferior ranges seem to be principally composed of secondary limestone, which, at a greater elevation, is succeeded by micaceous schist and quartz-rock; and the higher chains are said to consist of granite, gneiss, mica-slate and clay-slate. The secondary and tertiary formations are frequently disturbed and upraised by trap-rocks of comparatively modern date. Lead, iron, copper, antimony, and sulphur, occur frequently here; and in the Marocco portion of the range, mines of gold and silver are said to exist. In the Algerian division are mines of copper, lead, silver, and antimony.

Atlas, in *Literature*, a collection of maps, charts, or other tables; so called from the fabulous king of that name, who is sometimes represented as supporting the world on his shoulders. The term was first used in this sense by the celebrated geographer Mercator, in the sixteenth century.

Atlas, in *Anatomy*, the first or uppermost vertebra in the neck, so called from its supporting the head. See Anatomy.

Atlas, a kind of Eastern silk.

ATMOMETER (from ἀτμός, *vapour*, and μετρόν, *a measure*), an instrument contrived by Professor Leslie, for measuring the quantity of moisture exhaled from any humid surface in a given time. It consists of a very thin ball of porous earthenware, from one to three inches in diameter, having a small neck firmly cemented to a long and rather wide tube of glass, to which is adapted a brass cap, with a narrow collar of leather to fit close. Being filled with distilled or pure water, the waste and descent of this column serves to indicate the quantity of evaporation from the external surface of the ball. The tube is marked downwards, through its whole length, by the point of a diamond, with divisions across it, amounting to from 200 to 500, each of which corresponds to a ring of fluid, that, spread over the whole exhaling surface, would form a film only one thousandth part of an inch in thickness. This graduation is performed by previously sealing one of the ends of the tube with wax, and introducing successive portions of quicksilver, to mark every 20, 50, or 100 of those divisions; being calculated of equal bulk to disks of water, that have the surface of the ball (exclusive of the neck) for their base, and so many thousand parts of an inch for their altitude.

The instrument, being thus constructed, has its cavity filled with pure water, and its cap screwed tight, and is then suspended freely out of doors, sheltered indeed from rain, but exposed to the action of the wind. The water transudes through the porous substance of the ball just as fast as it evaporates from the external surface; and

Atmometer.

this waste is measured by the corresponding descent of the liquid in the stem. At the same time, the column is suspended in consequence of the tightness of the cap, and prevented from oozing so freely as to drop from the ball. As the process of evaporation goes on, minute globules of air, separated by the removal of atmospheric pressure from the body of the water, or partly introduced by external absorption, continue to rise in fine streamlets to the top, where they partially occupy the space left by the subsidence of the fluid column. We need scarcely observe, that, after the water has sunk to the bottom of the stem, it will be requisite again to fill the cavity.

It is a fact of main importance for the accuracy of the atmometer, that the rate of evaporation is nowise affected by the quality of the porous ball, and continues precisely the same whether the exhaling surface appears almost dry or glistens with excess of moisture. This rate must evidently depend on the effect of the dryness of the air combined with its quickness of circulation. In a close room the instrument might therefore serve the purpose of an hygrometer; and, placed out of doors, first screened, perhaps, for an hour, and then exposed during an equal space of time, it would furnish data for calculating the velocity of the wind.

This instrument is of extensive application and great practical utility. To ascertain readily and accurately the rate of evaporation from any surface, is an important acquisition, not only in meteorology, but in agriculture, and in the various mechanical arts. The quantity of exhalation from the surface of the ground is not of less consequence than the measure of the fall of rain, and a knowledge of it might often direct the farmer advantageously in his operations. On the rapid dispersion of moisture depends the efficacy of drying-houses, which are generally constructed on most erroneous principles.

The atmometer, in its most compendious form, is admirably fitted for delicate experiments on the evaporation which takes place in close vessels when absorbent substances are introduced. Let the ball of the instrument, for example, be immersed in air variously rarefied or condensed, under a receiver covering a surface of sulphuric acid which has different degrees of strength; and, things being thus disposed, on extracting the common air, and introducing hydrogen gas, the rate of evaporation will then be nearly tripled.

We shall close this notice with mentioning a striking fact, which shows the necessity of extreme caution in all physical inquiries. Let the ball of an atmometer be cemented to a narrow glass tube of three or four feet in length, and the whole capacity filled with fresh distilled water. Now invert the instrument upright in a basin of quicksilver, and secure it in that situation; the quicksilver, following the column of water, will rise at first quickly, and then by degrees more slowly, till it reaches, perhaps, an elevation of 28 inches, where it will remain stationary and afterwards sink down, when the evaporation is nearly spent. Ice-water is raised in this way about 26 inches only, and common water scarcely 24 inches; the air separated from such liquids forming near the top of the ball a thin medium, which, by its elasticity, counteracts in part the pressure of the external atmosphere supporting the mercurial column. But a similar experiment, where the shoot of a vine was cemented to a tube holding quicksilver, has been thought, by Dr Hales and M. Du Hamel, quite conclusive in proving the *power* of the living principle of vegetation. It is obvious that the force of evaporation alone was sufficient to explain the facts advanced by those ingenious philosophers. See METEOROLOGY.

(J. L.)

Atmosphere.

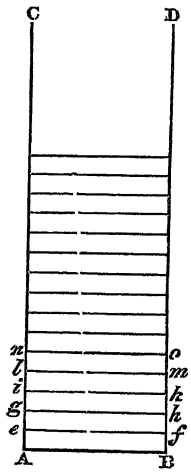
ATMOSPHERE is the name applied to the invisible elastic medium which surrounds the globe of the earth to an unknown height. The fluid of which it is composed is usually distinguished by the name of *air*.

It is well known that the pressure of the atmosphere is the cause of the rise of the mercury in the barometer. Now the mean height of the barometer at the level of the sea is 29·82 inches. Hence it follows that the whole weight of the atmosphere is equal to that of a sphere of mercury covering the whole surface of the globe, and extending to the height of 29·82 inches. The specific gravity of mercury is 13·568, and a cubic inch of water at the temperature of 60° weighs very nearly 252·5 grains. Hence a cubic inch of mercury will weigh 3425·92 grains, or 0·48956 lb. avoirdupois; and a column of the atmosphere reaching from the surface of the earth to the utmost height to which that elastic fluid reaches, and whose base is a square inch, weighs about 14·6 lbs. avoirdupois, or exerts a pressure equal to 14·6 lbs. upon the earth or any substance on which it rests.

The atmosphere consists chiefly of *air*, an elastic fluid composed of a mixture of four volumes of azotic with one volume of oxygen gas. Now, from the most exact experiments hitherto made, it follows, that at the temperature of 60°, and under the mean pressure of the atmosphere, a cubic inch of air weighs 0·311446 grains. If, therefore, the air were everywhere of the same density, the height of the atmosphere above the surface of the earth would be 328,021 inches, or 27,335 feet, or 5·17 miles.

Density of the atmosphere.

But air is an elastic fluid, the particles of which repel each other with a force varying inversely as the distance of the centres of the particles from each other. It is obvious, from this property of air, that its volume, and consequently its density, will depend upon the pressure. The greater the pressure, the smaller the volume. Those portions of the atmosphere that are in contact with the earth are pressed upon by the whole portion above them. The air at the top of a mountain is pressed upon by all the air above it; while all that portion below it, or lying between the top of the mountain and the surface of the sea, exerts no action on it whatever. This will be better understood by the following diagram. Let ABCD be conceived to be a section of a vessel extending from the surface of the earth at AB to the limit of the atmosphere CD, and filled with air. Let this pillar of air be divided into an infinite number of equal sections, each exceedingly thin, by the planes *ef*, *gh*, *ik*, *lm*, *no*, &c. Since the density of air is always as the compressing force, it follows that the density of the stratum AB*ef* is to that of the density of the stratum *efgh* as *ef*CD to *gh*CD. So that the difference between the pressures on *ef* and *gh* is equal to the quantity of air *efgh*. For the same reason, the difference between the pressures on *gh* and *ik* is equal to the quantity of air *ghik*; and this ratio holds to the very limit of the atmosphere. Therefore the densities of air in these spaces are proportional to the quantities of which they themselves are the differences. Now, when there is a series of quantities whose terms are proportional to their own differences, both those quantities and their differences are in geometrical progression; therefore the densities of the strata of air AB*ef*, *efgh*, *ghik*, *iklm*, &c. are in geometrical progression.



It is equally obvious that the heights of these equal spaces above AB, the surface of the earth, are in arithme-

Atmosphere.

tical progression. If *ef* be 1 inch above the earth's surface, *gh* will be 2 inches, *ik* will be 3 inches, and so on. From all this we derive this remarkable conclusion, that *if the altitudes above the surface of the earth be taken in arithmetical progression, the densities of the air at these altitudes will be in geometrical progression decreasing.* If at a certain altitude above the earth's surface the density of the air be one half what it is at the surface of the earth, then at twice that altitude the density will be reduced to one fourth of the density at the earth's surface, and so on.

We can calculate the density of the atmosphere at all heights above the earth's surface very readily by means of a table of logarithms; for logarithms constitute a set of numbers in arithmetical progression annexed to another set of numbers which are in geometrical progression. If, therefore, we take logarithms to represent the heights, the numbers to which these logarithms are attached will represent the corresponding densities of the air. Suppose the density of the air at one mile above the surface of the earth to be represented by unity; then, from the common tables of logarithms, we easily deduce the following densities at greater heights:

Height.	Density.
1 mile	1·
2	0·7943
3	0·6309
4	0·5011
5	0·3981
6	0·3163
7	0·2511
8	0·1995
9	0·1585
10	0·1260

So that at 10 miles the density of the air is only $\frac{1}{8}$th of its density at one mile above the surface of the earth.

Its height.

These observations are sufficient to show that the height of the atmosphere above the surface of the earth must greatly exceed five miles; but how much, we have no data to enable us to determine.

Air possesses the property of refracting light; that is, of bending it from a right line, and making it move in a curve. The consequence of this property is, that the sun continues visible for some little time after he sets, and is seen also a short time before he rises. Nor are we deprived of all the benefits of his rays so long as any of them are capable of reaching the utmost limit of the atmosphere. This light, brought to the surface of the earth by the refracting power of the atmosphere, is called *twilight;* and mathematicians have endeavoured to determine the height of the atmosphere by observing how many degrees below the horizon the sun must sink before twilight ends. The result of this calculation is, that, at the height of 45 miles, the atmosphere has no sensible power of refracting light. Its rarity therefore at that height must be very great.

There is another way in which an estimate may be formed of the height of the atmosphere. That height must ultimately depend upon the degree of rarity which air is capable of bearing. The particles of air repel each other with forces varying inversely as the distances of the centres of these particles from each other. Now there is no great difficulty in rarefying air by means of a good air-pump, till it is capable of supporting a column of mercury only $\frac{1}{10}$th of an inch in height. In such a case air is rarefied about 300 times, and the distance between the centres of its particles is increased seven times; consequently the force of repulsion between these particles is reduced to $\frac{1}{7}$th of what it is when air is of its mean density. If we suppose that this is the utmost limit to the rarefaction of air (a supposition not at all likely to be strictly true), we are entitled to infer that the atmosphere extends to the height of 40 miles, with properties yet unimpaired by extreme rarefaction.

Atmosphere.

If matter be infinitely divisible, the extent of the atmosphere must be equally infinite. But if air consists of ultimate atoms no longer divisible, then must the expansion of the medium composed of them cease at that distance where the force of gravity downwards upon a single particle is equal to the resisting force arising from the repulsive force of the particles. If the air be composed of indivisible atoms, our atmosphere may be conceived to be a medium of finite extent, and may be peculiar to our planet; but if we adopt the hypothesis of the infinite divisibility of matter, we must suppose the same medium to pervade all space, where it would not be in equilibrio, unless the sun, the moon, and all the planets, possess their respective shares of it condensed around them, in degrees depending on the force of their respective attractions.

Has a limit.

It is obvious that the atmosphere of the moon (supposing it to have any) could not be perceived by us; for, since the density of an atmosphere of infinite divisibility at her surface would depend upon the force of her gravitation at that point, it would not be greater than that of our atmosphere when the earth's attraction is equal to that of the moon at her surface. Now this takes place at about 5000 miles from the earth's surface,—a height at which our atmosphere, supposing it to extend so far, would be quite insensible.

But since Jupiter is fully 309 times greater than the earth, the distance at which his action is equal to gravity must be as $\sqrt{309}$, or about 17·6 times the earth's radius; and since his diameter is nearly 11 times greater than that of the earth, $\frac{17{\cdot}6}{11} = 1{\cdot}6$ times his own radius will be the distance from his centre at which an atmosphere equal to our own should occasion a refraction exceeding 1°. To the fourth satellite this distance would subtend an angle of about 3° 37′; so that an increase of density to $3\frac{1}{2}$ times our common atmosphere would be more than sufficient to render the fourth satellite visible to us when behind the centre of the planet, and consequently to make it appear on both sides at the same time. It is needless to say that this does not happen, and that the approach of the satellites, instead of being retarded by refraction, is regular till they appear in actual contact; showing that there is not that extent of atmosphere which Jupiter should attract to himself from an infinitely divisible medium filling space.

If the mass of the sun be considered as 330,000 times that of the earth, the distance at which his force is equal to gravitation will be $\sqrt{330{,}000}$, or about 575 times the earth's radius; and if his radius be 111·5 times that of the earth, then this distance will be $\frac{575}{111{\cdot}5} = 5{\cdot}15$ times the sun's radius. But Dr Wollaston has shown, by the phenomena attending the passage of Venus very near the sun on the 23d May 1821, that the sun has no sensible atmosphere. For the apparent and calculated place of that planet were the same when the planet was only 53′ 15″ from the sun's centre. M. Vidal of Montpellier observed Venus on the 30th May 1805, when her distance from the centre of the sun was only 46′ of space; and the apparent and calculated positions of that planet corresponded. These observations leave no doubt that the sun has no sensible atmosphere, and of course are inconsistent with the notion of the infinite divisibility of the matter of our atmosphere.

Atmosphere. But if air consist of atoms incapable of further division, it is obvious that the height of the atmosphere has a limit, and that limit is the place where the gravitation of the atoms of air just balance the force of their repulsion. The exact situation of this limit we cannot assign; but it cannot far exceed the height of 45 miles above the earth's surface. Nor are the objections to this determination drawn from meteors of sufficient weight to overturn the force of the arguments just adduced. Dr Halley observed a meteor in the month of May 1719, whose altitude he computed to be between 69 and 73½ English miles, its diameter 2800 yards, and its velocity about 350 miles in a minute. The celebrated meteor which appeared on the 18th August 1783 was not less than 90 miles above the surface of the earth. Its diameter must have been at least equal to that of Dr Halley's meteor, and its velocity certainly not less than 1000 miles in a minute. We know too little about the nature of these meteors to connect them with the earth's atmosphere. Indeed their velocity would lead to the conclusion that they were revolving round the earth like satellites. The light which they emitted, or the state of combustion which they exhibited, we cannot explain. But the same difficulty occurs to account for the volcanoes which have been seen in the moon, though we are quite certain that her atmosphere is far too rare to support combustion.

About 45 miles high.

Air a mixture of two gases, The ancients thought that air constituted one of the four *elements*, from which, in their opinion, all things originated; and this doctrine continued prevalent till after the year 1774. It was during that year that Dr Priestley first discovered oxygen gas, and showed it to be a constituent of air. He determined several of its most remarkable properties, and called it *dephlogisticated air*, from a notion he entertained that it was air deprived of *phlogiston*.

oxygen and azotic, When *azotic* gas, the other constituent of air, was discovered soon after, the difference between its properties and those of oxygen gas could not fail to strike the most careless observer. Bodies burn more rapidly, with much greater splendour, and with the evolution of much greater heat, in oxygen gas than they do in common air; while in azotic gas they cannot be made to burn at all. Animals breathe oxygen gas without inconvenience, and they live much longer when confined in a given bulk of it, than when in the same volume of common air; but in azotic gas animals cannot live at all. When plunged into it they die of suffocation, precisely as they would do if plunged under water. Dr Priestley considered *oxygen* gas as the pure elementary principle of the ancients: common air was oxygen united to a certain quantity of phlogiston, while azotic gas was oxygen saturated with phlogiston.

Scheele discovered both oxygen and azotic gas, without any knowledge of what had been done in Britain; and he first drew the proper consequences from his experiments. Air, in his opinion, consists essentially of a mixture of two distinct elastic fluids, namely, oxygen and azote. He determined the properties of each, and made a set of experiments to ascertain the relative volumes of each contained in the atmosphere. The result of these experiments led him to the conclusion that air is a mixture of

27 volumes oxygen gas,
73 volumes azotic gas.

100.

Lavoisier drew the same conclusions as Scheele had done; and he assures us that he did so before he knew any thing of the researches and discoveries of the Swedish chemist; and, what is very remarkable, he deduced the same volumes of each gas, as constituents of the atmosphere, as Scheele had done. His experiments were made in the same way as Scheele's, and no doubt the mistakes of both had the same origin. Atmosphere.

It was in 1782 that Mr Cavendish, by a careful analysis of the air in the neighbourhood of London, repeated frequently, and continued for a whole year, determined that the volume of oxygen gas in atmospherical air is a good deal smaller than Scheele and Lavoisier had made it. He found the constituents of air to be—

79·18 volumes of azote,
20·82 volumes of oxygen.

100·00.

He found that these proportions never varied, though he analyzed air at different periods of the day, and during all the different seasons of the year. Hence it followed that the conclusions drawn by Dr Ingenhousz and others, that air differs in the proportion of oxygen gas which it contains in different parts of the earth, and that the salubrity of different places is connected with this difference, were erroneous.

These experiments of Mr Cavendish were published in the *Philosophical Transactions* for 1783; but they continued for many years unattended to. The determination of Scheele and Lavoisier was universally adopted; and the notion of Dr Ingenhousz, that the proportions between the oxygen and the azote vary in different places, was also adopted. At last, in 1802, Berthollet announced that he had frequently analyzed the air in Egypt, by absorbing its oxygen by means of a stick of phosphorus, and that he had always found it a compound of

79 volumes azote,
21 volumes oxygen.

100.

Davy about the same time announced that he had tried air from the coast of Africa, from Cornwall, and from the neighbourhood of Bristol, and had uniformly found it composed of 79 volumes of azotic gas and 21 volumes of oxygen gas. It was soon after analyzed in Edinburgh, in North America, and in France, with the very same results. Gay-Lussac and Humboldt made a set of careful experiments to determine the exact proportions of the two constituents, and confirmed the ratio of 21 volumes of oxygen gas and 79 volumes of azotic gas. This ratio has been generally adopted by chemists.

in the proportion of 80 vol. azote to 20 vol. oxygen. But there is a circumstance which cannot avoid striking an attentive observer; namely, the very near approach of these numbers to 80 volumes azotic and 20 volumes oxygen gas, or four volumes azotic and one volume oxygen gas. It has been deduced from a great variety of unexceptionable experiments, that a volume of azotic gas is equivalent to an atom, while half a volume of oxygen gas is equivalent to an atom. Hence four volumes azotic and one volume oxygen gases are equivalent to four atoms azote and two atoms oxygen, or to two atoms azote and one atom oxygen. If, therefore, we were to admit that air consists of 80 volumes azotic and 20 volumes of oxygen gases, it would follow that it is a compound of two atoms azote and one atom oxygen. There is no evidence, indeed, that in air the oxygen and azotic gases are chemically combined; the phenomena of air rather lead to the conclusion that the two elastic fluids are merely mixed. And the hypothesis of Dalton, that the particles of elastic fluids only repel particles of their own kind, but that two elastic fluids are not mutually elastic to each other, will enable us to account for their remaining intimately mixed, though not chemically united.

It may seem immaterial, then, whether air be a mixture of azotic and oxygen gases in the proportion of two atoms of the former to one atom of the latter, or in the pro-

Atmosphere.

portion (as chemists at present think) of 1·975 atom azote and 1·05 atom oxygen; or, as fractions of atoms can hardly be admitted, of 79 atoms of azote and 42 atoms of oxygen. But certainly the constitution of air must appear much simpler, and therefore much more agreeable to contemplate, when viewed as consisting of the simple ratio of two to one, than in the much more complex ratio of 79 to 42. The writer of this article was induced in consequence to make a set of experiments with all possible attention to accuracy, in order to deduce the volume of oxygen gas which it contains. The air was collected in a grass field at some distance from houses and trees; and this spot was selected as likely to furnish air containing as great a proportion of oxygen as it ever contains, because grass and vegetables in general are supposed to make up the waste of oxygen which the air sustains by the processes of combustion and respiration,[1] and because the quantity of carbonic acid which it was likely to contain would be too small to make any sensible alteration in the experiments.

Ten measured volumes of this air were placed successively in a small glass jar, over mercury, together with a stick of phosphorus. After the oxygen gas had been removed by the phosphorus, the air was washed, and then measured. The following table exhibits the result of these ten trials. 100 volumes of air consist of

	Volumes of Azotic Gas.	Volumes of Oxygen Gas.
1	80·927	19·073
2	79·246	20·754
3	80·504	19·496
4	79·532	20·468
5	79·851	20·149
6	79·652	20·348
7	79·374	20·626
8	80·770	19·230
9	79·843	20·157
10	80·028	19·972
Mean,	79·9735,	20·0265

The mean of these ten trials gives us air, a mixture of 79·9735 volumes of azotic and 20·0265 volumes of oxygen gas. Now, this approaches as near 80 volumes of azotic and 20 volumes of oxygen gas as the mode of experimenting permitted, for the measure employed to determine the volume of the gases was about half an inch in diameter.

It was found, also, that when 100 volumes of air were mixed with 42 volumes of hydrogen gas, and an electric spark passed through the mixture, the diminution of bulk by the explosion was precisely 60 volumes; and this in three successive experiments. Now, this diminution is owing to the oxygen of the air uniting with the hydrogen gas and forming water, and water is a compound of two volumes hydrogen and one volume oxygen gas. The third part of the diminution, therefore, gives us the quantity of oxygen gas consumed. Now, the third of 60 is 20, which constitutes therefore the volumes of oxygen gas in 100 volumes of air.

If we employ less than 42 volumes of hydrogen gas, the whole oxygen of the air is not consumed. Thus, when we employ a mixture of 100 volumes of air and 40 volumes of hydrogen gas, the diminution of volume after combustion is only 57 volumes, which would indicate 19 volumes of oxygen instead of 20 in the air; so that one volume of oxygen in this case has escaped combustion. When we mix more hydrogen than 42 volumes with 100 volumes of common air, the diminution of volume is somewhat greater than 60, and it goes on increasing slowly till the volume of hydrogen gas is equal to that of the air. 100 volumes of air being mixed with 100 volumes of hydrogen gas, and fired, the diminution amounted to 64 volumes. This would raise the amount of the oxygen in 100 volumes of air to $21\frac{1}{3}$ volumes.

Atmosphere.

It is obvious from these experiments that absolute certainty cannot be obtained by firing mixtures of air and hydrogen gas. The reason, doubtless, is, that when the surplus of hydrogen is considerable, a little of it unites with the azotic gas of the air, and forms ammonia, which, being absorbed by the water over which the explosion is made, occasions a greater diminution of bulk than would have proceeded from the simple union of all the oxygen of the air with hydrogen gas.

Specific gravity of these two gases.

Knowing the composition of air to be 80 volumes azotic and 20 volumes oxygen gas, and knowing the atomic weight of these bodies to be azote 1·75 and oxygen 1, we can easily deduce the specific gravity of azotic and oxygen gases, reckoning that of air unity, in the following manner:—

100 parts of air by weight must be a compound of

oxygen $22{\cdot}2\dot{2}=a$,

azote $77{\cdot}7\dot{7}=b$.

Let x=specific gravity of oxygen gas,

y=specific gravity of azotic gas,

$$\frac{x+4y}{5}=1 \text{ and } x=5-4y$$

$$x:4y::a:b \text{ and } x=\frac{4ay}{b}.$$

Hence $5-4y=\frac{4ay}{b}$, from which we deduce

$$y=\frac{5b}{4a+4b}=\frac{5\times 77{\cdot}7\dot{7}}{4\times 22{\cdot}22+4\times 77{\cdot}7\dot{7}}=0{\cdot}9722\dot{}$$

and $x=5-4y=5-3{\cdot}888\dot{8}=1{\cdot}111\dot{1}$.

Thus, the specific gravity of these two gases is as follows:—

oxygen gas.....1·111$\dot{1}$,

azotic gas.....0·9722$\dot{}$.

That the specific gravity of these two gases hitherto determined by the most careful experimenters is inaccurate, is obvious from this, that when we calculate the specific gravity of air from them, it never comes out unity, but usually higher than unity.

Air contains carbonic acid.

Besides oxygen and azotic gases, air contains likewise a little carbonic acid gas. Who first made that remark we do not know; but it could not avoid being inferred as soon as the cause of the difference between caustic and mild alkali came to be known. Chemists at first stated the volume of carbonic acid gas in the atmosphere at 1 per cent., but this determination was not founded on any accurate experiments. Mr Dalton found the quantity much smaller than had been stated by preceding experimenters. He observed, that if a glass vessel, filled with 102,400 grains of rain water, be emptied in the open air, and 125 grains of lime water poured in, and the mouth then closed, by sufficient time and agitation the whole of the lime water is just saturated with the carbonic acid which it finds in the inclosed volume of air; but 125 mea-

[1] It is easy to show, that whether the oxygen thus withdrawn from the air be supplied or not, no alteration in the proportions of the constituents amounting to one millionth part can possibly have taken place. It would therefore be quite insensible as far as our means of estimating it can go.

Atmosphere.

sures of lime water require 70 measures of carbonic acid gas to saturate them. Hence it follows that 10,000 volumes of air contain 6·8 volumes of carbonic acid.[1] Thenard ascertained by means of barytes water that 10,000 volumes of air which he examined contained 3·91 volumes of carbonic acid.[2] This is little more than half the quantity found by Mr Dalton. But by far the most complete set of experiments on the volume of carbonic acid gas in the atmosphere was made by M. Saussure. He abstracted the carbonic acid from given volumes of air by means of barytes water. The carbonic acid was estimated by dissolving the precipitated carbonate of barytes in muriatic acid, and throwing down the barytes in the state of sulphate from the solution. The sulphate of barytes, ignited and weighed, easily furnished the weight of carbonic acid; and this weight, together with the known specific gravity of carbonic acid gas, furnished the data for determining its volume. The experiments were continued for two years. Sometimes (indeed most commonly) the air examined was collected at Chambeisy, a meadow about three fourths of a league from Geneva, elevated about 52½ feet above the lake, and distant from it 820 feet. Its elevation above the level of the sea is 1272 feet. It is dry, open, and consists of a clay soil, a little inclined. The mean quantity of carbonic acid gas found in 10,000 volumes of air deduced from 104 observations made during both day and night, and at all seasons, was 4·15 volumes. The greatest quantity was 5·74 volumes, and the smallest 3·13 volumes. The quantity of this gas is affected by rainy weather; for when the soil is soaked with water, it has the property of imbibing this gas. Hence in rainy seasons the quantity of carbonic acid gas in the atmosphere is usually rather less than in dry seasons. On the contrary, it would seem, from the observations of Saussure, that a continued frost has a tendency to augment the quantity of carbonic acid in the atmosphere, doubtless because the frozen and dry soil does not possess the property of absorbing it.

Air taken from the surface of the lake of Geneva, at an elevation of four feet, was found in general to contain less carbonic acid than the air of Chambeisy; but the same kind of variation, depending on the season of the year, was observable in both. Air from the streets of Geneva, on the contrary, was found rather more loaded with carbonic acid than the air above Chambeisy; but the difference was not great. The volume of carbonic acid in air from the tops of mountains was found to be rather greater than that of carbonic acid in air from the low country; and this difference is more remarkable in rainy than in dry weather.

Wind has rather a tendency to augment the quantity of carbonic acid in the air in low situations, doubtless by mixing together the air on the mountains and in the valleys; but the difference is so small that it only becomes perceptible by a long series of observations.

In general, the air over plains contains a greater proportion of carbonic acid during the night than during the day; but this difference is not nearly so great in winter as in summer. Indeed during that season of the year the quantity is often as great or even greater during the day than during the night.[3]

The reason why the quantity of carbonic acid gas in the atmosphere is greater in the superior strata than at the surface of the earth, is, probably, that vegetables have the property of absorbing it and applying it to the purposes of vegetation. Hence, doubtless, the reason why it does not increase, notwithstanding the prodigious quantity of it constantly thrown into the atmosphere by the breathing of animals and the combustion of fuel.

Atmosphere. Its quantity.

If we admit the mean volume of carbonic acid gas in air to be 0·000415, then the true component parts of 100 volumes of air will be

Azotic gas	79·9668
Oxygen gas	19·9917
Carbonic acid gas	0·0415
	100.

This, doubtless, will somewhat modify the specific gravity of oxygen and azotic gases; but the alteration is too insignificant to claim any attention.

Air contains vapour.

Besides these three constituents, there is a fourth, namely, the vapour of water, from which air is never altogether free, and the proportion of which, owing to causes which cannot at present be fully explained, is continually altering. The consequence of this is, that if we weigh air in its natural state ever so often, we shall hardly ever find its weight in any two consecutive experiments altogether the same. It is sufficiently known that water evaporates spontaneously at all temperatures, and mixes with air in the state of an invisible elastic fluid known by the name of *vapour* or of *steam* when its elasticity is so great as to balance that of the atmosphere. The elasticity of vapour varies with the temperature. At 32° it is capable of supporting a column of mercury 0·2 inch high. At 80° it supports a column of 1 inch, at 163° of about 10 inches, at 180° of about 15 inches, and at 212° of about 30 inches. Now, the quantity of it which can exist in the atmosphere at the same time is proportional to this elasticity.

Its volume determined.

Mr Dalton has shown, that if p = pressure of the atmosphere in inches of mercury, f = elasticity of vapour contained in the atmosphere, x = volume of dry air in 100 volumes of the given atmospherical air; then

$$\frac{px}{p-f} = 100; \text{ consequently } x = \frac{100}{\frac{p}{p-f}}.$$

Let air be saturated with moisture at 32°. In that case we have

$$\frac{px}{p-f} = \frac{30}{29{\cdot}8} = 1{\cdot}00671$$

$$x = \frac{100}{1{\cdot}00671} = 99{\cdot}333;$$

so that the volume of vapour (supposing its specific gravity 0·625) in 100 volumes of such air will amount to 0·666, which is just $\frac{1}{150}$th part of the volume of the air.

At the temperature of 60° $f = 0{\cdot}52$, we have therefore $\frac{px}{p-f} = \frac{30\,x}{29{\cdot}48} = 100$, and $x = 98{\cdot}267$; so that the volume of vapour capable of existing in the atmosphere at 60° is $\frac{17{\cdot}33}{100{\cdot}000}$ of the atmosphere.

The highest temperature that the writer of this article has had an opportunity of witnessing in Great Britain was 93°. At that temperature $f = 1{\cdot}5$

$$\frac{px}{p-f} = \frac{30x}{28{\cdot}5} = 100, \text{ and } x = 95;$$

so that the volume of vapour capable of existing in the atmosphere at such a temperature is $\frac{5}{100}$ or $\frac{1}{20}$.

To determine the volume of vapour in the atmosphere

[1] *Phil. Mag.* (1st series), xxiii. 354.

[2] *Traité Elem. de Chim.* i. 303.

[3] *Ann. de Chim. et de Phys.* xliv. 5.

Atmosphere.

at any particular time, various instruments have been contrived, called *hygrometers*, some more and some less exact; but the simplest and most accurate method of all is that employed by Leroi, and afterwards by Mr Dalton. Take a glass tumbler, as thin as possible, and fill it with water somewhat colder than the temperature of the air at the time. Observe if vapour be condensed on the outside of the tumbler; if not, the water employed is not cold enough for our purpose. Its temperature must be lowered either by putting pieces of ice into it or by dissolving in it some carbonate of soda or sulphate of soda, retaining their water of crystallization, but in powder. If vapour condense on the outside of the tumbler, pour out the water into another glass and wipe the outside of the tumbler dry. When the temperature of the water has had time to be a little elevated, pour it into the tumbler again, and observe whether moisture condense on the outside of the glass. If it do, pour out the water, wipe the outside of the tumbler again, and repeat the process when the water has become a little warmer. This method of proceeding is to be persevered in till you find the temperature at which the moisture just ceases to be condensed on the glass. That temperature, by means of the following table, will enable you to determine the volume of vapour (of the specific gravity 0·625) existing in the atmosphere at the time that your observation is made.

Atmosphere.

Temperature.	Force of Vapour in Inches of Mercury.	Temperature.	Force of Vapour in Inches of Mercury.	Temperature.	Force of Vapour in Inches of Mercury.	Temperature.	Force of Vapour in Inches of Mercury.
32°	0·2000	47°	0·3264	62°	0·5560	77°	0·9175
33	0·2066	48	0·3372	63	0·5749	78	0·9487
34	0·2134	49	0·3483	64	0·5944	79	0·9809
35	0·2204	50	0·3600	65	0·6146	80	1·0120
36	0·2277	51	0·3735	66	0·6355	81	1·04
37	0·2352	52	0·3875	67	0·6571	82	1·07
38	0·2429	53	0·4020	68	0·6794	83	1·10
39	0·2509	54	0·4171	69	0·7025	84	1·14
40	0·2600	55	0·4327	70	0·7260	85	1·17
41	0·2686	56	0·4489	71	0·7507	86	1·21
42	0·2775	57	0·4657	72	0·7762	87	1·24
43	0·2866	58	0·4832	73	0·8026	88	1·28
44	0·2961	59	0·5012	74	0·8299	89	1·32
45	0·3059	60	0·5200	75	0·8581	90	1·36
46	0·3160	61	0·5377	76	0·8873		

Suppose we find that the temperature of the water when moisture ceases to be condensed on the outside of the tumbler is 40°, we look into the above table, and opposite to 40° in it, we find 0·26 inch of mercury. This denotes the force of the vapour contained in the atmosphere at the time our experiment was made. Suppose the barometer to be standing at 30 inches, then the volume of vapour in the atmosphere is $\frac{26}{3000}$, or nearly $\frac{1}{113}$ of the volume of the atmosphere.

The absolute quantity of vapour in the atmosphere is usually greatest in summer on account of the temperature being so much higher; but the moisture or dryness of the air does not depend so much upon the absolute quantity of vapour which it contains, as on its approach to saturation. Suppose the temperature of the air to be 60°, and that a tumbler filled with water of 60° condenses water on its outside. This would indicate a force of vapour equal to 0·52 inch of mercury. Now, as this is the force of vapour at 60°, it is clear that as much vapour exists in the air as is possible at that temperature. The air is saturated with moisture, evaporation cannot go on in it, and moisture will be deposited upon all bodies the least colder than the air itself. Such a state of things takes place pretty frequently in this country during winter, though rarely during summer. Hence the atmosphere is moister during winter than during summer, though the absolute quantity of vapour which it contains may be much less.

With respect to the quantity of vapour in the atmosphere we have still very few data. Mr Daniel, in his book on Meteorology, has given a table of the force of vapour in the atmosphere at London for three years. The following table gives the mean force of vapour in Glasgow during every fortnight, from May 1823 to February 1824:

Quantity of vapour in the air at Glasgow.

		Force of Vapour in Inches of Mercury.
1823. May,	1st fortnight	0·2707
	2d	0·3494
June,	1st	0·3052
	2d	0·2822
July,	1st	0·3526
	2d	0·3819
August,	1st	0·4000
	2d	0·3546
September,	1st	0.3790
	2d	0·3404
October,	1st	0·3233
	2d	0·3026
November,	1st	0·2808
	2d	0·3230
December,	1st	0·2449
	2d	0·2453
1824. January,	1st	0·2481
	2d	0·2578
February,	1st	0·2468
	2d	0·2170

The mean force of vapour in the atmosphere in Glasgow is nearly 0·3 inch, which indicates the quantity of vapour capable of existing in the atmosphere at 45°. Now the mean temperature of Glasgow is 47°·75. It is obvious from this that the atmosphere in that part of Scotland is moist.

It would be very interesting if we knew the force of

Atmosphere. vapour at all the different seasons in the torrid zone. The regularity of the weather in these climates, and the little alteration in height of the barometer, would make a set of such observations particularly valuable. They would probably throw more light on the theory of rain than has yet been done. The only set of observations which we have seen on the quantity of vapour in countries approaching the torrid zone, are the following by Dr Heinecker, in which he gives the maximum and minimum dew points at Funchal in Madeira (lat. 32½ N.), during the year 1828, which in that part of the world was remarkably dry.

	Maximum.	Minimum.	Rain in Inches.
January	65°	50°	4·08
February	56	50	1·64
March	65	48	1·68
April	63	45	3·35
May	69	51	2·14
June	70	54	0·21
July	72	61	0·10
August	73	63	0
September	75	69	1·39
October	74	56	0
November	72·5	54	2·56
December	67	50	0·52
			17·67[1]

These observations are not sufficient to give us an accurate notion of the state of the atmosphere at Funchal. The highest dew point is 75°, indicating a force of vapour amounting to 0·8581 inch, so that the vapour at that time in the atmosphere was nearly $\frac{1}{35}$th of its volume. The lowest dew point is 45°, indicating a force of vapour amounting to 0·3059 inch, so that the vapour at that time in the atmosphere was nearly $\frac{1}{100}$ of its volume. The mean dew point deduced from the maxima and minima is 61°, indicating a force of vapour of 0·5377 inch, or a quantity of vapour amounting to nearly $\frac{1}{55}$th of the volume of the atmosphere. The mean temperature of Madeira is 66°·3. Now since the mean dew point is 61°, it is obvious that the atmosphere over Madeira is much drier than at Glasgow, though the absolute quantity of vapour which it contains is much greater.

Why the different gases in air remain mixed. Thus the atmosphere is a mixture of at least four different elastic fluids, namely, azotic gas, oxygen gas, carbonic acid gas, and the vapour of water. Doubtless all other gaseous bodies and many vapours exist in it also, but in too small quantities to be discovered by the most delicate tests that we have it in our power to apply. These different elastic fluids are mixed equably together; and though there be a considerable difference in their specific gravities, that difference has no tendency to cause them to separate. The reason of this equable mixture was first pointed out by Dalton. It depends upon a principle not yet generally recognised, but of the existence of which recent observations leave little doubt. This principle is, that the particles of elastic fluids are not mutually elastic to each other. The particles of oxygen repel the particles of oxygen, the particles of azotic gas repel those of azotic gas; but a particle of oxygen does not repel a particle of azotic gas. Hence, when a gas issues from an orifice into a space filled by another gas, it rushes precisely as if it were flowing into a vacuum. But the full development of this important principle belongs to the article Pneumatics.

Salubrity of the atmosphere. A great deal has been written about the salubrity of the atmosphere in different countries. It has been supposed, and is still believed, that the average length of life in different places depends chiefly upon the state of the atmosphere. It has been generally admitted that the atmosphere is frequently a vehicle by which diseases are communicated; and the prevalence of certain epidemic diseases, as the plague and the yellow fever, in particular places, at particular seasons, has been accounted for in this way. But no satisfactory evidence has ever been adduced to satisfy us of the accuracy of these opinions. The constituents of the atmosphere, azotic and oxygen gases, never undergo any sensible change in their proportions. Carbonic acid varies somewhat, but its proportion is always so small that it cannot be considered as a source of disease. The proportion of aqueous vapour is much more variable, and there can be no doubt that it may have an effect upon individuals predisposed to certain diseases. Consumptive patients suffer much more when they breathe a very moist than when they breathe a dry atmosphere. There are few places in the habitable globe, if there be any, where the atmosphere is constantly saturated with moisture; and it cannot prove very injurious, even to consumptive patients, except when in this state. Besides, that a very dry atmosphere is not the best adapted for the continuance of health, is obvious from the sufferings to which those who inhabit the west coast of Africa are liable during the prevalence of the sirocco, a wind so excessively dry that even the wood of the floors shrinks in consequence of its action.

Nothing has been more completely ascertained than that marshy countries are subject to intermittent fevers, and that the malignancy of these intermittent fevers increases with the heat of the climate. These diseases disappear when the marshes are drained, and therefore are connected with moisture; but that they are not owing to mere moisture, is obvious from this, that they do not appear at the sea-shore or on the banks of rivers, though the moisture be as great as in marshy countries. It is the general opinion that these diseases owe their origin to certain vapours which are given out during the putrefaction of vegetable substances; but of the nature of these *miasmata* nothing is known. In the West Indies marshes are most fatal to the inhabitants just when they are almost (but not quite) dried up by the heat of the weather. It is then that the exhalations are most abundant and most deadly. It is known that smallpox, &c. may be communicated by the mixture of a particular matter with the blood. It is possible, though not very probable, that this matter may at times exist in the atmosphere in the state of vapour, or in combination with one or other of the constituents of air, most probably the aqueous vapour, and the disease may be communicated by breathing such air. It is a conceivable thing that the matter, which, like a ferment, is capable of inducing certain diseases when it enters into the blood, may exist occasionally united to the aqueous vapour in the atmosphere.

It has been ascertained, by experiments that seem conclusive, that these noxious states of the atmosphere, however they originate, may be destroyed, and the air rendered healthy, by mixing it with chlorine. This is most easily accomplished by introducing into the chamber to be so purified a quantity of chloride of lime in an open dish and pouring on it sulphuric acid. The chlorine is disengaged and speedily fills the apartment. Then the mixture is withdrawn and the room ventilated. See Climate, Meteorology, Pneumatics. (T. T.)

ATOM (α, priv., and τέμνω), a particle of matter, so minute as to admit of no division. Atoms are the *minima*

[1] Brewster's *Journal* (new series), i. 34.

Atomic Theory || Atri.

naturæ, and are conceived to be the first principles or component parts of all physical magnitude.

ATOMIC THEORY. See CHEMISTRY.

ATOMICAL PHILOSOPHY, or the doctrine of atoms, a system which, from the hypothesis that atoms are endued with gravity and motion, accounted for the origin and formation of all things. This philosophy, first broached by Leucippus, was developed by Democritus, and afterwards cultivated and improved by Epicurus, whence it is denominated the *Epicurean Philosophy*. See EPICUREAN PHILOSOPHY.

ATONEMENT. See THEOLOGY.

ATOOI, one of the larger Sandwich Islands, in the South Pacific Ocean. Towards the north-east and north-west the country is rugged and broken, but to the southward it is more level. The hills rise from the sea with a gentle acclivity, and at a little distance back are covered with wood. The produce of this island is the same with that of the rest of the cluster; but its inhabitants greatly excel their neighbours in the management of their plantations. It is nearly 30 miles in length, and contains about 10,000 inhabitants. Long. 159. 40. W. Lat. 21. 57. N.

ATRATO, a river of New Granada, in South America, which, after a course of 250 miles, falls into the Gulf of Darien. The gold and platinum mines of Choco were on some of its affluents, and its sands are still auriferous.

ATREBATII, or ATREBATES, a people of Britain, who inhabited part of Berkshire and Wiltshire, next to the Dobuni. This was one of those Belgic colonies which came out of Gaul into Britain. Their capital was Nemetocenna, or Nemetacum, now Arras. They are mentioned by Cæsar among the nations which composed the Belgic confederacy against him; and the quota of troops which they engaged to furnish on the occasion to which he refers was 15,000. Commius of Arras was a king or chieftain among the Atrebatii of Gaul in Cæsar's time; and he seems to have possessed some influence over the Atrebatii of Britain, for he was sent by Cæsar to persuade them to submission. This circumstance renders it probable that this colony of the Atrebatii had not been settled in Britain very long before that time. The Atrebatii were amongst the British tribes which submitted to Cæsar; nor do we hear of any remarkable resistance they made against the Romans at their next invasion under Claudius. It is indeed probable that, before the time of this second invasion, they had been subdued by some of the neighbouring states; perhaps by the powerful nation of the Cattivellauni; which may also be the reason why they are so little mentioned in history. Calleva Atrebatum, mentioned in the seventh, twelfth, thirteenth, and fourteenth Itinera of Antoninus, and called by Ptolemy *Calcula*, seems to have been the British capital of the Atrebatii. But our antiquaries differ respecting the situation of this ancient city; some of them placing it at Wallingford, and others at Silchester.

ATREUS, in *Ancient History*, the son of Pelops and Hippodameia, grandson to Tantalus, and the father of Agamemnon and Menelaus, is supposed to have been king of Mycenæ and Argos about 1228 years before the Christian era. He drove his brother Thyestes from court for having criminal intercourse with Ærope his wife; but, understanding that two children were the fruit of this connection, he recalled his brother, and served up their flesh to him at a banquet; at which enormity the sun, it is said, withdrew his light.—Hygin. *Fab.*; Æschyl. *Agamemnon*; Soph. *Ajax*.

ATRI, or ATRIA, the ancient *Hadria*, a town of Naples, in the province of Abruzzo Ulteriore I., situated on a steep mountain 5 miles from the Adriatic, and 18 miles south-east of Teramo. It is the see of a bishop, and has a cathedral, a parish church, several convents and hospitals, and contains about 6000 inhabitants. In its vicinity are some remarkable ancient excavations.

Atrienses || Attachment.

ATRIENSES, in *Antiquity*, a kind of servants or officers in the great families of Rome, who had the care and inspection of the atria and the things lodged therein.

ATRIUM, in *Roman Architecture*. See ARCHITECTURE.

ATRIUM, in *Ecclesiastical Antiquity*, denotes an open place or court before a church, making part of what was called the *narthex* or *ante-temple*. The atrium in the ancient churches was a large area or square plat of ground, surrounded with a portico or cloister, situated between the porch or vestibule of the church and the body of the church. Some have erroneously confounded the atrium with the porch or vestibule, from which it was distinct; others with the narthex, of which it was only a part. The atrium was the mansion of those who were not suffered to enter farther into the church; and more particularly, it was the place where the first class of penitents stood to solicit the prayers of the faithful as they went into the church.

ATROPA, a genus of plants belonging to the natural order of Solenaceæ, most of which are active poisons. *A. Belladonna* (deadly nightshade), and *A. Mandragora*, are well-known examples.

ATROPHY (α, privative, and τροφή, a nourishment), in *Medicine*, a disease in which the body does not receive the necessary nutriment from the blood, but wastes and decays incessantly.

ATROPOS, in *Heathen Mythology*, the name of the third of the Parcæ or Fates, whose business it was to cut the thread of life.

ATTACHMENT, in *English Law*, is a process from a court of record, awarded by the justices at their discretion, on a bare suggestion, or on their own knowledge; and is properly grantable in cases of contempt. It differs from arrest, in that he who arrests a man carries him to a person of higher power to be forthwith disposed of; but he that attaches keeps the party attached, and presents him in court at the day assigned, as appears by the words of the writ. Another difference is, that arrest is only upon the body of a man, whereas an attachment is often upon his goods. It is distinguished from distress in not extending to lands, as the latter does; nor does a distress touch the body, as an attachment does. Every court of record has power to fine and imprison for contempt of its authority.

The county courts in this respect are regulated by the 9th and 10th Vict. cap. 95, § 113, and the 12th and 13th Vict. cap. 101, § 2.

The following are the ordinary instances of contempts:—

1. Contempt of the Queen's writs, *e.g.*, by witnesses not attending in pursuance of their subpœna on the trial to give evidence, and being unable to show any lawful ground of excuse (such as that of dangerous illness), or by parties proceeding in an inferior court after a prohibition or a certiorari.

2. Contempt in the face of the court.

3. Contemptuous words or writings concerning the court.

4. Contempt of the rules or awards of the court, by disobedience thereto. Under this head may be introduced the mode of punishing a party for the non-performance of an award by attachment. The first instance, it appears, of granting an attachment in such a case was in the reign of Charles II., when Kelynge was chief-justice, in Sir John Humble's case. The submission must be made a rule of court and be served on the party with an oral demand of performance of the award. An affidavit of the due execution of the award by the arbitrator is necessary, and it must be shewn that the award was made within the time limited for that purpose. There is, however, another mode of proceeding where the payment of money or of costs is awarded, by rule under the 1st and 2d Vict. cap. 110,

Attachment ‖ Attainder.

§ 18, and under which execution will issue. But an attachment cannot be obtained after proceedings under this statute.

5. Abuse of the process of the court, as suing out execution where there is no judgment, or using it in a vexatious, oppressive, or unjust manner, without colour of serving any other end thereby.

6. Forgeries of writs and other deceits tending to impose on the court, by altering the teste or filling them up after being sealed.

Attachments also lie against officers of the court for abuses committed by them; against sheriffs or other officers guilty of corrupt practice in not serving a writ, receiving a bribe in order to prevent the service, making false returns, or for exceeding their power; against attorneys for injustice or for delaying suits.

Attachments are granted on a rule in the first instance to show cause, which must be personally served before it can be made absolute, except for non-payment of costs on a master's allocatur, and against a sheriff for not obeying a rule to return a writ or to bring in the body (See order 168 of *Hilary Term*, 1853). The offender is then arrested, and when committed will be compelled to answer interrogatories, exhibited against him by the party at whose instance the proceedings have been had; and the examination when taken is referred to the master, who reports thereon, and on the contempt being reported, the court gives judgment according to their discretion, in the same manner as upon a conviction for a misdemeanour at common law.

Attachment out of Chancery, is used to enforce answers and obedience to decrees and orders of that court, and is made out without order upon an affidavit of the due service of the process, &c., with whose requirements compliance is sought. A corporation, however, is proceeded against by distringas and not by attachment.

Attachment of the Forest, is the proceeding in the courts of attachments, woodmote, or forty days' courts. These courts have now fallen into absolute desuetude. They were held before the verderors of the royal forests in different parts of the kingdom once in every 40 days, for the purpose of inquiring into all offences against "vert and venison." The attachment is by the bodies of the offenders, if taken in the very act of killing venison, or stealing wood, or preparing so to do, or by fresh and immediate pursuit after the act is done; else they must be attached by their goods. These attachments were received by the verderors and enrolled, and certified under their seals to the Court of Justice seat, or sweinmote, which formed the two superior of the forest courts.

Attachment, Foreign, a local custom in some parts of England resembling the practice of arrestment in Scotland, is the attachment of money or goods found within a liberty or city, to satisfy some creditor within such liberty or city. But it cannot be obtained where a suit is pending in any of the courts at Westminster, nor can money due to an executor or administrator as such be attached, nor trust money, nor money awarded under a rule of court. By the custom of London, and several other places, a man can attach money or goods in the hands of a stranger, to satisfy himself. (R. M—M.)

ATTACOTTI, an ancient people of Britain, mentioned by Ammianus Marcellinus and St Jerome, as well as in the *Notitia Imperii*. They were allies of the Scots and Picts, and inhabited the west coast of Scotland, but their precise boundaries have not been determined.

ATTAINDER, in the *Law of England*, imports that extinction of civil rights and capacities which takes place whenever a person who has committed treason or felony receives sentence of death for his crime, and is the immediate inseparable consequence from the common law upon the sentence of death. When it is clear beyond all dispute that the criminal is no longer fit to live, he is called *attaint, attinctus*, stained or blackened, and could not, before the 6th and 7th Vict. c. 85, § 1, be a witness in any court. This attainder takes place after judgment of death, or upon such circumstances as are equivalent to judgment of death, such as judgment of outlawry on a capital crime, pronounced for absconding from justice. Attainder.

A man is attainted by *appearance*, that is, by confession when he answers guilty upon his indictment, or by verdict, when he pleads not guilty, but is found guilty by the jury; by *process*, otherwise called judgment by default or outlawry, when the party fleeth, and is not to be found in the country, and is outlawed on the fifth proclamation upon his default; and by *act of parliament*.

The consequences of attainder are—1st, Forfeiture; 2d, Corruption of blood.

1*st, Of forfeiture:*

The offender becomes incapable of maintaining a suit in any court of justice, whether civil or criminal, except for the purpose of procuring the reversal of his attainder. In cases of treason or murder, or of abetting, procuring, or counselling the same (to which, by the 54th Geo. III. cap. 145, it is limited), all lands and tenements of inheritance, whether fee-simple or fee-tail, and all rights of entry in lands or tenements at the time of the commission of the offence, or at any time afterwards, and all the profits of all lands and tenements which the offender had in his own right, for life or years, so long as such interest shall subsist, are forfeited to the crown. He also forfeits all his chattel interests absolutely, and the profits of all estates of freehold during life; and this forfeiture of goods and chattels accrues in every treason or misprision thereof, felonies of all sorts, self-murder, or felony-de-se.

There is, however, this distinction between the forfeiture of lands, and of goods and chattels: lands are not forfeited before attainder, and the forfeiture has relation back to the time of the commission of the offence, so as to avoid all intermediate sales and incumbrances; goods and chattels are forfeited by conviction, and the forfeiture has no relation backwards.

2*d, Of corruption of blood:*

The ancient law has been much narrowed in its application by recent enactments. Formerly the person attainted was incapable himself of inheriting, or of transmitting his own property by heirship; and this corruption could not be absolutely removed but by authority of parliament.

But now, under the 54th Geo. III. cap. 145, no attainder for felony, except for treason or murder, extends to the disinheriting of any person, nor to the prejudice of the right or title of any person beyond the natural life of the offender; and by the 3d and 4th Will. IV. cap. 106, § 10, when the person, from whom the descent of any land is to be traced, shall have had any relation who, having been attainted, shall have died before such descent shall have taken place, then such attainder shall not prevent any person from inheriting such land, who would have been capable of inheriting the same by tracing his descent through such relation, if he had not been attainted; and by the 13th and 14th Vict. cap. 60, § 46, no lands, stock, or chose in action, vested in any person on any trust, or by way of mortgage, or any profits thereof, shall be forfeited by reason of attainder or conviction for any offence of such trustee or mortgagee, but the Court of Chancery has power, under the 15th and 16th Vict. cap. 55, § 8, to appoint new trustees in lieu of persons convicted of felony.

It is, however, in the power of the Sovereign to restore the forfeited land by grant to the families of the former owner, and the consequences of this forfeiture are, therefore, at the present time frequently remitted.

Attainder and conviction must be taken advantage of by plea.

Attainders may be reversed or falsified (*i.e.*, proved to be false) by writ of error, or by plea. If by writ of error, it

Attalea || Atterbury.

must be by the Queen's leave, &c.; and when by plea, it must be by denying the treason, pleading a pardon by act of parliament, &c.

By a reversal of attainder, all the former proceedings are absolutely set aside, and the party stands as if he had never been accused, and is restored to his credit, his capacity and blood, and his estates,—by a free pardon the person cannot sue on any right accrued before his pardon, although he may for a subsequent right. (R. M—M.)

ATTALEA, an important genus of palms, described by Spix and Martins as found in the dense forests of Brazil. The fibres of the leaf-stalks of *A. funifera* afford the finest cordage for the Brazilian navy. The fruit of *A. compta* is about the size of the egg of a goose, and contains an esculent kernel. Its leaves form excellent thatch. *A. speciosa* affords oily nuts, which are applied to various useful purposes in Brazil.

ATTALEIA (now ADALIA), a maritime city of Pamphylia, near the mouth of the Catarrhactes, visited by Paul and Barnabas, A.D. 45. Extensive ruins attest its former greatness.

ATTAR, or OTTO of ROSES, a well-known perfume of great strength, is an essential oil prepared in several parts of Asia and in Egypt from the *Rosa moschata* and *Rosa Damascena*. It is said that 100,000 roses yield but 180 grains of attar. This oil is at first of a palish green colour, which by keeping becomes darker, and presents various tints of green, yellow, and red.

ATTENTATES, proceedings in a court of judicature, after an inhibition is decreed.

ATTENTION, a due application of the ear or of the mind to anything said or done, in order to acquire a knowledge thereof. The word is compounded of *ad*, to, and the verbal substantive derived from *tendo*, I stretch.

Attention, in respect of hearing, is the stretching or straining of the *membrana tympani*, so as to make it more susceptible of sounds, and better prepared to catch even a feeble agitation of the air; or it is the adjusting of the tension of that membrane to the degree of loudness or lowness of the sound to which we are attentive.

According to the degree of attention, objects make a stronger or weaker impression. Attention is requisite even to the simple act of seeing: the eye can take in a considerable field at one look, but no object in the field is seen distinctly except that singly which fixes the attention: in a profound reverie, which totally occupies the attention, we scarcely see what is directly before us. In a train of perceptions, no particular object makes such a figure as it would do singly and apart; for when the attention is divided among many objects, no particular object is entitled to a large share. Hence the stillness of night contributes to terror, there being nothing to divert the attention.

Attention is classed by Dugald Stewart as a distinct faculty of the mind; an arrangement from which some other philosophers have dissented. But his admirable illustrations of the effects or results of attention are not at all dependent on the opinion which may be formed on this question.—See *Elements of the Philosophy of the Human Mind*, ch. ii.

ATTENUATION (*ad* and *tenuis*), the act of making any fluid thinner and less consistent than it was before, or of enlarging bodies in superficial extent.

ATTERBURY, FRANCIS, a man who holds a conspicuous place in the political, ecclesiastical, and literary history of England, was born in the year 1662, at Middleton in Buckinghamshire, a parish of which his father was rector. Francis was educated at Westminster School, and carried thence to Christ Church a stock of learning which, though really scanty, he through life exhibited with such judicious ostentation that superficial observers believed his attainments to be immense. At Oxford, his parts, his taste, and his bold, contemptuous, and imperious spirit soon made him conspicuous. Here he published, at twenty, his first work, a translation of the noble poem of Absalom and Ahithophel into Latin verse. Neither the style nor the versification of the young scholar was that of the Augustan age. In English composition he succeeded much better. In 1687 he distinguished himself among many able men who wrote in defence of the Church of England, then persecuted by James II., and calumniated by apostates who had for lucre quitted her communion. Among these apostates none was more active or malignant than Obadiah Walker, who was master of University College, and who had set up there, under the royal patronage, a press for printing tracts against the established religion. In one of these tracts, written apparently by Walker himself, many aspersions were thrown on Martin Luther. Atterbury undertook to defend the great Saxon reformer, and performed that task in a manner singularly characteristic. Whoever examines his reply to Walker will be struck by the contrast between the feebleness of those parts which are argumentative and defensive, and the vigour of those parts which are rhetorical and aggressive. The Papists were so much galled by the sarcasms and invectives of the young polemic, that they raised a cry of treason, and accused him of having, by implication, called King James a Judas. Atterbury.

After the Revolution, Atterbury, though bred in the doctrines of non-resistance and passive obedience, readily swore fealty to the new government. In no long time he took holy orders. He occasionally preached in London with an eloquence which raised his reputation, and soon had the honour of being appointed one of the royal chaplains. But he ordinarily resided at Oxford, where he took an active part in academical business, directed the classical studies of the under-graduates of his college, and was the chief adviser and assistant of Dean Aldrich, a divine now chiefly remembered by his catches, but renowned among his contemporaries as a scholar, a Tory, and a high-churchman. It was the practice, not a very judicious practice, of Aldrich, to employ the most promising youths of his college in editing Greek and Latin books. Among the studious and well-disposed lads who were, unfortunately for themselves, induced to become teachers of philology when they should have been content to be learners, was Charles Boyle, son of the Earl of Orrery, and nephew of Robert Boyle, the great experimental philosopher. The task assigned to Charles Boyle was to prepare a new edition of one of the most worthless books in existence. It was a fashion among those Greeks and Romans who cultivated rhetoric as an art, to compose epistles and harangues in the names of eminent men. Some of these counterfeits are fabricated with such exquisite taste and skill, that it is the highest achievement of criticism to distinguish them from originals. Others are so feebly and rudely executed that they can hardly impose on an intelligent schoolboy. The best specimen which has come down to us is perhaps the oration for Marcellus, such an imitation of Tully's eloquence as Tully would himself have read with wonder and delight. The worst specimen is perhaps a collection of letters purporting to have been written by that Phalaris who governed Agrigentum more than 500 years before the Christian era. The evidence, both internal and external, against the genuineness of these letters is overwhelming. When, in the fifteenth century, they emerged, in company with much that was far more valuable, from their obscurity, they were pronounced spurious by Politian, the greatest scholar of Italy, and by Erasmus, the greatest scholar on our side of the Alps. In truth, it would be as easy to persuade an educated Englishman, that one of Johnson's Ramblers was the work of William Wallace, as to persuade a man like Erasmus, that a pedantic exercise, composed in the trim and artificial Attic of the time of Julian, was a despatch written by a crafty and ferocious Dorian who roasted people alive many

Atterbury. years before there existed a volume of prose in the Greek language. But though Christ Church could boast of many good Latinists, of many good English writers, and of a greater number of clever and fashionable men of the world than belonged to any other academic body, there was not then in the college a single man capable of distinguishing between the infancy and the dotage of Greek literature. So superficial indeed was the learning of the rulers of this celebrated society, that they were charmed by an essay which Sir William Temple published in praise of the ancient writers. It now seems strange, that even the eminent public services, the deserved popularity, and the graceful style of Temple, should have saved so silly a performance from universal contempt. Of the books which he most vehemently eulogized his eulogies proved that he knew nothing. In fact, he could not read a line of the language in which they were written. Among many other foolish things, he said that the letters of Phalaris were the oldest letters and also the best in the world. Whatever Temple wrote attracted notice. People who had never heard of the Epistles of Phalaris began to inquire about them. Aldrich, who knew very little Greek, took the word of Temple who knew none, and desired Boyle to prepare a new edition of these admirable compositions which, having long slept in obscurity, had become on a sudden objects of general interest.

The edition was prepared with the help of Atterbury, who was Boyle's tutor, and of some other members of the college. It was an edition such as might be expected from people who would stoop to edite such a book. The notes were worthy of the text; the Latin version worthy of the Greek original. The volume would have been forgotten in a month, had not a misunderstanding about a manuscript arisen between the young editor and the greatest scholar that had appeared in Europe since the revival of letters, Richard Bentley. The manuscript was in Bentley's keeping. Boyle wished it to be collated. A mischief-making bookseller informed him that Bentley had refused to lend it, which was false, and also that Bentley had spoken contemptuously of the letters attributed to Phalaris, and of the critics who were taken in by such counterfeits, which was perfectly true. Boyle, much provoked, paid, in his preface, a bitterly ironical compliment to Bentley's courtesy. Bentley revenged himself by a short dissertation, in which he proved that the epistles were spurious, and the new edition of them worthless: but he treated Boyle personally with civility as a young gentleman of great hopes, whose love of learning was highly commendable, and who deserved to have had better instructors.

Few things in literary history are more extraordinary than the storm which this little dissertation raised. Bentley had treated Boyle with forbearance; but he had treated Christ Church with contempt; and the Christ-Churchmen, wherever dispersed, were as much attached to their college as a Scotchman to his country, or a Jesuit to his order. Their influence was great. They were dominant at Oxford, powerful in the Inns of Court and in the College of Physicians, conspicuous in parliament and in the literary and fashionable circles of London. Their unanimous cry was, that the honour of the college must be vindicated, that the insolent Cambridge pedant must be put down. Poor Boyle was unequal to the task, and disinclined to it. It was, therefore, assigned to his tutor Atterbury.

The answer to Bentley, which bears the name of Boyle, but which was, in truth, no more the work of Boyle than the letters to which the controversy related were the work of Phalaris, is now read only by the curious, and will in all probability never be reprinted again. But it had its day of noisy popularity. It was to be found not only in the studies of men of letters, but on the tables of the most brilliant drawing-rooms of Soho Square and Covent Garden. Even the beaus and coquettes of that age, the Wildairs and the Lady Lurewells, the Mirabels, and the Millamants, congratulated each other on the way in which the gay young gentleman, whose erudition sate so easily upon him, and who wrote with so much pleasantry and good breeding about the Attic dialect and the anapæstic measure, Sicilian talents and Thericlean cups, had bantered the queer prig of a doctor. Nor was the applause of the multitude undeserved. The book is, indeed, Atterbury's masterpiece, and gives a higher notion of his powers than any of those works to which he put his name. That he was altogether in the wrong on the main question, and on all the collateral questions springing out of it, that his knowledge of the language, the literature, and the history of Greece, was not equal to what many freshmen now bring up every year to Cambridge and Oxford, and that some of his blunders seem rather to deserve a flogging than a refutation, is true; and therefore it is that his performance is, in the highest degree, interesting and valuable to a judicious reader. It is good by reason of its exceeding badness. It is the most extraordinary instance that exists of the art of making much show with little substance. There is no difficulty, says the steward of Moliere's miser, in giving a fine dinner with plenty of money: the really great cook is he who can set out a banquet with no money at all. That Bentley should have written excellently on ancient chronology and geography, on the development of the Greek language, and the origin of the Greek drama, is not strange. But that Atterbury should, during some years, have been thought to have treated these subjects much better than Bentley, is strange indeed. It is true that the champion of Christ Church had all the help which the most celebrated members of that society could give him. Smalridge contributed some very good wit; Friend and others some very bad archæology and philology. But the greater part of the volume was entirely Atterbury's: what was not his own was revised and retouched by him; and the whole bears the mark of his mind, a mind inexhaustibly rich in all the resources of controversy, and familiar with all the artifices which make falsehood look like truth, and ignorance like knowledge. He had little gold; but he beat that little out to the very thinnest leaf, and spread it over so vast a surface, that to those who judged by a glance, and who did not resort to balances and tests, the glittering heap of worthless matter which he produced seemed to be an inestimable treasure of massy bullion. Such arguments as he had he placed in the clearest light. Where he had no arguments, he resorted to personalities, sometimes serious, generally ludicrous, always clever and cutting. But, whether he was grave or merry, whether he reasoned or sneered, his style was always pure, polished, and easy.

Atterbury.

Party-spirit then ran high; yet, though Bentley ranked among Whigs, and Christ Church was a stronghold of Toryism, Whigs joined with Tories in applauding Atterbury's volume. Garth insulted Bentley, and extolled Boyle in lines which are now never quoted except to be laughed at. Swift, in his Battle of the Books, introduced with much pleasantry Boyle, clad in armour, the gift of all the gods, and directed by Apollo in the form of a human friend, for whose name a blank is left which may easily be filled up. The youth, so accoutred and so assisted, gains an easy victory over his uncourteous and boastful antagonist. Bentley, meanwhile, was supported by the consciousness of an immeasurable superiority, and encouraged by the voices of the few who were really competent to judge the combat. "No man," he said, justly and nobly, "was ever written down but by himself." He spent two years in preparing a reply, which will never cease to be read and prized while the literature of ancient Greece is studied in any part of the world. This reply proved not only that the letters ascribed to Phalaris were spurious, but that Atterbury, with all his wit, his eloquence, his skill in controversial fence, was the most audacious pretender that ever wrote about what he did not understand. But to Atterbury this exposure was matter of

Atterbury. indifference. He was now engaged in a dispute about matters far more important and exciting than the laws of Zaleucus and the laws of Charondas. The rage of religious factions was extreme. High church and low church divided the nation. The great majority of the clergy were on the high church side; the majority of King William's bishops were inclined to latitudinarianism. A dispute arose between the two parties touching the extent of the powers of the Lower House of Convocation. Atterbury thrust himself eagerly into the front rank of the high-churchmen. Those who take a comprehensive and impartial view of his whole career, will not be disposed to give him credit for religious zeal. But it was his nature to be vehement and pugnacious in the cause of every fraternity of which he was a member. He had defended the genuineness of a spurious book simply because Christ Church had put forth an edition of that book; he now stood up for the clergy against the civil power simply because he was a clergyman, and for the priests against the episcopal order, simply because he was as yet only a priest. He asserted the pretensions of the class to which he belonged in several treatises written with much wit, ingenuity, audacity, and acrimony. In this, as in his first controversy, he was opposed to antagonists whose knowledge of the subject in dispute was far superior to his; but in this, as in his first controversy, he imposed on the multitude by bold assertion, by sarcasm, by declamation, and, above all, by his peculiar knack of exhibiting a little erudition in such a manner as to make it look like a great deal. Having passed himself off on the world as a greater master of classical learning than Bentley, he now passed himself off as a greater master of ecclesiastical learning than Wake or Gibson. By the great body of the clergy he was regarded as the ablest and most intrepid tribune that had ever defended their rights against the oligarchy of prelates. The Lower House of Convocation voted him thanks for his services; the University of Oxford created him a doctor of divinity; and soon after the accession of Anne, while the Tories still had the chief weight in the government, he was promoted to the deanery of Carlisle.

Soon after he had obtained this preferment, the Whig party rose to ascendancy in the state. From that party he could expect no favour. Six years elapsed before a change of fortune took place. At length, in the year 1710, the prosecution of Sacheverell produced a formidable explosion of high-church fanaticism. At such a moment Atterbury could not fail to be conspicuous. His inordinate zeal for the body to which he belonged, his turbulent and aspiring temper, his rare talents for agitation and for controversy were again signally displayed. He bore a chief part in framing that artful and eloquent speech which the accused divine pronounced at the bar of the Lords, and which presents a singular contrast to the absurd and scurrilous sermon which had very unwisely been honoured with impeachment. During the troubled and anxious months which followed the trial, Atterbury was among the most active of those pamphleteers who inflamed the nation against the Whig ministry and the Whig parliament. When the ministry had been changed and the parliament dissolved, rewards were showered upon him. The Lower House of Convocation elected him prolocutor. The Queen appointed him Dean of Christ Church on the death of his old friend and patron Aldrich. The college would have preferred a gentler ruler. Nevertheless, the new head was received with every mark of honour. A congratulatory oration in Latin was addressed to him in the magnificent vestibule of the hall; and he in reply professed the warmest attachment to the venerable house in which he had been educated, and paid many gracious compliments to those over whom he was to preside. But it was not in his nature to be a mild or an equitable governor. He had left the chapter of Carlisle distracted by quarrels. He found Christ Church at peace; but in three months his despotic and contentious temper did at Christ Church what it had done at Carlisle. He was succeeded in both his deaneries by the humane and accomplished Smalridge, who gently complained of the state in which both had been left. "Atterbury goes before, and sets everything on fire. I come after him with a bucket of water." It was said by Atterbury's enemies that he was made a bishop because he was so bad a dean. Under his administration Christ Church was in confusion, scandalous altercations took place, opprobrious words were exchanged; and there was reason to fear that the great Tory college would be ruined by the tyranny of the great Tory doctor. He was soon removed to the bishopric of Rochester, which was then always united with the deanery of Westminster. Still higher dignities seemed to be before him. For, though there were many able men on the episcopal bench, there was none who equalled or approached him in parliamentary talents. Had his party continued in power, it is not improbable that he would have been raised to the archbishopric of Canterbury. The more splendid his prospects, the more reason he had to dread the accession of a family which was well known to be partial to the Whigs. There is every reason to believe that he was one of those politicians who hoped that they might be able, during the life of Anne, to prepare matters in such a way that at her decease there might be little difficulty in setting aside the Act of Settlement and placing the Pretender on the throne. Her sudden death confounded the projects of these conspirators. Atterbury, who wanted no kind of courage, implored his confederates to proclaim James III., and offered to accompany the heralds in lawn sleeves. But he found even the bravest soldiers of his party irresolute, and exclaimed, not, it is said, without interjections which ill became the mouth of a father of the church, that the best of all causes and the most precious of all moments had been pusillanimously thrown away. He acquiesced in what he could not prevent, took the oaths to the House of Hanover, and at the coronation officiated with the outward show of zeal, and did his best to ingratiate himself with the royal family. But his servility was requited with cold contempt. No creature is so revengeful as a proud man who has humbled himself in vain. Atterbury became the most factious and pertinacious of all the opponents of the government. In the House of Lords his oratory, lucid, pointed, lively, and set off with every grace of pronunciation and of gesture, extorted the attention and admiration even of a hostile majority. Some of the most remarkable protests which appear in the journals of the peers were drawn up by him; and, in some of the bitterest of those pamphlets which called on the English to stand up for their country against the aliens who had come from beyond the seas to oppress and plunder her, critics easily detected his style. When the rebellion of 1715 broke out, he refused to sign the paper in which the bishops of the province of Canterbury declared their attachment to the Protestant succession. He busied himself in electioneering, especially at Westminster, where as dean he possessed great influence; and was, indeed, strongly suspected of having once set on a riotous mob to prevent his Whig fellow-citizens from polling.

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After having been long in indirect communication with the exiled family, he, in 1717, began to correspond directly with the Pretender. The first letter of the correspondence is extant. In that letter Atterbury boasts of having, during many years past, neglected no opportunity of serving the Jacobite cause. "My daily prayer," he says, "is that you may have success. May I live to see that day, and live no longer than I do what is in my power to forward it." It is to be remembered that he who wrote thus was a man bound to set to the church of which he was overseer an example of strict probity; that he had repeatedly sworn allegiance to the House of Brunswick; that he had assisted in placing

Atterbury. the crown on the head of George I., and that he had abjured James III., "without equivocation or mental reservation, on the true faith of a Christian."

It is agreeable to turn from his public to his private life. His turbulent spirit, wearied with faction and treason, now and then required repose, and found it in domestic endearments, and in the society of the most illustrious of the living and of the dead. Of his wife little is known: but between him and his daughter there was an affection singularly close and tender. The gentleness of his manners when he was in the company of a few friends was such as seemed hardly credible to those who knew him only by his writings and speeches. The charm of his "softer hour" has been commemorated by one of those friends in imperishable verse. Though Atterbury's classical attainments were not great, his taste in English literature was excellent; and his admiration of genius was so strong that it overpowered even his political and religious antipathies. His fondness for Milton, the mortal enemy of the Stuarts and of the church, was such as to many Tories seemed a crime. On the sad night on which Addison was laid in the chapel of Henry VII., the Westminster boys remarked that Atterbury read the funeral service with a peculiar tenderness and solemnity. The favourite companions, however, of the great Tory prelate were, as might have been expected, men whose politics had at least a tinge of Toryism. He lived on friendly terms with Swift, Arbuthnot, and Gay. With Prior he had a close intimacy, which some misunderstanding about public affairs at last dissolved. Pope found in Atterbury not only a warm admirer, but a most faithful, fearless, and judicious adviser. The poet was a frequent guest at the episcopal palace among the elms of Bromley, and entertained not the slightest suspicion that his host, now declining in years, confined to an easy chair by gout, and apparently devoted to literature, was deeply concerned in criminal and perilous designs against the government.

The spirit of the Jacobites had been cowed by the events of 1715. It revived in 1721. The failure of the South Sea project, the panic in the money market, the downfall of great commercial houses, the distress from which no part of the kingdom was exempt, had produced general discontent. It seemed not improbable that at such a moment an insurrection might be successful. An insurrection was planned. The streets of London were to be barricaded; the Tower and the Bank were to be surprised; King George, his family, and his chief captains and councillors were to be arrested, and King James was to be proclaimed. The design became known to the Duke of Orleans, regent of France, who was on terms of friendship with the House of Hanover. He put the English government on its guard. Some of the chief malcontents were committed to prison; and among them was Atterbury. No bishop of the Church of England had been taken into custody since that memorable day when the applauses and prayers of all London had followed the seven bishops to the gate of the Tower. The Opposition entertained some hope that it might be possible to excite among the people an enthusiasm resembling that of their fathers, who rushed into the waters of the Thames to implore the blessing of Sancroft. Pictures of the heroic confessor in his cell were exhibited at the shop windows. Verses in his praise were sung about the streets. The restraints by which he was prevented from communicating with his accomplices were represented as cruelties worthy of the dungeons of the Inquisition. Strong appeals were made to the priesthood. Would they tamely permit so gross an insult to be offered to their cloth? Would they suffer the ablest, the most eloquent member of their profession, the man who had so often stood up for their rights against the civil power, to be treated like the vilest of mankind? There was considerable excitement; but it was allayed by a temperate and artful letter to the clergy, the work, in all probability, of Bishop Gibson, who stood high in the favour of Walpole, and shortly after Atterbury became minister for ecclesiastical affairs.

Atterbury remained in close confinement during some months. He had carried on his correspondence with the exiled family so cautiously that the circumstantial proofs of his guilt, though sufficient to produce entire moral conviction, were not sufficient to justify legal conviction. He could be reached only by a bill of pains and penalties. Such a bill the Whig party, then decidedly predominant in both houses, was quite prepared to support. Many hotheaded members of that party were eager to follow the precedent which had been set in the case of Sir John Fenwick, and to pass an act for cutting off the bishop's head. Cadogan, who commanded the army, a brave soldier, but a headstrong politician, is said to have exclaimed with great vehemence: "Fling him to the lions in the Tower." But the wiser and more humane Walpole was always unwilling to shed blood; and his influence prevailed. When parliament met, the evidence against the bishop was laid before committees of both houses. Those committees reported that his guilt was proved. In the Commons a resolution, pronouncing him a traitor, was carried by nearly two to one. A bill was then introduced which provided that he should be deprived of his spiritual dignities, that he should be banished for life, and that no British subject should hold any intercourse with him except by the royal permission.

This bill passed the Commons with little difficulty. For the bishop, though invited to defend himself, chose to reserve his defence for the assembly of which he was a member. In the Lords the contest was sharp. The young Duke of Wharton, distinguished by his parts, his dissoluteness, and his versatility, spoke for Atterbury with great effect; and Atterbury's own voice was heard for the last time by that unfriendly audience which had so often listened to him with mingled aversion and delight. He produced few witnesses, nor did those witnesses say much that could be of service to him. Among them was Pope. He was called to prove that, while he was an inmate of the palace at Bromley, the bishop's time was completely occupied by literary and domestic matters, and that no leisure was left for plotting. But Pope, who was quite unaccustomed to speak in public, lost his head, and, as he afterwards owned, though he had only ten words to say, made two or three blunders.

The bill finally passed the Lords by eighty-three votes to forty-three. The bishops, with a single exception, were in the majority. Their conduct drew on them a sharp taunt from Lord Bathurst, a warm friend of Atterbury and a zealous Tory. "The wild Indians," he said, "give no quarter, because they believe that they shall inherit the skill and prowess of every adversary whom they destroy. Perhaps the animosity of the right reverend prelates to their brother may be explained in the same way."

Atterbury took leave of those whom he loved with a dignity and tenderness worthy of a better man. Three fine lines of his favourite poet were often in his mouth:—

> "Some natural tears he dropped, but wiped them soon:
> The world was all before him, where to chuse
> His place of rest, and providence his guide."

At parting he presented Pope with a Bible, and said with a disingenuousness of which no man who had studied the Bible to much purpose would have been guilty: "If ever you learn that I have any dealings with the Pretender, I give you leave to say that my punishment is just." Pope at this time really believed the bishop to be an injured man. Arbuthnot seems to have been of the same opinion. Swift, a few months later, ridiculed with great bitterness, in the Voyage to Lapute, the evidence which had satisfied the two houses of parliament. Soon, however, the most partial friends of the banished prelate ceased to assert his innocence, and contented themselves with lamenting and excusing what they could not defend. After a short stay at Brussels, he had

Atterbury ‖ Attica.

taken up his abode at Paris, and had become the leading man among the Jacobite refugees who were assembled there. He was invited to Rome by the Pretender, who then held his mock court under the immediate protection of the Pope. But Atterbury felt that a bishop of the Church of England would be strangely out of place at the Vatican, and declined the invitation. During some months, however, he might flatter himself that he stood high in the good graces of James. The correspondence between the master and the servant was constant, Atterbury's merits were warmly acknowledged, his advice was respectfully received, and he was, as Bolingbroke had been before him, the prime minister of a king without a kingdom. But the new favourite found, as Bolingbroke had found before him, that it was quite as hard to keep the shadow of power under a vagrant and mendicant prince as to keep the reality of power at Westminster. Though James had neither territories nor revenues, neither army nor navy, there was more faction and more intrigue among his courtiers than among those of his successful rival. Atterbury soon perceived that his counsels were disregarded, if not distrusted. His proud spirit was deeply wounded. He quitted Paris, fixed his residence at Montpelier, gave up politics, and devoted himself entirely to letters. In the sixth year of his exile he had so severe an illness that his daughter, herself in very delicate health, determined to run all risks that she might see him once more. Having obtained a license from the English Government, she went by sea to Bordeaux, but landed there in such a state that she could travel only by boat or in a litter. Her father, in spite of his infirmities, set out from Montpelier to meet her; and she, with the impatience which is often the sign of approaching death, hastened towards him. Those who were about her in vain implored her to travel slowly. She said that every hour was precious, that she only wished to see her papa and to die. She met him at Toulouse, embraced him, received from his hand the sacred bread and wine, and thanked God that they had passed one day in each other's society before they parted for ever. She died that night.

It was some time before even the strong mind of Atterbury recovered from this cruel blow. As soon as he was himself again he became eager for action and conflict: for grief, which disposes gentle natures to retirement, to inaction, and to meditation, only makes restless spirits more restless. The Pretender, dull and bigoted as he was, had found out that he had not acted wisely in parting with one who, though a heretic, was, in abilities and accomplishments, the foremost man of the Jacobite party. The bishop was courted back, and was without much difficulty induced to return to Paris and to become once more the phantom minister of a phantom monarchy. But his long and troubled life was drawing to a close. To the last, however, his intellect retained all its keenness and vigour. He learned, in the ninth year of his banishment, that he had been accused by Oldmixon, as dishonest and malignant a scribbler as any that has been saved from oblivion by the Dunciad, of having, in concert with other Christ Churchmen, garbled Clarendon's History of the Rebellion. The charge, as respected Atterbury, had not the slightest foundation: for he was not one of the editors of the History, and never saw it till it was printed. He published a short vindication of himself, which is a model in its kind, luminous, temperate, and dignified. A copy of this little work he sent to the Pretender, with a letter singularly eloquent and graceful. It was impossible, the old man said, that he should write anything on such a subject without being reminded of the resemblance between his own fate and that of Clarendon. They were the only two English subjects that had ever been banished from their country and debarred from all communication with their friends by act of parliament. But here the resemblance ended. One of the exiles had been so happy to bear a chief part in the restoration of the Royal house. All that the other could now do was to die asserting the rights of that house to the last. A few weeks after this letter was written Atterbury died. He had just completed his seventieth year.

Atterbury ‖ Attica.

His body was brought to England, and laid, with great privacy, under the nave of Westminster Abbey. Only three mourners followed the coffin. No inscription marks the grave. That the epitaph with which Pope honoured the memory of his friend does not appear on the walls of the great national cemetery is no subject of regret: for nothing worse was ever written by Colley Cibber.

Those who wish for more complete information about Atterbury may easily collect it from his sermons and his controversial writings, from the report of the parliamentary proceedings against him, which will be found in the State Trials; from the five volumes of his correspondence, edited by Mr Nichols, and from the first volume of the Stuart papers, edited by Mr Glover. A very indulgent but a very interesting account of the Bishop's political career will be found in Lord Mahon's valuable History of England. (T. B. M.)

A T T I C A,

Boundaries and extent.

An ancient kingdom of Greece, situated between the Strait of Euripus or Negropont on the north-east, and the Gulf of Saron or Ægina on the south-west. It may be considered as forming a triangle, the base of which constituted the conterminous boundery with Bœotia, while the two other sides, washed by the sea, had their vertex at the promontory of Sunium or Cape Colonna. The prolongation of the south-western side northward till it reached the extremity of the base at the foot of Mount Cithæron served as the line of demarcation between the Athenian territory and that belonging to the small state of Megara. Hence Attica may be described generally as bounded on the north-east by the channel of Negropont; on the south-west by the Gulf of Ægina and part of Megara; and on the north-west by the territory which formed the ancient Bœotia; including, within these limits an area or superficies of about 750 square miles.

Soil and climate.

The soil of Attica was not so unsuited to the purposes of agriculture as has commonly been supposed. It was, indeed, stony and uneven in many places; a considerable part consisted of bare rock, on which little or nothing could be grown; but even the less fertile portion produced barley and wheat—the latter, it is true, with difficulty; and the mildness of the climate allowed all the more valuable products of the earth to ripen the earliest and go out of season the latest. Every kind of plant and animal throve notwithstanding the poverty of the soil; and the advantages which nature had denied were, in a great measure, compensated by the effects of skill and industry. It seldom happens that the richest countries are the most productive, or that the bounty of nature, where it has been profusely lavished, is improved by corresponding exertions on the part of man. Repugnant to labour where labour can be dispensed with, it is necessity alone that compels him to earn his bread with the sweat of his brow, and to torture the ungrateful soil for its scanty products. But habits of exertion being once formed, a variety of causes gradually contribute to stimulate his activity and extend his resources. He naturally aspires to improve his condition and circumstances by all the means in his power. Experience soon teaches him better modes of exerting his industry;—as society advances, the natural reward of labour and skill is increased;—and if

Attica. the public policy of the state be wisely directed to accelerate the operation of natural causes, the most striking results may be produced, and countries originally barren covered with well-cultivated fields, teeming with abundant harvests. Such seems to have been the progression of improvement in Attica; which, though one of the least fertile of the Grecian provinces, was, by the industry and skill of its inhabitants, rendered ultimately one of the most productive in proportion to its extent, and the portion of its surface which was susceptible of cultivation.

Chief cities. The chief cities in the ancient kingdom of Attica were Athens, the capital, of which a full description has been given under that head (see article ATHENS); Eleusis, situated on the gulf of the same name, at an equal distance from Megara and the Peiræus, where the greater mysteries of Demeter were quadrennially celebrated; and, lastly, Rhamnus, famous for the temple of Amphiaraus, and a statue of the goddess Nemesis, executed by Phidias.

The history of Attica, like that of nearly every state of Greece, is almost entirely mythical down to the beginning of the Olympiads—that is, down to the year B.C. 676. All that is related concerning the period previous to that era, consists partly of fictions and partly of traditions, which no doubt have a certain historical foundation, but have been so much modified and embellished by poets and late writers that it is now impossible to say what is historical and what is not. As regards chronology in particular, it is useless to attempt to fix the exact date of any event before the commencement of the Olympiads. As, however, the legends of early Attic history are frequently alluded to by poets and other authors, they cannot be altogether passed over in any account of the history of Attica.

Ogyges. Ogyges had the reputation of being the first king of Attica; and ancient chronologers even undertook to fix the date of his reign, which has been variously set down at 150 and 200 years before the arrival of Cecrops. But we have no assurance that even the name of Ogyges was known to the older Grecian authors; and if anything can be gathered from the traditions concerning this fabulous personage, reported by later writers, it is, that at some very remote period, a flood, having desolated the rich fields of Bœotia, over which he reigned, drove many of the inhabitants to establish themselves in the adjoining district of Attica, which, though hilly, rocky, and little fruitful, was yet judged preferable to a plain country, surrounded on all sides by mountainous tracts, and consequently exposed to a recurrence of the calamity by which so many of them had been overwhelmed. We may therefore safely consign this legendary monarch to that primitive obscurity in which his existence, his origin, and his achievements, are equally involved.

There was a time when it was generally believed that Attica, and Greece in general, had received the first elements of civilization from Egypt. This belief was founded upon the tradition, that about 150 years after the time of Ogyges, Cecrops came from Egypt to Attica, and not only gave his name to the land, but founded the city of Athens, on the rock which, down to the latest times, was often called the Cecropian rock, or the Cecropian city. He is said to have introduced among the savage natives of Attica a new and simple religion, and the institution of marriage, so that, in fact, the elements of civilized life were traced to this Egyptian immigrant. But his Egyptian origin, to say the least, is extremely doubtful; for the early Greek poets and historians appear to have known nothing about him; and when at a later period Cecrops began to be spoken of, he is frequently described as a native of the Attic soil (*αὐτόχθων*). After the time of Cecrops, two other Egyptian settlers, Erechtheus and Peteus, are said to have arrived in Attica. But the fact is that all these personages are utterly fictitious, and that the traditions about them belong entirely to a home-sprung Attic fable. But although we must reject these stories about Cecrops and Erechtheus as fabulous, we are not on that account obliged to reject the tradition of an Egyptian settlement in Attica. Even if we admit that at some time or another a band of Egyptians settled among the ancient inhabitants of Greece, it is not easy to conceive how they could have affected the national character of those among whom they established themselves. The Greek language, at least, bears no trace of any such influence; and the question how far the religion and the arts were derived from Egypt, is one which cannot be satisfactorily answered until the religion of both the Greeks and Egyptians shall be much better known and understood than they are at present. The resemblance between the early works of art among the Greeks and those of Egypt can prove nothing, for the rude beginnings of the arts are more or less the same among all nations.

The list of the successors of Cecrops down to Theseus is a mere compilation, in which some of the names appear to have been invented merely to fill up a gap; others are purely mythical, and not one can safely be pronounced historical.[1] In the reign of Erechtheus, the Athenians are said to have been involved in a war with the Thracian Eumolpus, who had established himself as sovereign at Eleusis. Erechtheus fell in battle, whereupon Eleusis concluded a treaty, in which it acknowledged the supremacy of Athens. Erechtheus was succeeded by a second Cecrops, who left his throne to his son Pandion. This last king was expelled from Attica, but found a place of refuge in Megara, where he married the king's daughter, and succeeded him on the throne. He there became the father of four sons, the eldest of whom, Ægeus, on his father's death, entered Attica at the head of an army, and recovered his patrimony. For a long time he remained childless, until some mysterious oracle led him to Troezen, where he became, by Æthra, the father of Theseus, the greatest hero in Athenian story. Theseus spent the first years of his life at Troezen, and then repaired to Athens to claim Ægeus for his father, who recognized him by certain tokens, and by his valour. This Theseus, whom some writers regard as the real founder of the Athenian state, is to Athens what Hercules is to Greece in general. All the deeds and exploits which are ascribed to him cannot have been accomplished by one man, but are probably representations of what was done in the course of several generations, or even centuries. But the life of Theseus may be regarded as composed of three main acts—his journey from Troezen to Athens, his victory over the Minotaur, and the political reforms which he is said to have effected in Attica. On his way to Athens from Troezen, he cleared the wild roads which were infested by monsters and savage men, who by their robberies had almost broken off all communication between Attica and Troezen. Amid the greatest difficulties he forced his way to his father. After being recognized by him, and purified from all his bloodshed, he went to Crete to deliver Athens from a disgraceful tribute of boys and maidens, who had to be sent annually to Minos, king of Crete, and were devoured by a monster called Minotaur. On his return to Athens, his father Ægeus died. Passing over a variety of other legends, we shall proceed to consider the political institutions ascribed to Theseus. Attica is said originally to have been divided into a number of small independent states, which, under Cecrops, formed a confederacy among themselves against the inroads of foreign enemies. On that occasion, Attica is reported to have been divided into twelve districts, and Athens, under the name of Cecropia, was probably at the head of this league. Besides this division into twelve districts, another is mentioned,

[1] Thirlwall, *Hist. of Greece*, vol. i. p. 148.

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according to which the whole country was divided into four tribes, which at different times had different names. The latest of these are ascribed to Ion, the reported founder of the Ionian race, who is said to have called the four tribes after his four sons, *Teleontes* (*Geleontes*, *Gedeontes*), *Hopletes*, *Ægicores*, and *Argades*. Some of these names are descriptive of occupations, while others are of uncertain import. These four tribes seem to have been so many distinct communities, separated by descent, situation, pursuits, and religion, yet still connected by affinities of blood and language, and the occasional need of mutual assistance. Their ultimate union with Athens, as their natural head and centre, is generally described as the work of Theseus, who is thus regarded as the founder of the national unity, and of the future greatness of Athens. The legend represents him as having thus for ever put an end to the discord and hostility which had until then prevented the inhabitants of Attica from considering themselves as one people. On that occasion the greater part of the nobles probably removed to Athens, which had become the seat of government, and they there occupied the same position and rank which they had formerly held in their respective districts. The union was cemented by religion, and by the institution of national solemnities which were periodically celebrated, such as the *Synœcia* and the *Panathenœa*, in honour of the tutelary divinity Athena. The city of Athens, which until then had occupied little more than the Cecropian rock, was enlarged by the formation of new habitations at the foot and around the rock.

The constitution which Theseus is said to have given to his country remained for many centuries after him rigidly aristocratical; and he is said to have promised all the nobles an equal share in the government, reserving for himself only the command in war and the administration of justice. Although the later Greeks were fond of describing Theseus as the founder of their democratic institutions, it is quite clear that his object was to institute a gradation of ranks, and a proportionate distribution of power. Accordingly, he distributed the people into three classes, the *nobles* (Εὐπατρίδαι), *husbandmen* (γεωμόροι), and *artisans* (δημιουργοί); the first of which possessed all the political power and influence, and the right of interpreting the laws, both human and divine. The king himself was only the first among his equals, and the four kings of the ancient tribes were his perpetual assessors or colleagues. The people of Athens, that is the δῆμος, had, no doubt, the right of meeting, but they do not appear to have exercised any political influence; and the first internal struggles of which we hear at Athens were not between the king and the people, but between the king and the nobles. Theseus himself is said to have been compelled by a conspiracy of the nobles to go into exile with his family, and to leave the throne to Menestheus, a descendant of the ancient kings. Theseus is said to have died in the island of Scyros.

Menestheus, Demophon, &c.

Menestheus reigned twenty-four years. He lost his life at the siege of Troy, and was succeeded by Demophon, one of the sons of Theseus by Phædra, who was likewise present at the siege, but had the good fortune to return in safety. Demophon was succeeded by his son or brother Oxyntes, who again was succeeded by his son Aphydes; and this last was murdered by a natural brother of the name of Thymœtes. But the bastard usurper discovered many base qualities unworthy of the station he had assumed, and was at last deposed by his subjects on account of the flagrant cowardice he had displayed on a critical occasion.

Melanthus, Codrus.

Thymœtes was appropriately succeeded by a foreign adventurer called Melanthus, who, after a long reign of thirty-seven years, left the kingdom to his son Codrus. The latter reigned twenty-one years, during which period the Dorians and Heracleidæ had regained all Peloponnesus, and were upon the point of invading Attica. Codrus, being informed that the oracle had promised them victory provided they did not kill the king of the Athenians, immediately came to the resolution to die for his country. Disguising himself, therefore, as a peasant, he went into the enemy's camp, and having quarrelled with some of the common soldiers, was killed in a brawl. On the morrow the Athenians, knowing what had happened, sent to demand the body of their king, at which the invaders were so terrified that they decamped without striking a blow.

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Upon the death of Codrus, a dispute among his sons concerning the succession furnished the nobles with a pretence for ridding themselves of their kings, and changing the monarchical into a republican form of government. It was highly improbable, they said, that they should ever again have so good a king as Codrus; and, to prevent their having a worse, they resolved to have none. That they might not, however, appear ungrateful to the family of Codrus, they made his son Medon their supreme magistrate, with the title of archon; an office which was afterwards rendered decennial, but nevertheless continued in the family of Codrus. But the extinction of the Medontidæ having at last left the nobles without restraint, they not only made this office annual, but at the same time created nine archons. By the latter expedient they provided against the exorbitant power of a single person, as by the former they took away all apprehension of the archons having time to establish themselves, so as to be able to change the constitution. In a word, they now attained what they had long sought after, namely, rendering the supreme magistracy accessible to all the nobles. The name of the first of these nine annual archons (ἄρχων ἐπώνυμος) was, like that of the consuls at Rome, used to mark the year in which any event happened. The second bore the title of king (ἄρχων βασιλεύς), and represented the former kings in their capacity of high priest of the nation.[1]

Aristocracy.

Archons; Draco

There has been handed down to us an enumeration of these archons for upwards of six centuries, beginning with Creon, who lived in 682 B.C., and coming down to Herodes, who lived only sixty years prior to the Christian era. The first archon of whom we hear anything really worthy of notice was Draco. He governed Athens in the year 624 B.C., when he promulgated his written laws; but although his name is very frequently mentioned in history, no connected account can be found either of the lawgiver or of his institutions. We only know generally that his laws were excessively severe, awarding the punishment of death for the smallest offences no less than for the most heinous crimes; and that, as Demades remarked of them, they seemed to have been written with blood. For this extraordinary and undiscriminating severity he gave no other reason, than that the smallest faults appeared to him to be worthy of death, and that he could find no higher punishment for the greatest. He was far advanced in years when he legislated for Athens; and he appears to have endeavoured to act as a mediator between the people and the oppressive nobles. His laws were called sanctions (θεσμοί). The Athenians, however, soon grew weary both of the sanctions and their author; upon which Draco was obliged to retire to Ægina, where he was received in the most flattering manner. But the favour of the inhabitants of this place proved more fatal to him than the hatred of the Athenians; for coming one day into the theatre, the audience, to evince their regard for the exiled legislator, are said to have thrown their cloaks upon him, and fairly stifled the old man to death with their kindness.

[1] It is remarkable, that Athenian and Roman superstition should have agreed so exactly in the extraordinary circumstance that, after the abolition of royalty among both, and while the very name of king was abhorred as a title of civil magistracy or military command, yet equally the title and the office were scrupulously retained for the administration of religious ceremonies.

Mitylenian war.

Not long after the expulsion of Draco, we find the republic engaged in a war with the Mitylenians about the city Sigeum, situated near the mouth of the river Scamander. The Athenian army was commanded by Phrynon, and that of the Mitylenians by Pittacus, one of the seven sages of Greece; but the generals, thinking the honour of their respective countries concerned, and being at the same time desirous to spare the effusion of blood, agreed to settle the dispute by single combat. They met accordingly; but the sage, trusting more to cunning than to courage, concealed behind his shield a net, wherewith he suddenly entangled his antagonist, and easily slew him. This, however, not putting an end to the war, Periander of Corinth interposed; and both parties having submitted to his arbitration, he decreed that Sigeum should belong to the Athenians.

Cylon's conspiracy.

About seven years after the Mitylenian war, 612 B.C., a conspiracy was entered into by Cylon, son-in-law of Theagenes, prince of Megara, for the purpose of seizing on the sovereignty of Athens. The people would have readily submitted to his rule to escape from the oppression of the many nobles. But having consulted the Delphic oracle as to the most proper time, and received directions to make the attempt while the citizens of Athens were engaged in celebrating the great festival of Zeus, Cylon and his associates made themselves masters of the citadel by a *coup-de-main*, at the time when the greater part of the citizens had repaired to Elis to witness the celebration of the Olympic games. But being instantly besieged by Megacles, who was at that time archon, and soon reduced to great distress from want of water, the chief conspirator and his brother contrived to effect their escape; upon which the remainder fled for safety to the temple of Athena, where they were barbarously massacred by order of Megacles, in virtue of one of those sophistical quibbles by means of which men sometimes reconcile their minds to the perpetration of the foulest and bloodiest deeds.

War with Megara.

At this period of confusion the Megarians attacked and took both Nisæa and Salamis. The former was a place of little or no importance to any, the latter one of the very greatest in every view; but so completely were the Athenians routed in every attempt to retake it, that a law was at last passed, declaring it capital for any one to propose the recovery of Salamis. About the same time the city was disturbed by reports of frightful appearances, and filled with superstitious fears, for it was believed that the crime of Megacles was the cause of all disasters. The oracle at Delphi was therefore consulted, and an answer returned that the city must be purified by certain expiatory rites. This was accordingly done under the superintendence of one Epimenides, a Cretan, who prescribed the sacrifice of white and black sheep, and also caused many temples and chapels to be erected, including one dedicated to Contumely, and another to Impudence! This man, after looking wistfully for a long time to the port of Munychia, spoke as follows to those that were near him: "How blind is man to the future! For, did the Athenians know what mischief will one day be derived to them from this place, they would eat it with their teeth." This prediction was thought to have been accomplished 270 years after, when Antipater constrained the Athenians to admit a Macedonian garrison into that place.

Solon.

About 604 years B.C., Solon, the famed Athenian legislator, began to show himself to his countrymen. He is said to have been lineally descended from Codrus, but left by his father in circumstances rather necessitous, which obliged him to apply himself to merchandise. From the first he appeared in the character of a patriot. The shameful decree, that none under pain of death should propose the recovery of Salamis, grieved him so much, that having composed an elegy such as he thought calculated to inflame the minds of the people, he ran into the market-place as if he had been insane, repeating his verses. A crowd soon collected around the pretended madman; his kinsman Peisistratus mingled with the people, and observing them moved with Solon's words, agreed to second the patriotic poet with all the eloquence he was master of; and at length they prevailed so far as to have the law rescinded, war declared against the people of Megara, and an expedition immediately fitted out for the recovery of Salamis; which was ultimately effected by a stratagem more creditable to the ingenuity than the bravery of the Athenians.

The success of this enterprise at once established the reputation of Solon; who, on his return to Athens, was greatly honoured by the people, and soon afforded them another occasion of admiring that wisdom for which they had already given him credit. The inhabitants of Cirrha, a town situated in the Bay of Corinth, having repeatedly committed acts of extortion and violence against pilgrims proceeding to Delphi, at last besieged the capital itself, with a view of making themselves masters of the treasures contained in the temple of Apollo. Advice of this intended sacrilege having been sent to the Amphictyons, Solon advised that the matter should be universally resented, and that all the states should join in punishing the Cirrhæans, and in saving the Delphic oracle. This suggestion was adopted, and a general war against Cirrha declared, B.C. 594. Cleisthenes, prince of Sicyon, commanded in chief, and the Athenian contingent was under the orders of Alcmæon. Solon accompanied the expedition as assistant or counsellor to Cleisthenes, and under his direction the war was conducted to a prosperous issue. According to Pausanias, the city was reduced by a singular stratagem, said to have been invented by Solon. He caused the river Pleistus, which flowed through Cirrha, to be turned into another channel, hoping thereby to distress the inhabitants for want of water; but finding they had many wells within the city, and were not to be reduced by that means, he caused a vast quantity of roots of hellebore to be thrown into the river, which was then suffered to return into its former bed. The inhabitants, overjoyed at the sight of running water, came in troops to drink of it; the consequence of which was, that an epidemic flux ensued, and the citizens being no longer able to defend the walls, the town was easily captured. This, as far as we know, is the only instance on record of a town taken by physic.

Athens in great confusion.

On his return to Athens after the hellebore achievement, Solon found things again in the utmost confusion. The remnant of Cylon's faction gave out that all sorts of misfortunes had befallen the republic on account of the impiety of Megacles and his followers; and this clamour was heightened by the retaking of Salamis about the same time by the Megarians. Solon interposed, and persuading those who were styled "execrable" to abide a trial, three hundred persons were chosen to judge them. The issue was, that the whole of Megacles' party who were alive were sent into perpetual exile, and the bones of such as had died were dug up and sent beyond the limits of their country. But although this decision restored tranquillity for the time, the people were still divided into three factions, contending about the proper form of government. These were called the Diacrii, Pediæi, and Parali; the first of whom, consisting of the inhabitants of the hilly country, declared for democracy; the second, dwelling in the low country, and far more opulent than the former, were in favour of an oligarchy, wishing to keep the government in their own hands; whilst the third party, who inhabited the sea-coast, were people of moderate principles, and therefore friendly to a mixed government. But besides these agitations, disturbances of a much more serious character arose, in consequence of the lamentable condition to which the people or Demos had been reduced, in consequence of the severity of the law of debt. According to Plutarch, the poor having become indebted to the rich, either tilled their grounds and paid them the sixth part of the produce, or impignorated their persons for their

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debts, so that many were made slaves at home, and not a few sold as such into foreign countries; while some were even obliged to sell their children to pay their debts, and others in despair quitted Attica altogether. The greater part, however, were for throwing off the yoke, and began to look about for a leader, openly declaring that they intended to change the form of government, to introduce a more equitable distribution of power, and to modify the law of debt.

Solon chosen archon.

In this extremity the eyes of all were turned to Solon, and some were for offering him the sovereignty at once; but, perceiving the intentions of these misjudging persons, he refused the sovereignty tendered to him, and preferring the substance to the shadow, quietly took upon himself, without any pomp or pageantry, the unqualified exercise of the supreme authority of the state, in all its branches, and wielded it with an absolutism which would have been intolerable, had it not been conferred upon him by the unanimous consent of the people. He was chosen archon (594, B.C.) without having recourse to the ballot, an anomaly of which there is no other example; and, after his election, he proved the wisdom of the choice by disappointing the interested expectations of all parties. It was a fundamental maxim with Solon, that those laws will be best observed which power and justice equally support. Hence, wherever he found the old constitution in any measure consonant to justice, he refused to make any alteration at all, and was at extraordinary pains to show the reason of such changes as were actually introduced. In a word, being a consummate judge of mankind generally, and, above all, thoroughly conversant with the character of his countrymen, he sought to rule only by showing the people that it was their interest to obey, and contented himself with giving them such institutions as they were prepared to receive, instead of forcing upon them those which might be esteemed theoretically the most perfect. Hence, to one who inquired whether he had given the Athenians the best laws in his power, he replied, "I have established the best which they could receive."

Seisachtheia.

With reference to the main cause of discontent, namely, the oppressed state of the meaner class, Solon removed it by a scheme which he called *seisachtheia*, or discharge. Ancient authors, however, are not agreed as to the precise nature of this contrivance. Some say that he cancelled all debts then in existence, and prohibited the seizure of any man's person in default of payment of a debt for the future; whilst others affirm that the poor were relieved, not by cancelling the debts, but by lowering the interest, and increasing the value of money, so that a mina, which before was equal to seventy-three drachmas only, was by him made equal to a hundred. The more probable opinion is, that the seisachtheia was a general disburdening ordinance, which relieved the debtor partly by a reduction of the rate of interest, and partly by lowering the standard of the coinage, whereby a debtor saved more than 25 per cent. in every payment. He also released the mortgaged lands from their encumbrances, and restored them to their owners. He then abolished the cruel law, by which a creditor might enslave his debtor, and restored to freedom those who were pining in bondage. These may seem measures of extreme violence; but it must be borne in mind that the whole people had conferred upon him unlimited power, on the understanding that they would acquiesce in his legislative regulations.

But in the midst of all the glory which Solon acquired by these measures, an accident occurred which for a time clouded his reputation, and almost entirely ruined his schemes. Having, it seems, consulted Conon, Clinias, and Hipponicus, three of his friends, on an oration he had prepared with a view to engage the people's consent to the seisachtheia, these worthies, thus apprized of the contemplated measure, availed themselves of their knowledge to borrow large sums of money before the law was promulgated, with the intention to take advantage of its provisions, and refuse to repay the lenders. We cannot wonder that Solon himself was at first believed to have been cognizant of the scheme, and a partner in this fraudulent adventure. But, happily for his credit, those suspicions were obliterated when it was discovered that the lawgiver was a creditor to a large extent, and likely to become a considerable loser by the operation of his own law. His friends, however, never recovered their credit, but were ever afterwards stigmatized with the opprobrious appellation of *chrciocopidæ* or *debt-sinkers*.

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Solon now set himself to the arduous task of compiling a body of laws for the people of Attica; and having at last completed his task in the best manner he could, or at least in the best manner that the character of the people would admit, he caused them to be duly ratified, and declared to be in force for a century from the date of their publication. Those which related to private actions were preserved on parallelograms of wood, with cases which reached from the ground, and turned upon a pin like a wheel, whence the appellation of *axones;* and were placed, first in the Acropolis, and afterwards in the Prytaneium, that all the subjects of the state might have access to consult them whenever they chose. Such as concerned public institutions and sacrifices were inscribed on triangular tablets of stone called *cyrbeis*. The Athenian magistrates were sworn to observe both. With regard to the axones, or *jus privatum* of Solon, our information is exceedingly imperfect; but if it be true that the decemviral constitutions at Rome were principally borrowed from this portion of his code, the fragments which remain of these celebrated laws are certainly calculated to give us no mean idea of his fitness for the task which circumstances as well as inclination had induced him to undertake. Nor will our opinion of the legislator be lowered by attending to his system of public law; concerning which more exact details have been preserved, and some account will be given when we come to speak of the Athenian government. We may, however, here remark in general, that Solon had abolished the ancient aristocratic government, in which all rights and privileges had been determined by birth, and that he substituted a timocracy, that is, a form of government in which a man's property forms the standard by which his rights and duties are determined.

Compilation of code.

After the promulgation of his code, Solon found himself obliged to leave Athens, to avoid being continually teased for explanations and emendations of his laws. He therefore pretended an inclination to merchandise, and obtained leave to withdraw himself for ten years, in the hope that during his absence his laws would grow familiar to the people. From Athens he accordingly travelled into Egypt, where he is said to have conversed with Psamenophis of Heliopolis and Sesonchis of Sais, the most learned priests of that age, from whom he learned the situation of the island Atlantis, and wrote an account of it in verse, which Plato afterwards continued. Leaving Egypt, he is reported to have visited Cyprus, where he was well received by one of the petty kings, and assisted in the foundation of a new city, the site of which he had pointed out, and which, out of gratitude to the Athenian legislator, was called Soli.

But while Solon was thus travelling in quest of wisdom, his countrymen were again divided into three factions. Lycurgus was at the head of what may be called the country party; Megacles the son of Alcmæon swayed those who lived on the sea-coast; and Peisistratus appeared as the champion of the *demos*, under the pretence of protecting them from tyranny, but in reality with the view of seizing on the sovereignty for himself. In the midst of all this confusion the legislator returned about 562 B.C. Each of the factions affected to receive him with the deepest reverence aud respect, beseeching him to resume his authority, and compose the disorders to which they themselves had given birth. But Solon declined this hollow invitation, on the ground that his age rendered him unable to speak and act

as formerly for the good of his country; he sent however for the chiefs of each party, and entreated them in the most pathetic manner not to ruin their common parent, but to prefer the public good to their own private interest; sound advice, doubtless, but entirely thrown away on those to whom it was administered.

Peisistratus.

Peisistratus, who of all the chiefs had unquestionably the least intention of following Solon's advice, appeared to be the most affected with his discourses; but perceiving that he affected popularity by all possible methods, Solon easily penetrated into his design of assuming the sovereign power. This he spoke of privately to Peisistratus himself; but as he saw that his admonitions had no effect, he unveiled the designs of this ambitious chief, that the public might be on their guard against him and his artful machinations. But all the wise discourses of Solon were lost upon the Athenians. Peisistratus had got the lower class entirely at his devotion, and therefore resolved to cheat them out of the liberty which they were incapable of appreciating. With this view he wounded himself, then drove into the market-place, and there showed his bleeding body, imploring the protection of the people against those whom his kindness to them had rendered his implacable enemies. It was for being their declared friend, he said, that he had thus suffered. They saw it was no longer safe for a man to be a friend to the people; they saw it was no longer safe for a man to live in Attica, unless they would take him under that protection which he implored. A crowd being instantly collected, Solon came amongst the rest, and, suspecting the deceit, openly taxed Peisistratus with his perfidious conduct; but to no purpose. A general assembly of the people was summoned, wherein it was moved that Peisistratus should have a guard. Solon alone had resolution enough to oppose this measure; the richer Athenians remaining silent through fear of the multitude, which implicitly followed Peisistratus, and applauded everything he said. A guard of 400 men was then unanimously decreed to Peisistratus; and with this inconsiderable body he managed, partly by stratagem and partly by force, to possess himself of the supreme power B.C. 560. Solon inveighed bitterly against the meanness of his countrymen, in thus tamely surrendering their liberties, and attempted to rouse them to take up arms in defence of the constitution and the laws; but finding his efforts unavailing, he withdrew, remarking that he had done his utmost for his country. He submitted to the tyranny of Peisistratus merely because he had no choice between a tyranny and anarchy.

Governs with great moderation.

Peisistratus, having thus obtained the sovereignty, did not overturn the laws of Solon, but on the contrary used his power with the greatest moderation, and even courted the friendship and asked the advice of Solon. It was not in the nature of things, however, that the Athenians could long remain satisfied with this form of government. On the usurpation of Peisistratus, Megacles and his family had retired from Athens, ostensibly in order to save their own lives; but having entered into a treaty with Lycurgus, whom they brought, along with his party, into a scheme for deposing the usurper, they concerted matters so skilfully, that Peisistratus was soon after obliged to withdraw from the city; and, on his departure, the Athenians ordered his goods to be confiscated. But Megacles had no sooner succeeded in his project against Peisistratus, than, finding his ally Lycurgus intractible, he changed sides, and began to plot the return of the very man whom he had just succeeded in expelling as a tyrant and usurper. This counter project was at length effected by means of a trick worthy of the parties engaged in this little political drama. Having found out a woman of the name of Phya, of a mean family and fortune, but of great stature and very handsome person, they dressed her in armour, placed her in a chariot, and having disposed things so as to make her appear to the utmost advantage, they conducted her towards the city, sending heralds before, with orders to address the people in the following terms: "Give a kind reception, O Athenians, to Peisistratus, who is so much honoured above all other men by Athena that she herself condescends to bring him back to the citadel." The report being universally spread that Athena was bringing back Peisistratus, and the ignorant multitude believing this woman to be the goddess, addressed their prayers to her, and received Peisistratus with the utmost joy. When he had recovered the sovereignty, Peisistratus married the daughter of Megacles, in fulfilment of a stipulation made between them to that effect, and also gave the mock goddess as a wife to his son Hipparchus. This last statement renders the whole story, which in itself is extremely childish, altogether improbable.

Second expulsion.

Peisistratus did not long enjoy the authority to which he had been thus restored. He had indeed married the daughter of Megacles according to treaty; but having children by a former marriage, and remembering that the whole family of Megacles were execrated by the Athenians, he thought it expedient to suffer his new spouse to remain in a state of perpetual widowhood. This the lady bore patiently for some time; but at last acquainting her mother with the state in which she was compelled to live, the affront was highly resented; and Megacles immediately entered into a treaty with the malcontents. Peisistratus, apprised of this step on the part of his father-in-law, and perceiving that a new storm was gathering, voluntarily quitted Athens and retired to Eretria; where, having consulted with his sons, he resolved to reduce Athens, and repossess himself of power by force of arms. With this view he applied to several of the Greek states, including that of Thebes, which furnished him with the troops he desired; and at the head of a considerable force he returned to Attica,—reduced Marathon, the inhabitants of which had taken no measures for their defence,—surprised and routed the republican forces, which had marched out of Athens to attack him,—and finally, after an absence of about ten years, re-established himself in power, by using victory with his accustomed moderation.

Return.

Peisistratus being thus reinstated once more in the sovereignty, took a method of securing himself in power directly opposite to that which Theseus had adopted. For, instead of collecting the inhabitants from the country into towns, as his predecessor had done, Peisistratus, made them retire from the towns into the country, in order to apply themselves to agriculture; and thus prevented their meeting together in bodies and caballing against him as they had hitherto been accustomed to do. By this means also the territory of Athens was greatly ameliorated, and extensive plantations of olives were reared over all Attica, which had hitherto been not only destitute of corn, but also naked and bleak in appearance from the total want of trees. And had he stopped here it would have been well. But actuated by that partiality for sumptuary laws which seems to have been the foible of nearly all the ancient legislators, he commanded his subjects in the city to wear a kind of sheepskin frock reaching to the knees, and appears to have set great store by this absurd enactment, which was doubtless intended to restore the simplicity of ancient manners. The Athenians, however, vehemently resented this interference with their *habits;* and so odious did the sheepskin garment become, that in succeeding times the frock or jacket of Peisistratus was a sort of by-word for the badge or garb of slavery. Experience shows that it is comparatively an easy matter to rob men of their liberty, and trample both on their political and civil rights; but an interference with their private habits or the adornment of their persons is almost always dangerous. As prince of Athens, Peisistratus exacted for the service of the state the tenth part of every man's revenue, and even of the fruits of the earth; a heavy tax, undoubtedly, and one which might well justify a little grum-

bling on the part of those who had to pay it; nor could all the magnificence with which the public revenue was expended reconcile the Athenians to the heavy burdens they were called upon to bear. Indeed they not unnaturally fancied themselves oppressed by tyranny, and indulged in perpetual complaints from the time Peisistratus first ascended the throne to the day of his death; which happened in 527 B.C., about thirty-three years after he had first assumed the sovereignty, of which period, according to Aristotle, he reigned about seventeen years.[1]

In taking a retrospect, however, of the government and character of this celebrated man, it is impossible to doubt that the one was enlightened and the other humane. The ancient writers are all agreed that he made no change of any consequence in the Athenian constitution. All the laws continued in force; the general assembly, the council of state, the courts of justice, and the magistracies, respectively retained their constitutional powers; and it is known that the usurper himself obeyed a citation from the Areiopagus upon a charge of murder. His hand, it is true, lay heavy on the purses of the people in the matter of taxation. But the sums which he raised were religiously expended in the decoration and improvement of the capital, or in works of public utility; and it cannot be questioned that, although he resorted to iniquitous or contemptible expedients to obtain power, he never abused it, either for the gratification of selfishness or revenge. "Take away only his ambition," said Solon; "cure him of the lust of reigning, and there is not a man more naturally disposed to every virtue, nor a better citizen than Peisistratus." He embellished the city with a great variety of edifices; he improved and strengthened its defences; he enlarged and ameliorated its harbours; and by various acts of taste and magnificence, not less than by his attention to the cultivation of the public mind, he may be said to have fixed the muses at Athens. In a word, if he was ambitious he was also enlightened and humane; and although no one can justify the modes which he took to possess himself of power, his use of it was characterized by a moderation and patriotism which have never as yet been exemplified by any other usurper, ancient or modern; insomuch that, reviewing his character and conduct, we are almost tempted to subscribe to the sentiment expressed by the poet Claudian, *Nunquam gratior extat libertas, quam sub rege pio.*

Hipparchus and Hippias.

Peisistratus left behind him three sons, Hipparchus, Hippias, and Thessalus, all men of abilities, who shared the government among them, and behaved for a time with lenity and moderation. But though, by the mildness of their government, the family of the Peisistratidæ seemed to be fully established on the throne of Athens, a conspiracy was unexpectedly formed against the brothers, by which Hipparchus was slain, and Hippias narrowly escaped death. There were at that time living in Athens two young men, called Harmodius and Aristogeiton. The former being remarkable for his personal beauty, was, on that account, it is said, unnaturally beloved by the other, and also by Hipparchus, who, if we may believe Thucydides, actually forced him. This was vehemently resented by Aristogeiton, who, in consequence, determined on revenge, which another circumstance contributed to accelerate. Hipparchus, finding that Harmodius endeavoured on all occasions to shun him, publicly affronted the youth, by refusing permission to his sister to carry the offering of Athena, as if she had been a person unworthy of that distinction. The two young men, not daring to show any public signs of resentment, consulted privately with their friends, amongst whom it was resolved, that at the approaching festival of the great Panathenæa, when the citizens were allowed to appear in arms, they should attempt to restore Athens to its former liberty; and in this they imagined they would be seconded by the whole body of the people. But when the appointed day arrived, they perceived one of their number talking familiarly with Hippias; wherefore, dreading a discovery, they immediately fell upon Hipparchus, and despatched him with many wounds, 514 B.C. In this exploit, however, the people were so far from aiding the conspirators, that they suffered Harmodius to be killed by the guards of Hipparchus; and seizing Aristogeiton, delivered him up to the vengeance of Hippias. But they soon had reason to change their opinion, and some time afterwards paid the most extravagant honours to the memory of these conspirators; causing their praises to be sung at the great Panathenæa, forbidding any citizen to call a slave by either of their names, and erecting brazen statues to them in the agora or market-place. Several immunities and privileges were also granted to the descendants of these (so-called) patriots, and all possible means were taken to render their memory respected and revered by posterity.

Cruelty of Hippias.

Hippias being now sole master of Athens, and burning to revenge the murder of his brother, began by torturing Aristogeiton, in order to force him to disclose his accomplices. But this proved fatal to his own friends; for Aristogeiton impeaching such only as he knew to be best affected to the government of Hippias, the latter were instantly put to death without further inquiry; and when he had exhausted his list, he at last told Hippias, that he now knew of none who deserved to suffer death except the tyrant himself. Hippias next vented his rage on a woman named Leaina, who had been kept by Aristogeiton, and who was put to the torture; which, however, she had the courage to endure without making any confession. After the conspiracy was thought to be crushed, Hippias set about strengthening his government by every means he could think of. With this view he contracted alliances with foreign princes; he increased his revenues by different expedients; married his only daughter, Archedice, to Æantides, son of Hippocles, tyrant of Lampsacus; and endeavoured, by affecting various arts of popularity, to conciliate that public opinion which his excessive severities had so rudely shocked. But all these precautions proved fruitless. The lenity of the government of Peisistratus had alone supported it; and although Hippias had fewer difficulties to contend with than his father, the vehemence of his resentment on account of his brother's murder betrayed him into courses repugnant alike to sound policy and to the interests of his family, and at last proved the cause of his expulsion from power in rather less than four years after the death of Hipparchus, 510 B.C. This revolution was principally brought about by the party of the Alcmæonidæ, or adherents of Megacles. Hippias retired to Sigeum, an appanage of his family, where he contrived by every means in his power to recover his lost position at Athens, and in the end, seeing that his plans could not succeed, even assisted the Persians in the war against his native city.[2]

State of Athens.

After the expulsion of the Peisistratidæ, the Athenians did not long enjoy the tranquillity which they had promised

[1] The government of Peisistratus, as we have seen, resolves itself into three distinct periods, interrupted by two exiles. Aristotle and Herodotus both agree in this. Larcher, Clavier, and Du Fresnoy, rightly give the two exiles at 5 + 11 = 16 years; but they differ materially in the duration of the first and last tyranny; nor on this point is it easy to decide between them. (Clinton's *Fasti Hellenici*, Appendix, No. ii. p. 180; Oxford, 1824, 4to.)

[2] The Peisistratidæ were expelled before the fourth year of Hippias was completed, eighteen years after the death of Peisistratus, twenty years before the battle of Marathon, and a hundred years before the constitution of the Four Hundred. (Herodotus, v. 55; Thucydides, vi. 59, and viii. 68; Plato, *Hipparch.* p. 229; Schol. Lysistrat. 619; *Fasti Hellenici*, 16.)

Attica. themselves. They became divided into two factions; one of which was headed by Cleisthenes, chief of the Alcmæonidæ; and the other by Isagoras, a man of quality, and highly in favour with the Athenian eupatrids or nobility. Cleisthenes cultivated the people, and endeavoured to gain their affection by increasing as much as possible their power; whilst Isagoras perceiving that the popular arts of his rival would secure him an ascendancy, applied to the Lacedæmonians for assistance; at the same time reviving the old story of Megacles's sacrilege, and insisting that Cleisthenes ought to be banished as being of that person's family. Cleomenes king of Sparta readily entered into his schemes, and suddenly Cleisthenes, probably dreading the old outcry against his family, withdrew from Athens; and when Cleomenes had entered Athens at the head of an army, the people, being without a leader, were so dismayed, that they allowed the Spartan king to act as if he were absolute master. On arriving at Athens, he condemned to banishment seven hundred families, in addition to those previously sent into exile. And, not content with this, he would have dissolved the senate, and vested the government in the heads of the faction of Isagoras; but happily the Athenians were not yet degraded enough to submit to such humiliation. Taking up arms, they drove the Spartan troops into the citadel, where, after sustaining a short siege, Cleomenes surrendered, on condition that Isagoras should depart unmolested with Cleomenes and the Lacedæmonian troops; but their adherents were left to the mercy of the people, and put to death. Cleisthenes and the 700 exiled families then returned to Athens in triumph. This happened in 508 B.C.

The Spartan king, however, had no sooner withdrawn from Athens, than he formed a strong combination in favour of Isagoras; having engaged the Bœotians to attack Attica on the one side, and the Chalcidians on the other, whilst he at the head of a powerful Spartan army entered the territory of Eleusis. But this powerful confederacy was quickly dissolved. The Corinthians, who had joined Cleomenes, doubting the justice of their cause, returned home: the rest of his allies likewise began to waver; and his colleague Demaratus, the other king of Sparta, differing in opinion with Cleomenes, the latter was obliged to abandon the enterprise. The Spartans and their allies having withdrawn, the Athenians quickly routed the Bœotians and Chalcidians, and carried off a great number of prisoners, who were afterwards set at liberty on paying a ransom of two minæ a head. The Bœotians, on the other hand, immediately vowed revenge, and engaging on their side the people of Ægina, who had a hereditary hatred to the Athenians, the Æginetans landed a considerable army, and ravaged the coasts of Attica while the Athenians were occupied with the Bœotian war.

Attempt to restore Hippias. In the meanwhile Cleomenes, exasperated by his unsuccessful expedition against Attica, and anxious for an opportunity of effacing the remembrance of his defeat, produced at Sparta certain pretended oracles which he alleged he had found in the citadel of Athens while he was besieged therein, the purport of which was, that Athens would soon become a rival of Sparta. At the same time it was discovered that Cleisthenes had bribed the priestess of Apollo to cause the Lacedæmonians to expel the Peisistratidæ from Athens; which was sacrificing their best friends to those whom interest necessarily rendered their enemies. This pitiful jugglery had such an effect, that the Spartans, repenting their folly in expelling Hippias, sent for him from Sigeum, in order to restore him to his principality; but the other states refusing to countenance the projected restoration, the Spartans were forced to abandon the enterprise, Attica. and Hippias returned to Sigeum to digest his disappointment.

About this period Aristagoras the Milesian, having stirred Persian up a revolt in Ionia against the Persian king, applied to the war. Spartans for assistance; but the Spartan king either felt no sympathy with the Greeks in Asia, who had been subjected by the Persians, or because the bribes offered by Aristagoras were not large enough, declined to have anything to do with the matter. Aristagoras then proceeded to Athens, where he found willing hearers. The Athenians regarding it as a religious duty to assist their kinsmen and colonists, passed a decree to send a squadron of twenty ships to support them, under the command of Melanthus, a nobleman universally esteemed.[1] This rash action cost the Greeks very dear; for no sooner did the king of Persia hear of the assistance sent from Athens to his rebellious subjects, than he declared himself the sworn enemy of that city, and solemnly besought the deity that he might one day have it in his power to be revenged on them. But besides the displeasure which Darius had conceived against the Athenians on account of the assistance they had afforded the Ionians, he was further encouraged, by the intrigues of the ex-tyrant Hippias, to undertake an expedition against Greece. Immediately on his return from Lacedæmon, as above related, Hippias passed over into Asia; proceeded to Artaphernes, governor of the adjacent provinces belonging to the Persian king; and excited him to make war upon his country, promising to do homage to the Persian monarch provided he was restored to the principality of Athens. Apprised of this step on the part of their late tyrant, the Athenians sent ambassadors to Artaphernes, desiring permission to enjoy their liberty in peace. But the Persians returned for answer, that if they would have peace with the Great King, they must immediately consent to receive Hippias; and as the Athenians were by no means disposed to purchase the forbearance of the Persian monarch at the price of compliance, they resolved to assist his enemies by every means in their power. This resolution being made known to Darius, he commissioned Mardonius to avenge him of the insults which he thought the Greeks had offered him; but that commander having met with a storm at sea and other accidents, which rendered him unable to do anything, Datis and Artaphernes (the son of the Artaphernes above mentioned) were commissioned to chastise Grecian insolence and presumption.

Persians invade Greece. War being thus declared, the Persian commanders, fearing again to attempt doubling the promontory of Athos, where their fleet had formerly suffered, drew their forces into the plains of Cilicia, and passing thence, through the Cyclades to Eubœa, directed their course towards Athens. Their instructions were to destroy both Eretria and Athens, and to bring away the people. The first attempt was made on Eretria; and on the approach of the Persian fleet the inhabitants sent to Athens to apply for assistance. Nor did they sue in vain. With a magnanimity almost unparalleled, considering the crisis, the Athenians sent 4000 men to their aid; but unhappily the Eretrians were so greatly divided in opinion, that, though the danger was urgent, nothing could be resolved on. One party was for receiving the Athenian succours into the city; another declared for abandoning the city and retiring into the mountains of Eubœa; whilst a third was base enough to seek to betray their country to the Persians. Matters being in this hopeless state, the Athenian commanders withdrew the auxiliary force, and retiring by Oropus, escaped the destruction with which they were threatened; whilst Eretria, betrayed into the hands of the Persians, was pillaged and burned, and its inhabitants sold

[1] Herodotus, v. 37, 38, 55, 97, 98, 99. Charon Lampsacenus apud Plutarch. *Mor.* p. 861; *Fasti Hellenici*, p. 20. Aristagoras was slain in Thrace, B.C. 497.

for slaves; a fate which their cowardice and treachery richly merited.

Battle of Marathon.

On the tidings of this disaster the Athenians immediately drew together such forces as they could muster, amounting in all to about 10,000 men; and these, with 1000 Platæans who afterwards joined them, were commanded by ten general officers, with equal power, amongst whom were the illustrious names of Miltiades, Aristides, and Themistocles, men distinguished alike for their valour, their conduct, their patriotism, and their virtue. But it being generally thought that so small a body of troops would be unable to resist the formidable power of the Persians, a messenger was despatched to Sparta to entreat the immediate assistance of that state. He communicated his business to the senate in the following terms:—"Men of Lacedæmon," said he, "the Athenians desire you to assist them, and not to suffer the most ancient of all the Grecian cities to be enslaved by the barbarians. Eretria is already destroyed, and Greece consequently weakened by the loss of so considerable a place." The assistance was readily granted; but the promised succours arrived too late for the occasion which required them; and, happily for their own glory, the Athenians were obliged to fight without waiting for their arrival. In the memorable engagement on the plains of Marathon, whither Hippias had conducted the Persian host, the latter were defeated with great loss by the Athenian infantry, under the command of Miltiades, and driven to their ships, 490 B.C.[1] They then endeavoured to double Cape Sunium (Colonna), in order to surprise Athens before the army could return. But in this they were prevented by Miltiades, who, leaving Aristides with 1000 men to guard the prisoners, returned so expeditiously with the main body, that he reached the temple of Hercules before the barbarians had time to commence a serious attack on the city. In the meanwhile the virtuous Aristides discharged the trust reposed in him with the strictest integrity. Though there was much gold and silver in the Persian camp, and the tents and ships they had taken were filled with all manner of riches, he not only forbore taking anything for his own use, but exerted himself to the utmost in order to prevent others from appropriating the spoils of the enemy, which were religiously reserved for the public service of the state.

After the victory of Marathon, the inhabitants of Platæa were declared free citizens of Athens, and Miltiades, Themistocles, and Aristides were treated with all possible marks of admiration and respect. Miltiades having now reached the highest pitch of power, demanded of the Athenians a fleet of seventy ships, with which he promised to increase their empire, and the people granted his request without even knowing what expedition he wished to undertake. He first attacked Paros, where he had to avenge some private wrong, but being thwarted by the Persians, and having received a dangerous wound in his knee, he returned to Athens without having accomplished the object for which he had induced the people to fit out the fleet. The ill-feeling thus created led some person of high standing to bring an accusation against him for having deceived the people. He was sentenced to pay a fine of 50 talents, and being unable to pay, he was thrown into prison, in which he soon after died of his wounds. This termination of the career of Miltiades has often been referred to as a proof of the ingratitude of the Athenians. But it must not be forgotten that he had really deceived the people by demanding of them a fleet for the purpose of accomplishing some private object, while he made them believe that he meant to employ it in their service. He appears, in fact, to have attempted to set himself above the laws, and to continue in the free state of Athens the same mode of life which he had led as dynast in the Chersonese. Under these circumstances we may indeed pity him, but cannot admit that he fell an innocent victim to the abuse of popular liberty. His colleague Aristides, by his regulation of the affairs of the Athenian allies, and by the reforms he introduced in the constitution during the period subsequent to the battle of Marathon, gained the highest esteem and respect among his fellow-citizens. Although he was descended from an ancient and noble family, and had been in positions in which he might have acquired great wealth, yet he seems to have lived almost in indigence. Such virtue was at all times extremely uncommon at Athens, and procured for him the honourable surname of the Just. This circumstance, however, made him an object of envy with many, and Themistocles, his most powerful opponent, induced the people to send him into honourable exile by ostracism, an institution by which the Athenians were enabled to rid themselves, for a time, of any man whose influence seemed to endanger the safety of their republican constitution. Such an exile, however, was not connected either with confiscation of property or with disgrace.[2] At his trial Aristides is said to have assisted an illiterate rustic in writing his own name on one of the shells that condemned him. After his removal, Themistocles was in the undivided possession of the popular favour, and exerted all his powers to make Athens a maritime state.

Xerxes invades Greece.

About three years after the banishment of Aristides, Xerxes king of Persia sent to demand of the Greeks earth and water as tokens of submission and homage. But Themistocles, desirous to widen the breach with that monarch, put to death the interpreter for publishing the decree of the king of Persia in the language of the Greeks; and having prevailed with the several states to lay aside their animosities and provide for their common safety, he got himself elected general of the Athenian army.

When the news arrived that the Persians were advancing to invade Greece by the Straits of Thermopylæ, and that with this view they were transporting their forces by sea, Themistocles advised his countrymen to abandon the city, embark on board their galleys, and encounter their enemies while yet at a distance. But this advice being disregarded, Themistocles put himself at the head of the army, and having joined the Lacedæmonians, marched towards Tempe. But intelligence was received that the Straits of Thermopylæ had been forced, and that Bœotia and Thessaly had submitted to the Persians; and the army in consequence returned without attempting anything. In this extremity the oracle at Delphi was consulted by the Athenians, and at first returned a very alarming response, threatening them with total destruction; but after much humiliation, a more favourable answer was obtained, in which, probably by the direction of Themistocles, they were promised safety in *walls of wood*. This being interpreted as a command to abandon Athens, and place all their hopes of safety in their fleet, the greater part began to prepare for embarkation, and money

[1] For an account of the memorable battle of Marathon, with military details of the Greek armies, including the Athenian, see the article ARMY. "The Athenians who fought at Marathon," says Herodotus, "were the first among the Greeks known to have used running for the purpose of coming at once to close fight; and they were the first who withstood (in the field) even the sight of the Median dress and of the men who wear it; for hitherto the very name of Medes and Persians had been a terror to the Greeks." This honest confession seems to have given great offence to Plutarch, but it is confirmed by Plato (*in Menexen.* p. 240) and other writers of the highest authority.

[2] The ostracism of Aristides took place B.C. 483, since he was recalled τρίτῳ ἔτει Ξέρξου διὰ Θεσσαλίας ἐλαύνοντος. (Plutarch, *Aristid.* c. 8.) Some, however, think that it took place the following year; and, in fact, he seems to have been in exile at the time of the battle of Salamis. But ten months afterwards he commanded the Athenian forces at the battle of Platæa; so that his recal must have taken place between those two actions. (Herodotus, ix. 28.)

was distributed among them by the council of the Areiopagus, to the amount of eight drachmas a head; but this not proving sufficient, Themistocles publicly gave out that somebody had stolen the shield of Athena, and, under pretence of searching for the lost ægis, he seized on all the money he could find. Some, however, still refused to embark, and, understanding the oracle in its literal sense, raised fortifications of wood, resolving to wait the arrival of the Persians, and defend themselves to the last.

Capture of Athens.

The Persians having advanced to Athens soon after the inhabitants had deserted it, met with no opposition except from the few who had resolved to remain; and as they would listen to no terms of accommodation, they were put to the sword, and the city utterly destroyed. Xerxes, however, being defeated in a great naval engagement at Salamis, 480 B.C., was forced to fly with prodigious loss. Themistocles was for pursuing him and breaking down the bridge of boats which he had thrown over the Hellespont; but this advice being overruled, the crafty Athenian sent a trusty messenger to the king, acquainting him that the Greeks intended breaking down his bridge, and at the same time suggesting the propriety of his making all haste in order to prevent his retreat being cut off. This advice, though misinterpreted by some, was certainly a prudent one; as Xerxes, although he had sustained a defeat, was still at the head of an army capable of destroying all Greece; and had he been driven to despair by finding himself shut up or even too hotly pursued, it is impossible to say what might have been the event. "Make a bridge of gold for a flying enemy," is a rule which the experience of war in all ages has sanctioned.

The defeat of Xerxes at Salamis disposed Mardonius, who had been left to carry on the war by land, rather to treat with the Athenians than to fight them; and with this view he sent Alexander, king of Macedon, to Athens to propose an alliance with the republic, exclusively of the other Grecian states. But this proposal was rejected; in consequence of which Athens was a second time destroyed,[1] and the Athenians were forced to retire to Salamis. But they were soon freed from the apprehension of final subjugation by the total defeat and death of Mardonius at Platæa, where Aristides and the Athenian troops under his command particularly distinguished themselves. And, by a singular coincidence, on the same day that the battle of Platæa was fought, another division of the Persians was defeated at Mycale in Ionia, where the Athenians also behaved with more signal gallantry than any of the other Greeks. The Persians being thus disposed of, the troops who had fought at Mycale crossed over to the Chersonesus, and laid siege to Sestos, which they at length captured after an obstinate defence by the garrison; a circumstance which appears to have irritated them so much that they put both the commanders to death in the most barbarous manner. One of them, Oibazus, was sacrificed to a Thracian god; whilst the other, Artayctes, was impaled alive, and his son stoned to death before his face, on the absurd pretence that he had rifled the sepulchre of Protesilaus.

City rebuilt and fortified.

After the victories of Platæa and Mycale, in 479 B.C., the Athenians, freed from all apprehension respecting the Persians, began to rebuild their city in a more magnificent manner than ever. Throughout the Persian war, the Athenians had been most forward in opposing the barbarians; and their generals, Aristides and Cimon, displayed qualities which formed such a strong contrast with the domineering conduct of the Spartan Pausanias and the Spartan harmosts, that, with the exception of the Peloponnesians, nearly all the Greeks were desirous to place themselves under the protection of Athens, which thus acquired the supremacy in Greece. The relations of the allies, and their annual tribute, which was deposited in the temple of Apollo at Delos, was the work of Aristides, in whom all had the fullest confidence. Athens, in return, undertook the duty of protecting her allies against Persia. The constitution of Athens also underwent some changes at this time, which are ascribed to Aristides. He is said to have removed the barrier which had hitherto separated the highest from the lower classes, by throwing open the archonship and the Areiopagus to all the citizens, without any distinction of birth or wealth. This change had been prepared by the circumstances of the time; and the noble exertions of the Athenian citizens had well entitled them to be thus raised to the full enjoyment of the advantages which the state could afford. About the same time Themistocles suggested the necessity of immediately fortifying the city, so as to prevent its being again destroyed whenever the Persians might deem it expedient to invade Greece. The Lacedæmonians disrelished this project exceedingly, and remonstrated against it, upon the hollow ground, that were Athens to be strongly fortified, and the Persians to become possessed of it, it might be impossible ever to dislodge them. The Athenians were not imposed on by this shallow pretence, which was soon changed into a peremptory command not to raise their walls higher; but, considering the great power of Sparta at that time, Themistocles advised the Athenians to temporize, and to assure the Spartan envoys that the work should not be proceeded with until by a special embassy satisfaction had been given to their allies. Being, at his own desire, named ambassador in conjunction with some other Athenians, Themistocles set out alone. Arrived at Sparta, he put off from time to time receiving an audience, on the pretence that his colleagues had not yet joined him; but in the meanwhile the walls of Athens were being built with the utmost expedition, neither houses nor sepulchres being spared for materials, and men, women, children, strangers, citizens, and servants, labouring at the work without intermission. The truth, however, having at length oozed out, Themistocles and his colleagues, who had by this time arrived, were summoned before the ephori, who immediately began to exclaim against the Athenians on account of their breach of compact. But Themistocles stoutly denied the charge; his colleagues, he said, assured him of the contrary; at all events, it did not become a great state to give heed to vague rumours of this description; and if they had any doubts about the truth of his statement, the proper course would be to send deputies to inquire into the fact of the matter, whilst he should himself remain as a hostage to be answerable for the event. This plausible suggestion being agreed to, Themistocles engaged his associates to advise the Athenians to commit the Spartan ambassadors to safe custody until he should be released. Soon after Aristides and one other Athenian envoy arrived, informing Themistocles that the walls were high enough to stand a siege. Themistocles, accordingly, now dropped the mask, and bade the Spartans in future to treat the Athenians as reasonable men, who knew what they owed to themselves as well as to their countrymen. The Spartans with their wonted skill dissembled their vexation, left the Athenians to act as they saw fit, and sent Themistocles back to Athens in safety.

The following year, 478 B.C., Themistocles, observing the inconvenience of the port of Phalerum, formed the resolution of improving the Peiræus, and rendering it the principal harbour of Athens. All the three ports, Phalerum, Munychia, and Peiræus, were fortified by a double range of wall, one on the landside, and the other following the windings of the coast. This wall was 60 feet in height, and of such breadth as to allow two waggons to pass each other. Peiræus now became a town of great importance, being the residence of merchants, sailors, and foreigners, who established themselves in it for purposes of trade and commerce. By these wise and prudent measures, undertaken

[1] Athens was occupied by Mardonius ten months after its occupation by Xerxes the preceding year, B.C. 480.

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and carried through with equal energy and address, the naval power of Athens was fixed on a sure basis, and the ascendency in Grecian politics transferred from the Spartans to the Athenians.[1]

Themistocles banished.

The victory of Salamis and his prudent management of the affairs of Athens had raised Themistocles to a giddy height, which made him proud, indiscreet, and rapacious, and drew upon him the charge of perfidy, avarice, and cruelty. His acts of selfishness made many persons his enemies, and the Spartans never forgiving him the manner in which he had thwarted their schemes, were ever active in rousing the jealousy and fears of his countrymen. In addition to all this, younger men were rising and taking his place in popular favour. The people accordingly were easily persuaded to consider him a dangerous person, and condemned him to a temporary exile by ostracism. He went to Argos, where he was still residing, 471 B.C., when the condemnation of the Spartan Pausanias for high treason brought ruin upon the head of Themistocles also. The Spartans charging him with being an accomplice of Pausanias, demanded of the Athenians to put him to death. His enemies at Athens rejoiced at this opportunity of crushing him, and officers were sent out to arrest him. But he fled and reached Ephesus in safety. Thence he proceeded to the court of Persia, where, by his prudence and cunning, he soon became a general favourite. King Artaxerxes at length sent him to Western Asia, where he was enabled by the king's munificence to maintain a sort of princely rank. At length, however, he is said to have made away with himself, because he felt unable to fulfil the promises he had made to the king.

Exploits of Cimon.

But the war with Persia was not yet discontinued, and about the end of the 77th Olympiad, the Athenians equipped a fleet to relieve certain Greek cities in Asia, subject to the Persians, and gave the command of it to Cimon, the son of Miltiades by a daughter of the king of Thrace. Cimon had already tasted the temper of his countrymen, having been thrown into prison for his father's fine, from which he was released by Callias, whom his sister Elpinice had married on account of his great wealth, procured, it is said, by no very honourable means. But he nevertheless accepted of the command, and gained such immense booty in this expedition, that the Athenians were thereby enabled to lay the foundation of that longimural inclosure which united the port to the city; as also to adorn the Agora with palm-trees, and beautify the Academy with delightful walks and fountains. Soon after this expedition, the Persians having invaded the Chersonesus, and made themselves masters of it, with the assistance of the Thracians, Cimon was hastily sent against both. He had only four ships under his command; but with these he captured thirteen of the Persian galleys, and reduced the whole of the Chersonesus; after which he attacked the Thracians, who had made themselves masters of the gold mines situated between the rivers Nessus and Strymon, and speedily obliged them to yield. But Cimon was as wise and politic as he was brave. Many of the Greek states, in virtue of the general tax established by Aristides with the view of providing a fund for the common defence, were bound to furnish men and galleys, as well as to pay for their support. But when they saw themselves exposed to danger from the Persians, most of them evinced an unwillingness to furnish their contingent of men. This exasperated the Athenian generals, who, finding them obstinate in their refusal, were for having immediate recourse to force; but Cimon overruled this proposal, permitted such as were desirous of staying at home to remain, and accepted a sum of money instead of a galley completely manned; by which means he inured the Athenians, whom he took on board his galleys, to hardship and discipline, whilst the allies, who remained at home, became enervated through idleness, and, from being confederates, dwindled into tributaries or subjects.

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Cimon banished.

Cimon had gained great wealth both to the state and to himself; but in his public character he had acted with unimpeached integrity, and as a private citizen he had dedicated his wealth to the most laudable purposes. He had demolished the inclosures about his grounds and gardens, permitting every one to enter and take what fruits they pleased; and he had kept open table, where both rich and poor were plentifully entertained. If he met a citizen in a tattered suit of clothes, he made some of his attendants exchange with him; or if the quality of the person rendered such a kindness unsuitable, he caused a sum of money to be privately given him. All this excessive liberality, however, was as degrading to the benefactor as to the benefited, and was nothing but the means by which he endeavoured to win popularity among the people. The nobles, to whose order Cimon belonged, had lost the power of oppressing the people, and now found it expedient to court them in every possible way for the purpose of securing to themselves all the power that yet remained to them. Pericles, his great rival, unable to cope with Cimon's profusion, became the author of a series of measures, all of which tended to provide for the subsistence and gratification of the poorer classes at the public expense. The apparent neglect of Cimon in not conquering a district in the north of the Ægean was the cause of an accusation against him, in which Pericles was requested to take the lead; but he honourably declined doing so, because in his eyes the charge was unfounded. The result of this trial is not certain; for according to some Cimon was acquitted, while according to others he was sentenced to pay a fine of 50 talents. Soon afterwards, however, the aristocratic party, of which Cimon was the leader, became involved in a serious struggle with the democratic party, led by Pericles: the latter having succeeded in reducing the power of the Areiopagus, the last stronghold of the aristocracy, it was thought advisable, for the public safety, to remove Cimon for a time from Athens by ostracism.

War with Sparta.

The Athenian power had now risen to such a height that all the states of Peloponnesus looked upon the republic with a jealous eye, and were continually watching for opportunities of making war upon it when engaged in troublesome affairs, or hard pressed by other enemies. These attempts, however, so far from lessening, generally contributed to increase the power of the Athenians. But in the year B.C. 458, the republic entered into a war with Sparta, which eventually proved nearly as fatal to the state as to the city. The Spartans had sent a considerable army to assist the Dorians against the Phocians; and on their return commenced intriguing with the aristocratic party at Athens. This led the Athenians to the determination not to wait till it was too late. Having therefore engaged the Argives and Thessalians as confederates, they posted themselves on the isthmus, so that the Spartan army could not return without encountering them. The Athenians and their confederates amounted to 14,000, and the Spartans to 11,500 men. The Lacedæmonian general, however, unwilling to hazard a battle, turned aside to Tanagra, a city of Bœotia, where some of the Athenians who were favourable to aristocracy entered into a correspondence with him. But before their designs were ripe for execution, the Athenian army marched with great expedition to Tanagra, and instantly made arrangements for the attack. They were however defeated with great loss, in consequence of the perfidy of the Thessalians, who in the midst of the battle went over to the enemy. Another engagement soon followed, in which both armies suffered so much that they were glad to conclude a short truce, that each might have time to recruit their shattered forces. But the

[1] For an account of the fortifications of the capital of Attica, the Long Walls, and the defences of Peiræus, Phalerum, and Munychia, see article ATHENS.

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scale of fortune soon turned in favour of the Athenians. The Thebans, who had been deprived of the command of Bœotia on account of their having sided with Xerxes, were now restored to it by the Lacedæmonians. At this the Athenians were so greatly displeased that they sent an army under Myronides the son of Callias into Bœotia to overturn all that had been done. That general was encountered by the Thebans and their allies, who composed a numerous and well-disciplined army; but although the Athenian army was but a handful in comparison to that of their enemies, Myronides gained a victory over the allies, which, in a purely military point of view, may perhaps be considered as more glorious than either that of Marathon or of Platæa. In these battles they had fought against the effeminate and ill-disciplined troops of Persia; but now they encountered and defeated a superior army composed of the bravest Greeks. After this victory Myronides marched to Tanagra, which he took by storm, and afterwards razed to the ground. He then plundered Bœotia; defeated another army which the Bœotians had drawn together to oppose him; next fell upon the Locrians; and having penetrated into Thessaly, chastised the inhabitants of that country for having revolted from the Athenians; after which he returned to Athens laden alike with riches and with glory.

Death of Cimon.

About this time, 457 B.C., Cimon was recalled from banishment by the will of the people, and soon after fell to his old employment of warring against the Persians; having nothing less in view, according to Plutarch, than the conquest and subjugation of the whole Persian empire. But, however this may be, the Great King, finding he could have no rest whilst he continued in a state of hostility with the Athenians, sent instructions to his generals, Artabazus and Megabizus, to conclude, if possible, a treaty of peace; which, after much discussion, was at length effected upon the following conditions: 1. That the Greek cities in Asia should be free, and governed by their own laws. 2. That the Persians should send no army within three days' journey of the sea. 3. That no Persian ship of war should sail between Phaselis in Pamphylia and the Chelidonian islands off the coast of Lycia. Whilst this treaty was pending, Cimon died B.C. 449, but whether of sickness or of a wound which he had received in battle remains unknown. This so-called peace of Cimon is probably a mere fable, which arose out of the recollection of the glorious exploits of that general. All the subsequent history shows that such a state of things as the terms of this peace imply never existed. The story does not appear to have assumed a distinct form until the time of the rhetorician Isocrates.

Truce with Sparta.

One thing, however, is certain, that after the death of this remarkable personage, the Athenian affairs began to fall into confusion. It was now the misfortune of the republic to be alike hated by her enemies and by her allies; and hence the latter missed no opportunity of throwing off their allegiance when they thought they could do so with impunity. The Megarians, for instance, who had long been under the protection of Athens, thought proper to disclaim all dependence on their ancient protectrix, and to have recourse to Sparta, with which they entered into a strict alliance offensive and defensive. Exasperated at this proceeding, and determined to punish the ingratitude of their former allies, the Athenians ravaged the country of the Megarians—a step which soon brought on a renewal of the Lacedæmonian war, which had been suspended rather than terminated. But Pericles procured the return of the first Lacedæmonian army without bloodshed, by bribing Cleandridas, the young king of Sparta's tutor; and the Lacedæmonians, finding it was not for their interest to carry on the war, concluded a truce or pacification with the Athenians for the period of thirty years,[1] 445 B.C.

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Six years after the conclusion of the peace between Athens and Sparta, a war broke out between the Samians and Milesians, about an insignificant town situated under Mount Mycale, in Ionia. In this war the Athenians took part, their protection having been solicited by the Milesians; and the island of Samos was reduced by Pericles, who established there a democracy, and left an Athenian garrison. He was no sooner gone, however, than the aristocratic party rose in arms and expelled the garrison; but Pericles quickly returning, besieged and took their city, demolished their walls, and fined them in the whole expense of the war, part of which he obliged them to pay down, and took hostages for the remainder.[2] This happened in 444 B.C.

Reduction of Samos.

Corcyræan war.

This insignificant contest was almost immediately followed by a war between the Corcyræans and Corinthians, which arose out of the following circumstances. An intestine broil breaking out in the little territory of Epidamnus, a town of Illyricum, founded by the Corcyræans, one party applied for aid to the Illyrians, and the other to the Corcyræans. But the latter having neglected the matter, Corinth was appealed to, as the Corcyræans were originally a colony from that place; and the Corinthians, partly out of pity for the Epidamnians, partly from dislike to the Corcyræans, despatched a considerable fleet to the assistance of the former, by which means the party which had appealed to Corinth gained the ascendency. This being resented by the Corcyræans, they sent a fleet to Epidamnus to support the exiles; but although this fleet began to act offensively on its entering the port, the chief commanders had instructions to propose terms of accommodation. To these, however, the Corinthians refused to accede; and next year the Corcyræans defeated the Corinthians and their allies at sea, took Epidamnus by storm, and wasted the territories of the allies of the Corinthians, 434 B.C. The latter, therefore, began to make great preparations for carrying on the war, and pressed their allies to imitate their example, that they might be in a condition to retrieve the honour they had lost, and to humble the ungrateful colony which had thus insulted the metropolitan city.

When the Corcyræans became acquainted with these proceedings, they despatched envoys to Athens to sue for aid; and these were quickly followed by others from Corinth on the same errand. At first the Athenians inclined to favour the Corinthians, but the next day they resolved to support the Corcyræans; contenting themselves, however, with entering into a defensive alliance with that little state, and furnishing the Corcyræans with ten galleys under the command of Lacedæmonius, the son of Cimon. But this determination did not retard the preparations of the Corinthians, who, as soon as the season permitted, sailed for the coast of Corcyra with a fleet of 150 ships, under the command of Xenoclides, assisted by four other Corinthian admirals; each squadron of their allies being commanded by an admiral of its own. The Corcyræan and Athenian fleet amounted to 120 sail; but the Athenians had orders to give as little assistance as possible. A brisk action ensued, in which the Corcyræan right wing broke the left of the Corinthian fleet, and drove some of the ships on shore; whilst the Corinthian ships in the right wing defeated the Corcyræan ships opposed to them. Next day preparations were made on both sides for renewing the battle; but twenty ships arriving opportunely from Athens to the assistance of the Corcyræans, turned the scale against the Corinthians, who therefore declined the combat, 432 B.C.

As soon as the Corcyræan war broke out, the Athenians

[1] On the subject of the thirty years' truce, concluded B.C. 445, the reader may consult and compare Andocid. *de Pace*, p. 14, 24; Æschin. *Fals. Leg.* p. 23, 51. It was about this time that Pericles began to assume the sole direction of affairs.

[2] Thucydides, i. 117.

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sent orders to the citizens of Potidæa to demolish part of their wall, to send back the magistrates they had received from Corinth, and to give hostages for their own behaviour. The Potidæans, however, refused to comply with this demand; upon which the Athenians despatched a considerable fleet against them under the command of Callias, a man celebrated for his courage; whilst the Corinthians, on the other hand, sent one Aristeus, with a considerable body of troops, to the assistance of the city. An engagement ensued, in which the Athenians were victorious, but their brave general fell in the action. Phormio, who succeeded to the command on the death of Callias, then invested the city in form, and blockaded its harbour with his fleet; but the Potidæans, dreading the vengeance of the Athenians, made a most obstinate defence, at the same time warmly soliciting the Corinthians to perform their promises, and to engage the rest of the states of Peloponnesus to take part in their quarrel.

Reparation demanded.

Meanwhile the Lacedæmonians having heard the complaints of the Corinthians and other small states of Greece, against the Athenians, sent ambassadors to Athens, to demand reparation for the injuries done to these states, and, in the event of refusal, to denounce war. The terms demanded were, first, that all Athenians who were allied to the family of Megacles should be expelled from Attica; secondly, that the siege of Potidæa should be raised; thirdly, that the inhabitants of Ægina should be left free; and lastly, that a decree prohibiting the Megarians from resorting to the ports and markets of Athens should be revoked, and all the Grecian states under the dominion of Athens set at liberty.

Refused.

By the persuasion of Pericles, however, these degrading terms were rejected; and while the right arbitrarily claimed by the commonwealth of Sparta to interfere in the concerns of the other Greek states, in the character of a lord-paramount, was peremptorily denied, an accommodation was proposed upon the fair principles of equality and reciprocity. In recommending the measure which he suggested for the adoption of his countrymen, this celebrated statesman argued that, whatever the Lacedæmonians might pretend as to the complaints of the allies, the true ground of their resentment was the prosperity of the Athenian republic, which they had always hated, and now sought an opportunity of humbling; and that it must be owing to the Athenians themselves if this design succeeded, because, for many reasons, Athens was better able to engage in a long and expensive war than the Peloponnesians. He then laid before the people an exact account of their circumstances, reminding them that the treasure brought from Delos amounted to no less than 10,000 talents; that although 4000 of these had been expended on the magnificence of their citadel, 6000 still remained in their coffers; that they were also entitled to the subsidies payable by the confederate states; that the statues of their gods, the spoils of the Persians, and other valuable property, were worth immense sums; that many private individuals had amassed vast fortunes; that considering the extent of their trade and commerce, they might calculate upon a certain annual increase of wealth; that they had on foot an army consisting of 12,000 men, besides 17,000 in their colonies and garrisons; that their fleet amounted to 300 sail; and finally, that the Peloponnesians, with whom they might be called to contend, had none of these advantages, and, as compared with the Athenians, were nearly destitute of all those resources which constitute the sinews of war. For these reasons he proposed, as at once the most consistent and most equitable satisfaction that could be given, to reverse the decree against Megara, provided the Lacedæmonians agreed to accede to the principle of reciprocity in favour of the Athenians and their allies; to consent to leave all those states free which were acknowledged as such at the conclusion of the last peace with Sparta, provided the latter state also agreed to give freedom to all the states which were under their dominion; and, finally, to submit to arbitration all disputes which might in future arise between the parties to this arrangement. He concluded by advising them to hazard a war in case these terms were rejected; telling them that they should not think they ran that hazard for a trifle, or retain a scruple in their minds as if a small consideration moved them to it, because on this matter depended their safety, and the reputation of their constancy and resolution. If they yielded in this, the next demand of the Lacedæmonians would be still more extravagant; for having once discovered that the Athenians were to be acted upon by fear, they would thence conclude that nothing could be denied them, whereas a stout resistance in the present case would teach them to treat Athens in future upon terms of reciprocity.

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Peloponnesian war.

The firm attitude which Athens assumed on this occasion, under the guidance of her most illustrious statesman, may be considered as the origin of the Peloponnesian war, which makes so prominent a figure in ancient history. The immediate preliminary to general hostilities, however, was an attempt of the Thebans to surprise Platæa in 431 B.C. With this view they in the depth of night sent 300 men to assist those of the Platæans whom they had drawn over to their interest, in making themselves masters of the place. But although the design succeeded very well at first,—the Platæans, who had promised to open the gates, keeping their words exactly, so that they instantly obtained possession of the city,—yet the other party, perceiving the smallness of the number they had to contend with, unanimously rose upon them, killed a great many, and forced the remainder to surrender themselves prisoners of war. The Thebans sent a reinforcement to assist their countrymen, but it arrived too late to be of any service, and the whole were ultimately obliged to withdraw. As soon as the Athenians were apprised of this attempt, they immediately despatched a considerable convoy of provisions to Platæa, together with a numerous body of troops for the purpose of escorting the wives and children of the inhabitants to Athens. This attempt leaving no doubt that all hopes of accommodation were at an end, both parties began to prepare in good earnest for war. Most of the Grecian states inclined to favour the Spartans, partly because the latter assumed the character of deliverers of Greece, and partly also because many of the states either had been, or feared they would be, oppressed by the Athenians. Accordingly, the whole of the Peloponnesians except the Argives and part of the Achæans made common cause with the Spartans; whilst, on the continent of Greece, the Megarians, Phocians, Locrians, Bœotians, Ambraciots, Leucadians, and Anactorians, declared for the Athenians; as also did the Chians, Lesbians, Platæans, Messenians, Acarnanians, Corcyræans, Zacynthians, Carians, Dorians, Thracians, and all the Cyclades, excepting Melos and Thera, together with Eubœa and Samos.

First year

The Peloponnesian war commenced in the year B.C. 431. The Lacedæmonian army, consisting of no less than 60,000 men, assembled on the isthmus, and, after a vain attempt at negotiation, the campaign opened. The Lacedæmonian army was commanded by Archidamus, king of Sparta; that of the Athenians by Pericles, with nine generals under him. Soon after the opening of the campaign, the Spartan force entered Attica and committed horrible ravages; Pericles having no force capable of opposing it, and steadily refusing to engage on disadvantageous terms, although prodigious clamours were in consequence raised against him by his countrymen. The invaders, however, had no great reason to boast of the advantages they had gained; for an Athenian fleet ravaged the coasts of Peloponnesus, whilst another infested the Locrians, expelled the inhabitants of Ægina, and repeopled the island from Athens and Attica. Cephalonia,

Attica. and some towns in Acarnania and Leucas which had declared for the Lacedæmonians, were also reduced; and in the autumn, when the Peloponnesians had retired, Pericles entered the Megarian territory, which he laid waste with fire and sword, in revenge for the devastation committed in Attica.

Second year. But the spring of the second year proved signally disastrous to Athens; for a dreadful plague carried off great numbers of the citizens, whilst the Peloponnesians, under Archidamus, wasted every thing abroad. In the midst of all these calamities, however, the firmness of Pericles remained unshaken; and he would suffer none of his countrymen to stir from the city, either to escape the plague, which committed horrible ravages within the walls, or to assail the enemy, who desolated the country without.[1] He meditated a deeper game, namely, an inroad into the enemy's territory, which in fact had been left completely uncovered by the attack upon Attica. With this view he caused a large fleet to be equipped, on board which he embarked 4000 foot and 300 horse, and immediately set sail for Epidaurus. This diversion produced the desired effect, in compelling the enemy to withdraw from Attica; but in other respects the expedition failed on account of the plague, which committed so great havoc among his men, that Pericles brought back to Athens only 1500 of the 4300 composing the expedition. By this disaster the Athenians were thrown into utter despair, and immediately sued for peace; but the Spartans refusing to accede to any terms of accommodation, their despair gave place to fury against their great statesman and commander, whom they dismissed from their service, and amerced in a heavy fine. And, as if this had not been enough, at the same time that Pericles experienced the ingratitude of his country, the plague carried off his children and nearly the whole of his kindred, leaving him almost alone in the world, childless and forsaken. This accumulation of misfortunes preyed deeply on his spirits and overwhelmed him with melancholy, in consequence of which he secluded himself for a time entirely from public view. But through the persuasion of Alcibiades and other friends, he was at length induced to show himself to the people; who, ever inconstant, and generally more prompt to pardon than to condemn, received him with acclamations of joy. The first use Pericles made of his recovered popularity was to procure the repeal of the law which he had himself caused to be enacted, whereby all Athenians of half blood were disfranchised of their natural liberty, and reduced to the state of aliens; a measure which was not altogether disinterested on his part, as he was thereby enabled to enrol in the list of citizens his only remaining son by a Milesian mother, whom the operation of the law in question had of course bastardized. But this was destined to be one of the last public acts of the great Athenian statesman and patriot.

Third year. The third year of the Peloponnesian war was chiefly remarkable for the death of Pericles, who at length fell a victim to the plague, which had already desolated his house, but who left behind him a name that will never die.[2] Platæa was also besieged by Archidamus, but without success; for although the greater part of it had been set on fire, the Platæans resolved to submit to every extremity rather than abandon the Athenian cause. In the end, therefore, the king of Sparta was obliged to convert the siege into a blockade, and to return to Peloponnesus. Attica.

Fourth year. In the following summer the Peloponnesians under Archidamus again invaded Attica, wasting everything with fire and sword; and at the same time the whole island of Lesbos, except the district of Methymna, revolted against the Athenians. In the meanwhile Platæa was strictly blockaded, and its inhabitants being reduced to the greatest extremity from want of provisions, the garrison came to the resolution of forcing a passage through the enemy's lines. When the moment arrived, however, for carrying this design into execution, many of them became intimidated; but the greater number persisted in their resolution, succeeded in their gallant attempt, and above 200 reached Athens in safety.

Fifth year. In the beginning of the fifth year the Peloponnesians sent forty ships to the relief of Mitylene, which the Athenians had invested after the revolt of Lesbos; but this effort proved unavailing, since the place had surrendered before the fleet could come to its assistance. Paches, the Athenian commander, then drove off the Peloponnesian fleet; and returning to Lesbos, sent the Lacedæmonian agent, whom he found in Mitylene, together with a deputation, to Athens. On their arrival the Lacedæmonian was immediately put to death; and in a general assembly of the people, it was resolved, on the proposal of Cleon, that all the Mitylenians who had attained to manhood should also be put to death, and the women and children sold as slaves. But the next day this cruel decree was revoked, and a galley despatched to countermand the sanguinary order. It arrived just in time to save Mitylene. Only about a thousand of the principal insurgents were put to death; the walls of the city were however demolished, their ships taken away, and their lands divided among the Athenians, who let them again to their former proprietors at a nominal rent. About this time also the Platæans who had failed in the attempt to break through the enemy's lines surrendered at discretion, and were cruelly put to death by the Lacedæmonians, who sold their women as slaves. The city was soon after razed by the Thebans, who left only an inn to show where it stood; but the fame of Platæa induced Alexander the Great afterwards to rebuild it on a more extensive scale.

Sedition of Corcyra. In this year also happened the famous sedition of Corcyra, proverbial for the horrors with which it was accompanied. We have already seen that the dispute between the Corcyræans and Corinthians was mainly instrumental in bringing on the Peloponnesian war, one of the most protracted and sanguinary contests of ancient times. At the commencement of this struggle a great number of Corcyræans were carried as prisoners to Corinth, where the chief of them were well treated, and the remainder sold as slaves. The motive of this conduct on the part of the Corinthians was a design they had formed of engaging these Corcyræans to influence their countrymen to join the Corinthians and their allies. With this view the latter treated them with all imaginable lenity and tenderness, endeavouring to instil into their minds a hatred of democratic government; after which they were informed that they might obtain their liberty upon condition of exerting their influence at home in favour of the allies, and to the prejudice of Athens. This the Corcyræans readily promised and endeavoured to perform; and

[1] In this campaign the Peloponnesians remained forty days in Attica, burning and destroying without, while the pestilence was raging within the city, and while the Athenians seemed abandoned to utter despair. For an account of this memorable plague see Thucydides, ii. 47, whose description has been often imitated, but never equalled, far less surpassed. That which approaches nearest to it in horrible truth and picturesqueness of delineation is the description of the plague in Egypt, and also in the prison of the Seraglio at Constantinople, contained in the novel entitled *Anastasius, or Memoirs of a Modern Greek*; a work which displays greater talents, and gives a more vivid and faithful picture of society and manners in the countries of the Levant, than all the books which have yet been written on the subject.

[2] Plutarch (*Pericl.* c. 16) says that Pericles was engaged in public affairs forty years, and performed certain functions during fifteen; but the fifteen are evidently included in the forty. Accordingly, Cicero (*Orat.* iii. 34) says, "Quadraginta annos præfuit Athenis;" and from other authorities we learn that he began to appear in public affairs about the year B.C. 469, and to have the sole direction about the year B.C. 444; so that he could not have exceeded fourscore at the time of his death, which took place in B.C. 429.

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at first the partisans of aristocracy so far prevailed, that, assisted by a Peloponnesian fleet, they murdered such of the opposite party as fell into their hands. But the Athenians having despatched first one fleet and then another to the assistance of their friends, the Peloponnesians were forced to withdraw, leaving the aristocrats at the mercy of the democratic party; who, having thus gained the ascendency, literally exterminated their antagonists with circumstances of horrible atrocity. Nor was this all. For, the example once set, the several states of Greece in their turn experienced similar commotions, which were invariably fermented by agents of Sparta or of Athens; the former endeavouring to establish an aristocratic and the latter a democratic form of government, wherever their influence happened to prevail.

Sicilian war.

While the Athenians were thus engaged in a contest in which they were already overmatched, they foolishly rushed into a new one, which in the end proved more disastrous than any in which they had yet embarked. The inhabitants of Sicily were, it seems, divided into two factions; the one called the Doric, at the head of which was Syracuse; the other the Ionic, at the head of which was Leontini. But the Ionic faction finding itself too weak to contend with its rival without foreign aid, sent Gorgias of Leontini, a celebrated orator, sophist, and rhetorician, to Athens to apply for assistance; and he by his fine speeches so captivated the multitude, the Μέγα Θρέμμα, or Great Beast (as the populace were sometimes contemptuously styled in private, by those who did not scruple to pander to their worst passions in public), that they rushed headlong into a war which they were unable to maintain while engaged in a death-struggle with nearly all the states of the Peloponnesus. Accordingly, bewrayed by the wily sophist,[1] and probably enticed by the hope of effecting the conquest of Sicily, they despatched a fleet to the assistance of the Leontines, under the command of Laches and Chabrias; and this had no sooner sailed than another destined for the same service was begun to be fitted out. In the mean time the plague continued its ravages to such an extent that in the course of this year four thousand citizens, and a much larger number of the lower class of people, fell victims to its fury.

Sixth and seventh years.

The sixth year of the Peloponnesian war was not remarkable for any great exploit. Agis, the son of Archidamus, king of Sparta, assembled an army in order to invade Attica; but was prevented from doing so by earthquakes, which shook almost every part of Greece, and produced general consternation. The next year, however, he entered Attica with his army; whilst the Athenians, on their part, sent a fleet, under the command of Demosthenes, to infest the coasts of Peloponnesus. As this fleet passed the coast of Laconia, the commander observed that the promontory of Pylos, which was joined to the continent by a narrow neck of land, had before it an island about two miles in circumference, which, though barren in itself, nevertheless contained an excellent harbour, sheltered from all winds either by the headland or isle, and capable of admitting the most numerous fleets; circumstances which led him to conclude that a garrison left here would alarm the Peloponnesians, and induce them to think rather of protecting their own country than of invading that of their neighbours. Accordingly, having raised a strong fortification, he established himself in the post, reserving five ships of war for its defence; and ordered the rest of the fleet to proceed to its intended destination. On the news of this event the Peloponnesian army immediately returned to besiege Pylos, and soon made themselves masters of the harbour, as well as of the island of Sphacteria, which was taken by a chosen body of Spartans. They then made a vigorous attack upon the fort, hoping to carry it before succours could arrive; but Demosthenes and his garrison made an obstinate defence; and an Athenian fleet arriving in the interval, relieved the besieged from all apprehensions on account of the superior force of the enemy. Battle was immediately offered; but as the Peloponnesian fleet declined the challenge, the Athenians sailed boldly into the harbour, and sunk or destroyed most of the enemy's ships, after which they besieged the Spartans in Sphacteria. Alarmed at finding the war carried into their own territory, the Peloponnesians now began to treat with their enemies; and whilst the negotiations were carrying on at Athens, a cessation of hostilities was agreed to, upon the condition that the Peloponnesians should in the mean time deliver up all their ships, but that in the event of the treaty not taking effect, these should be immediately restored. In as far as regards the negotiations, the Athenians, having heard the propositions of the Spartan plenipotentiaries, were at first strongly inclined to put an end to this ruinous and destructive war, all the evils of which had been so greatly aggravated by the dreadful pestilence which at the same time ravaged the city of Athens and part of the territory of Attica. But the demagogue Cleon, a fiery and headstrong man, persuaded his countrymen to insist on the most unreasonable terms; and as the confederates were by no means so far reduced as to suffer the Athenians *pacis imponere morem*, to dictate terms of peace, the plenipotentiaries withdrew, and by doing so, of course put an end to the armistice. The Peloponnesians then demanded the restoration of their vessels, conformably to the stipulation above mentioned; but the Athenians refused to deliver them up, on pretence that the former had violated the truce. Hostilities, therefore, were immediately recommenced on both sides; and the Lacedæmonians attacked the Athenians at Pylos, while the latter attacked the Spartans at Sphacteria. But the Lacedæmonians, though only a handful of men, and under every imaginable discouragement, defended themselves with so much bravery that the siege proceeded very slowly; and the people of Athens becoming uneasy at its duration, began to wish they had embraced the offers of the Spartans, and to rail vehemently against Cleon, who had been primarily instrumental in occasioning their rejection. To excuse himself, however, Cleon affirmed it would be an easy matter for the general of the forces which they were then sending to attack the Spartans in the isle, and reduce them at once. Nicias, who had just been appointed to the command, replied that if Cleon believed he could perform such wonders, he would do well to repair to the scene of action in person. Cleon, compelled to sustain his part, rejoined without hesitation that he was ready to go with all his heart; upon which Nicias caught him at his word, and declared that he had relinquished his command. Startled at this renunciation, the speech-maker protested that he was no general; but Nicias tauntingly assured him that he might some day become one; and the people amused with the controversy, held Cleon to his word. He then advancing, told them he was so little afraid of the enemy, that, with a very inconsiderable force, he would undertake, in conjunction with that already at Pylos, to bring to Athens in twenty days the Spartans who had given them so much trouble. The people laughed at this apparent gasconade; but having furnished him with the troops he desired, he, to the infinite surprise of every one,

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[1] Diodorus, xii. 53. See also Pausanias, vi. 17, 5, and Philostratus *in Vit. Gorg.* This celebrated artist in the dangerous craft of making the worse appear the better reason, would seem to have been a singular specimen of "health and longevity:" for, according to Philostratus, λέγεται ὁ Γοργίας ἐς ὀκτὼ καὶ ἑκατὸν ἐλάσαι ἔτη; but the sounder opinion seems to be, that he was born about B.C. 485, and died soon after B.C. 380, at the age of 105 or 106. He was in reputation as a sophist and rhetorician for nearly fourscore years. (*Fasti Hellenici*, p. 63.)

brought the Spartans prisoners to Athens within the time he had specified.[1]

Eighth year.

In the eighth year of the war Nicias reduced the island of Cythera on the coast of Laconia, and Thyræa, a frontier territory, which had been given to the Æginetans when expelled from their own country by the Athenians. In Sicily, Hermocrates of Syracuse, having persuaded the inhabitants of the island to adjust their differences without foreign interference, the Athenian generals returned home; a step which so greatly displeased their countrymen, that two of them were banished, and the third was sentenced to pay a heavy fine. The Athenians, under the conduct of Hippocrates and Demosthenes, next laid siege to Megara; but Brasidas, a Spartan general, coming to its relief, a battle ensued, which, though indecisive in its result, gave the Lacedæmonian faction an ascendency in Megara, and forced many who had favoured the Athenians to withdraw. In Bœotia some commotions were raised in favour of the Athenians; but their generals Hippocrates and Demosthenes being defeated by the Lacedæmonian party, all hopes ceased of the Athenian power being established in this district of Greece.[2]

Ninth year.

In the ninth year the Spartans made new proposals of peace, which the Athenians were now more inclined to accept than formerly; and finding their affairs much unsettled by the loss of Amphipolis, which had been reduced by Brasidas, a truce for a year was agreed on, while negotiations were immediately opened for restoring a general peace. But this pacific scheme was soon overthrown by a misunderstanding, arising out of an occurrence purely accidental, and the war was in consequence renewed.

Nician pacification.

The following year commenced with an attempt by Brasidas upon Potidæa; but this having failed, the Athenians began to recover some courage; and the truce expiring on the day of the Pythian games, Cleon advised the Athenians to send an army under his own command into Thrace. They agreed to this proposal, and immediately fitted out a force, consisting of 1200 foot and 300 horse, all Athenian citizens, embarked on board thirty galleys, of which the demagogue took the command. Brasidas was inferior in numbers to his opponent; but, observing that the Athenian commander was careless, and neglectful of discipline, the Spartan suddenly attacked him, and routed his army with the loss of half its numbers, while that of the assailants amounted to only seven killed and a few wounded. In this encounter, which appears to have been a complete surprise, the commanders on both sides were slain; and although the Athenians might well spare their general, whom impudence and accident had invested with a military command, the death of their brave leader was a serious loss to the Spartans, who, in fact, lamented him more than the Athenians did the loss of the battle. In consequence of this event, however, the latter were now much more disposed than formerly to listen to terms of accommodation. Amongst the Spartans, too, there was a party, at the head of whom was Plistoanax, their king, who earnestly wished for peace; and as Nicias laboured no less assiduously at Athens to bring about this desirable event, a peace was at last, 421 B.C., concluded between the two nations for the period of 50 years.[3] The conditions were, a restitution of places and prisoners on both sides, with the exception of Nisæa, which was to remain in the hands of the Athenians, who had taken it from the Megarians, and of Platæa, which was to continue in possession of the Thebans, who could not possibly give it up without uncovering the whole of their territory. The Bœotians, Corinthians, and Megarians, refused to be included in this peace; but the rest of the allies acquiesced; and being accordingly ratified, it received the name of the Nician pacification, from that of the general who had been mainly instrumental in restoring the blessing of peace to his country.

New misunderstandings.

But although peace was nominally established, tranquillity was far from being restored. Dissatisfied with the treaty on various grounds, several states of the Peloponnesus, headed by Argos, immediately commenced organizing a new confederacy; even the Lacedæmonians found it impossible to fulfil exactly the stipulations of the agreement; and the town of Amphipolis in particular peremptorily refused to return under the government of Athens; for which reason the Athenians also refused to evacuate Pylos. In the course of the winter fresh negotiations were opened, but nothing definite was agreed upon, and the time passed in mutual complaints and recriminations. At Athens, in particular, the flame of discontent was artfully fanned by Alcibiades, who now began to rival Nicias in public favour, and who, perceiving that the Lacedæmonians paid their court principally to his rival, took every opportunity of incensing his countrymen against that nation. On the other hand, Nicias, whose reputation was concerned in maintaining the treaty inviolate, used his utmost endeavours to bring about a reconciliation, and even undertook a journey to Sparta, in the hope of effecting an accommodation; but, most unhappily, the artifices of Alcibiades, added to the turbulent and haughty disposition of both nations, rendered all his efforts unavailing, and at length satisfied him that a renewal of the war was inevitable. If the intrigues of that remarkable man, however, were mainly instrumental in bringing about a rupture, it cannot be denied that he took the most prudent methods for insuring the safety of his country. With this view he entered into a league with the Argives for the long term of a hundred years; he then marched into the territories of that state at the head of a considerable force; and he exerted all his influence, both at Argos and at Patræ, to persuade the people to connect their cities with the sea by means of walls, in order to facilitate the landing of succour, when it might be necessary, by the Athenians. But, though vigorous preparations were now made for a renewal of the war, nothing of any consequence was undertaken this year; if we except an attempt by the Argives to make themselves masters of Epidaurus, which was, however, defeated by the Lacedæmonians throwing a strong garrison into the place.

Renewal of the war.

The next being the fourteenth year of the Peloponnesian war, a Spartan army, under the command of Agis, entered the territory of Argos; but just as battle was on the eve of commencing, a truce was suddenly concluded between two of the Argive generals and the king of Sparta. But it so happened that neither party felt satisfied with this proceeding, and both the king and the generals were very ill received by their respective fellow-citizens. Accordingly, on the arrival of some fresh troops from Athens, the Argives immediately broke the truce; and a battle ensuing soon afterwards, the allied army was defeated with great slaughter by Agis, who thus achieved a victory on the very spot which was afterwards destined to acquire additional celebrity as the scene of one of the most disastrous defeats which the Spartan arms ever experienced. In the winter a strong party in Argos joined the Lacedæmonians; in consequence of which that city renounced her alliance with Athens, and concluded peace with Sparta for the period of half a century. Further, in compliment to their new allies, the Argives abolished democracy in their city, substituting an aristocracy in its stead; and also assisted the Lacedæmonians in forcing the Sicyonians to adopt a similar form of government. Notwithstanding all this, however, the Argives, with a levity natural to the Greeks, renounced their

[1] Thucydides, iv. 39.

[2] Alcibiades seems to have already begun to take part in public affairs. See a passage in the Wasps of Aristophanes, 44, where his manner of speaking is ridiculed. At this time he was about twenty-four years of age.

[3] Thucydides, v. 18, 19, 20.

alliance with Sparta the following year; abolished aristocracy, drove the Lacedæmonians out of the city, and renewed their league with Athens. On the other hand the Athenians, convinced of the bad faith of Perdiccas, king of Macedonia, abjured his alliance and declared war against him; preferring, as they said, an open enemy to a treacherous friend. And as Argos was still distracted by adverse factions, Alcibiades in the course of the ensuing year terminated all disputes between them by the expulsion of the Spartan party. He then sailed for the island of Melos, which had shown the greatest inveteracy against his countrymen, in order to punish the inhabitants for repeated acts of wanton hostility; but perceiving that the reduction of the island would be a work of time, he left a considerable body of forces there, and returned to Athens. In his absence, however, the capital of Melos surrendered at discretion, and the inhabitants were treated with the utmost severity; all the men capable of bearing arms being slaughtered, and the women and children carried into captivity.

Loss of the Athenian army in Sicily.

In the beginning of the seventeenth year, Nicias was appointed commander-in-chief of an expedition destined to act against the Syracusans, with Alcibiades and Lamachus as colleagues. But whilst the necessary preparations were being made, Athens was thrown into terrible confusion by the defacing of the Hermæ or statues of Hermes, of which there was a great number in the city; an outrage equally wanton in itself, and appalling to the people of Athens, who revered these statues both as monuments of art and as symbols of religion. Great efforts were in consequence made to discover the perpetrators of this sacrilege; but although ample rewards were offered, no disclosure was then made. At last, from some cause unexplained, suspicion fell upon Alcibiades, who in consequence received orders to return immediately from Sicily in order to take his trial for this alleged crime. But he knew the temper of his countrymen too well to trust himself to their mercy; and, instead of returning to Athens, he fled to Sparta, where he met with a gracious reception; whilst the Athenians were severely punished by the loss of their army, generals, and fleet, in Sicily; a disaster which the superior abilities of Alcibiades would in all probability have prevented.

Intrigues of Alcibiades.

The nineteenth and twentieth years of the war were spent by the Athenians in equipping a new fleet in order to repair their losses; but Alcibiades hurt their interests greatly by persuading Tissaphernes the Persian to league with the Spartans against them, and at the same time stirring up several of the Ionian states to revolt against what he described as the mob government of Athens. Equally restless and profligate, however, this celebrated Athenian had scarcely established himself amongst his new allies when he contrived, by means of a handsome person and an insinuating address, to debauch the wife of Agis the Lacedæmonian commander; and as the latter strongly resented the affront which had been put upon him, the Athenian seducer was obliged to quit Sparta and pass over into Persia. Here, however, he met with a favourable reception from Tissaphernes, who profited much by his advice, which, in fact, was equally shrewd and insidious. "Let the Greeks," said he to the Persian general, "exhaust themselves by their mutual wars; foment discord among them, which you will always find comparatively an easy task; take care never to let one state be totally destroyed, but always to support the weaker party against the more powerful;—follow this policy for a time, and the Greeks will themselves spare you the trouble of conquering them. By their incessant contests they will so weaken themselves that their country will become the prey of the first invader."

Abolition of democracy.

As may easily be supposed, Tissaphernes readily acquiesced in these counsels; upon which Alcibiades wrote privately to some of the officers in the Athenian army at Samos, informing them that he had been treating with the Persians in behalf of his countrymen, but that he did not choose to return till the democracy should be abolished; adding, that the Persian king disliked a democracy, but would immediately assist them if that was abolished, and an oligarchy established in its stead. On the arrival of Pisander and other deputies from the army with the proposals of Alcibiades, the oligarchial party succeeded in overturning the democratic constitution; in consequence of which Pisander and the deputies received directions to return to Alcibiades, in order to ascertain precisely on what terms the king of Persia was disposed to enter into an alliance with them. But perceiving that Tissaphernes was by no means inclined to assist the Athenians, on account of their recent successes, Alcibiades artfully set up such extravagant demands in the king of Persia's name, that the Athenians of themselves broke off the treaty, and thus enabled him to outwit both parties without offending either. But notwithstanding the failure of the negotiations with Tissaphernes, the democratical form of government was abolished, first in the cities subject to Athens, and afterwards in the capital itself; whilst, according to the scheme substituted in its stead, it was provided that the old form of government should be entirely dissolved;—that five Prytanes should be elected;—that these five should choose a hundred others, and each of the hundred choose three more;—that the Four Hundred thus elected should become a senate with full power, but should nevertheless consult occasionally with Five Thousand of the wealthiest citizens, who alone were henceforth to be accounted The People;—and that no authority whatever should remain in the hands of the lower class of citizens. Such was the scheme proposed by Pisander; and although the people were opposed to this change, those who conducted it, being men of great parts, found means to establish it by one of those unceremonious acts of audacity which commonly distinguish revolutions in popular governments.

The army declares for a democracy.

In the meanwhile the Athenian army having changed their mind, declared for a democracy; and recalling Alcibiades, they invested him with full power, and insisted on his immediate return to Athens for the purpose of restoring the ancient government. But he peremptorily refused to comply with their wishes; persuaded them to stay where they were in order to save Ionia; and further prevailed on them to allow some deputies, who had been sent by the new governors of Athens, to deliver the message with which they were charged. When the deputies had done so, Alcibiades enjoined them in reply to return immediately to Athens, and acquaint the Four Hundred that they were commanded instantly to resign their authority and restore the senate; adding, that the Five Thousand might retain their power for the present, provided they used it with moderation. By this answer the city was thrown into the utmost confusion; but the party of the new government prevailing, ambassadors were despatched to Sparta with orders to conclude peace upon any terms. This, however, was not so easy a matter as some had hastily imagined; for the Spartans proved intractable; and Phrynichus, the chief of the embassy, was murdered on his return. When the news of his death arrived, Theramenes, the head of the democratical party, seized the leaders of the Four Hundred; upon which a tumult ensued that had almost proved fatal to the city itself; but the people being at last dispersed, the Four Hundred immediately assembled, and sent deputies to the people, promising to comply with all their reasonable demands. A day was accordingly appointed for convoking a general assembly, and settling the form of government; but when it arrived, intelligence was brought that the Lacedæmonian fleet was in sight, and steering directly for Salamis. Thus all was again thrown into confusion; and the people, instead of deliberating on the subject proposed, ran in crowds down to the port, whence a fleet of 36 ships was immediately despatched, under the command of Timochares, to engage the

enemy, who were perceived to be making for Eubœa. But this fleet was utterly defeated, 22 ships being taken, and the remainder either sunk or disabled; and this disaster was followed by the revolt of all Eubœa, except the small district of Oreus. When the dismal tidings reached Athens, everything was given up for lost; and had the Lacedæmonians taken this opportunity of attacking the city, they would undoubtedly have succeeded in the attempt, and thus put an end to the war by the subjugation of Athens. But being at all times slow, especially in naval affairs, they allowed the Athenians time to equip another fleet, and to retrieve their affairs; while Alcibiades, by his intrigues, so effectually embroiled the Persians and Peloponnesians that neither party knew whom to trust, and mutual distrust at length rose to such a pitch as almost to involve them in open hostility; and several advantages gained by the Athenians at sea tended to revive their hopes and restore their confidence.

Alcibiades triumphant and disgraced.

During the succeeding years of this celebrated war the Athenians were also in the first instance very successful. Thrasybulus obtained a signal advantage at sea; and in the same day Alcibiades gained two victories, one by land and another by sea, capturing the whole Peloponnesian fleet, besides an immense spoil. The Spartans, humbled by these reverses, were reduced in their turn to the necessity of suing for peace. But the Athenians, intoxicated with success, sent back the envoys without vouchsafing an answer to their proposals; and the Spartans, justly incensed at this insolent and contemptuous conduct, renewed the war with the utmost vigour, and soon after made themselves masters of Pylos. Nor was this the only misfortune of the Athenians. The Megarians surprised Nisæa, and put the garrison to death; an act which so exasperated the Athenians, that they immediately sent an army against that people,—defeated them with great slaughter,—and committed horrid devastations, in revenge for the affair of Nisæa. But these misfortunes were still in some measure counterbalanced by the great actions of Alcibiades, Thrasybulus, and Theramenes. When Alcibiades returned in triumph to Athens, 408 B.C., he brought with him a fleet of 200 ships, together with such a load of spoils as had never been seen in the capital since the conclusion of the Persian war. The people crowded to the port to behold the hero as he landed; old and young blessed him as he passed; and next day, when he had delivered a harangue to the assembly, they directed the record of his banishment to be thrown into the sea, absolved him from the curses he lay under on account of the alleged sacrilege, and created him generalissimo of their forces. But this enthusiasm was too violent to be lasting; and in point of fact a casual reverse which Alcibiades sustained soon after this obliterated all remembrance of his former services, and involved him in disgrace. Having sailed to the Hellespont with part of his fleet, he left the remainder under the command of Antiochus his pilot, with strict orders to attempt nothing in his absence. But the pilot chose to disobey his instructions, and having provoked Lysander, the Lacedæmonian admiral, to an engagement, he paid for his temerity by a total defeat, with the loss of fifteen ships, and that of his own life into the bargain. On receiving intelligence of this disaster, Alcibiades returned, and endeavoured to induce the Lacedæmonian commander to hazard a second battle; but Lysander was too prudent to incur such a risk; and in the meanwhile the Athenians deprived Alcibiades of his command, and named ten new generals in his stead. By this proceeding their ruin was sealed. Conon, who succeeded to the command, was beaten by Callicratidas, Lysander's successor; but being afterwards strongly reinforced, he retrieved this disgrace by defeating the Lacedæmonians with the loss of no less than 77 ships. Such a victory might have been supposed to inspire the Athenians with some gratitude towards the generals who had gained it; but instead of this eight of them were recalled, on pretence of their not having assisted the wounded during the engagement: two were prudent enough not to return; and the six who trusted to the justice of their country were all put to death without mercy.

Athenians defeated at Ægospotami.

The following year Lysander, appointed commander of the Peloponnesian fleet, succeeded in capturing both Thasus and Lampsacus. Conon was immediately despatched against him with 180 ships; a force so superior to that under Lysander, that the Lacedæmonian declined accepting battle, and was consequently blocked up in the river Ægos. While the Athenians lay there observing him, they grew quite idle and careless, insomuch that Alcibiades, who had built a habitation for himself in the neighbourhood, entreated them to be more watchful, as he well knew Lysander's great abilities, and dreaded that they might have reason to repent their security if they disregarded his advice. They replied by expressing their wonder at the assurance of one who was an exile and a vagabond, in pretending to offer advice to them; adding, that if he gave them any further trouble, they would seize and send him a prisoner to Athens. The consequences of such conduct may easily be imagined. Lysander fell unexpectedly upon them, and gained a complete victory; Conon, with only nine galleys, escaping to Evagoras at Cyprus: after which the Lacedæmonian commander returned to Lampsacus, where he put to death Philocles with 3000 of his soldiers, and the whole of the officers except Adimantus. He then reduced all the cities subject to Athens, and artfully sent home their garrisons, that the city, overstocked with inhabitants, might thus be rendered incapable of holding out for any length of time when he came to besiege it.

Capture of Athens.

Nor was any time lost in undertaking this decisive operation. Lysander appeared before the harbours with a fleet; while Agis, at the head of a powerful army, invested it on the land side. For a considerable time the Athenians resisted both attacks; but they were at last forced to send deputies to Agis, who referred them to Sparta; and when they repaired thither they were told that no terms could be granted unless they consented to demolish their walls. They next applied to Lysander, but he also referred them to Sparta; to which Theramenes, with other deputies, was immediately despatched. On their arrival they found assembled the council of the confederates, who all except the Spartans gave their votes for the utter destruction of Athens; but the latter would on no account consent to the ruin of a city which had deserved so well of Greece. The Athenian envoys did all in their power to mitigate the severity of the terms, but without effect; and finally peace was concluded, on condition that the long walls and the fortifications of the port should be demolished, and that the Athenians should deliver up all their ships excepting twelve, receive back such as had been banished for political offences, and consent to follow the fortune of the Lacedæmonians. And these severe terms were punctually executed. Lysander caused the walls and fortifications to be pulled down; established an oligarchy expressly against the will of the people; and thus completed the ruin of Athens in the twenty-seventh year of the Peloponnesian war, and the 404th B.C.

The Thirty Tyrants.

As soon as the Lacedæmonian had demolished the long walls and the fortifications of the Peiræus, he constituted a council of thirty, with power, as was pretended, to make laws, but in truth to subjugate the state. These were the persons so famous in history under the title of The Thirty Tyrants. They were all the creatures of Lysander; and as they derived their power from conquest and the law of the sword, they exercised it in a manner worthy of its origin. Instead of making laws, they governed without them; they appointed a senate and magistrates at their will; and, lastly, they applied for a garrison from Lacedæmon, that, under the protection of a foreign military force, they might give a freer and bolder scope to the licentiousness of tyranny.

Attica.

Critias and Theramenes, two men of the greatest power and abilities in Athens, were at the head of this odious oligarchy. The former was ambitious and cruel beyond measure; but the latter was of a more merciful and humane disposition. The one pushed on all the bloody schemes framed by his confederates, and carried into execution many of his own; the other always opposed them, at first with moderation, at last with vehemence. In the course of his expostulations he said, that power was given them to rule and not to despoil the commonwealth; that it became them to act like shepherds, not like wolves; and that they ought to beware of rendering themselves at once odious and ridiculous, by attempting to domineer over all, being a mere handful of men, whom the slightest resistance would crush. This hint was not thrown away; for the remaining oligarchs immediately chose three thousand persons, whom they constituted the representatives of the people, and on whom they granted the notable privilege of not being liable to be put to death except by judgment of the senate; thereby assuming by implication a power of sacrificing the other Athenian citizens at their pleasure. Nor were they slow in practically confirming the justice of this interpretation; for as many as they conjectured to be unfriendly to the government in general, or to any of themselves in particular, they put to death, without cause and without mercy. Theramenes stoutly resisted this wantonness of cruelty; and absolutely refusing to concur in such measures, Critias accused him to the senate as a man of unsteady principles, sometimes for the people, sometimes against them, and favourable to nothing except innovation and revolution. The accused admitted that he had sometimes changed his measures, but alleged that he had always done so for the benefit of the people. It was solely with this view that he made peace with Sparta, and accepted of office as one of the Thirty; nor had he ever opposed their measures while they cut off the wicked; but when they began to destroy men of fortune and family, solely for the purpose of confiscating their property, then he owned he had differed with them, which he conceived to be no crime against the state.

Critias and Theramenes.

Theramenes put to death.

Whilst Theramenes was speaking, Critias, perceiving the impression made upon the senate by his words, withdrew abruptly; but he soon returned with a guard, crying out that he had struck the name of Theramenes out of the list of the three thousand; that the senate had therefore no longer cognizance of the cause; and that the Thirty had already judged and condemned him to death. Theramenes, seeing that they intended to seize him, fled to the altar in the midst of the senate-house, and laying his hands thereon, said, "I do not seek refuge here because I expect to escape death, or desire it; but that, tearing me from the altar, the impious authors of my murder may interest the gods in bringing them to speedy judgment, and thereby restore freedom to my country." The guards then dragged him from the altar, and carrying him to the place of execution, he drank the poison with undaunted courage; reminding the people, with his last breath, that the same tyrants who had arbitrarily struck his name out of the list of the three thousand, might also strike out any of theirs, and that none could say whose turn it might next be to drink the fatal cup which he had just drained. The death of this heroic man was followed by a train of murders such as are to be found recorded only in the annals of republican oligarchies or aristocratical republics. Almost every citizen of any eminence either died a violent death or was driven into exile.[1]

At length Thrasybulus, and such as like him had taken shelter in the Theban territory, resolved to hazard every thing rather than remain in a state of perpetual exile from their country; and although he had no more than thirty men on whom he could depend, yet, inspired by the remembrance of the victories he had heretofore obtained in the cause of his country, he boldly made an irruption into Attica, and seizing on Phyle, a castle at a short distance from Athens, numbers flocked to his standard, and he soon found himself at the head of seven hundred men, maddened by cruelty and oppression, and prepared to devote themselves for their country. The tyrants of course had the disposal of the Spartan garrison, which they employed to reduce Thrasybulus and his party; yet he prevailed in various skirmishes, and at last obliged them to decamp from Phyle, which they had intended to blockade. The Thirty and their partisans conceiving it expedient to obtain possession of Eleusis, marched thither; and having persuaded the people to go unarmed out of their city, on the pretence of numbering them, the monsters instantly commenced an indiscriminate massacre. But the forces of Thrasybulus increasing daily, he seized on the Peiræus, which he fortified in the best manner he could; and although the tyrants came down against him with the utmost force they could raise, he defended himself with so much obstinacy, that in the end they were forced to retreat, having lost before the place not only a great number of their men, but Critias, the president of the Thirty, and other members of this sanguinary oligarchy. By this gallant resistance the fate of the oligarchy was sealed. The people indeed differed among themselves; and the sanguinary monsters, who during their short administration had destroyed more men than had fallen during half the Peloponnesian war, had still a considerable party in Athens. But happily the cause of humanity prevailed; the tyrants were expelled, and withdrew to Eleusis.

Attica.

Tyranny overthrown.

But although the citizens had changed the government, they had made no agreement with those in the Peiræus;[2] whilst the tyrants, who had retired to Eleusis, sent deputies to Lacedæmon to announce the revolt of the Athenians, and request assistance to reduce them. Nor did their application prove fruitless. Besides remitting them a large sum of money to aid their intrigues, the Lacedæmonians appointed Lysander commander-in-chief, and his brother admiral; resolving to send both a fleet and an army, in order to reduce Athens a second time, and, as most of the Greek states then strongly suspected, to add it to their other dominions. Nor is it improbable that this design would have taken effect, had not Pausanias, the rival and enemy of Lysander, resolved to obstruct it by every means in his power. With this view he caused another army to be raised, of which he took the command, and immediately marched for the ostensible purpose of besieging the Peiræus. But while he lay before the place, and pretended to attack it, he entered into a private correspondence with Thrasybulus, instructing him what propositions to make in order to induce the Lacedæmonians, who were suspected by their allies, to abandon the contest, and conclude a peace upon equitable terms. These intrigues had all the success that could be desired. The Ephori who were with Pausanias in the camp concurred in his measures; and in a short time a treaty was concluded, by which, amongst other things, it was provided that all the citizens of Athens should be restored to their homes and privileges, with the exception of the Thirty, the Eleven who had acted as their ministers, and the Ten who during the time of the oligarchy had been constituted governors of the Peiræus; that all should remain quiet for the future in

Spartans attempt to reduce Athens a second time.

[1] Alcibiades died during the tyranny of the Thirty. He was then in the forty-fourth year of his age, and had been more or less engaged in public affairs for about twenty years. He was a bold and able, but bad man; of great personal and mental endowments, but utterly devoid of principle, and addicted to the most shameless profligacy; prompt, skilful, brave, enterprising, restless, ambitious, yet fond of intrigue and finesse in all things; an enemy to liberty, under the mask of ultra-democracy; and reckless of every consideration which was opposed to the gratification of his pride, vanity, ambition, sensuality, revenge, and love of perpetual bustle and turmoil.

[2] Οἱ ἐν Πειραιεῖ, that is, Thrasybulus and his party.

the city; and that, if any persons were afraid to trust to this agreement, they should have permission to retire unmolested to Eleusis. Pausanias then marched away with the Spartan army; and Thrasybulus at the head of his forces entered Athens, where, having laid down their arms, they sacrificed with the rest of their fellow-citizens in the temple of Athena, and then, to the great delight of all, restored the popular form of government, which was afterwards consolidated by an act of general amnesty and oblivion.[1]

Virtue of Thrasybulus.

Throughout the whole of this transaction the conduct of Thrasybulus was admirable. When he first seized the castle of Phyle, the tyrants privately offered to receive him into their number instead of Theramenes, and to pardon at his request any twelve persons whom he might choose to name. But he nobly replied that he considered his exile far more honourable than any authority could be, purchased on such terms; and by persisting in his design he accomplished the deliverance of his country from a ferocious and sanguinary oligarchy which, as Isocrates informs us, had put 1400 citizens to death without any form of law, and had driven 5000 more into banishment, besides committing a variety of other acts of cruelty and oppression.

But, although Athens was thus restored to liberty by the virtuous patriotism of Thrasybulus, the age of Athenian glory had passed away. From this period till the reign of Philip of Macedonia the republic gradually sunk in energy, though it still continued to enjoy tolerable prosperity; and although many of the great masterpieces of Athenian genius were the productions of a later age, the most splendid of these only serve to prove beyond all question that the national spirit had degenerated, and that, "sunk in its glory, decayed in its worth," the Athenian Demos, which had once been the wonder and terror of the world, was now prepared to receive the law from the hands of almost any master. Philip accordingly found but little difficulty in extinguishing the feeble remains of liberty; and his son Alexander having completed the subjugation of Greece, the history of the Grecian states henceforward ceases to be of almost any interest. With regard to the capital, however, a rapid sketch of its history from this period till the present time will be found under the article ATHENS, to which reference is accordingly made.

Having thus laid before the reader an outline of the general history of Attica, it now only remains to give, as briefly as possible, some account of the character, government, religion, and public economy of the Athenians.

Character of the Athenians.

National character may be defined as the aggregate of those qualities or peculiarities, physical, moral, and political, by which one community of men is distinguished from another; in other words, it is a complex result produced by the action and re-action of primary and secondary causes, or the joint effect of all the circumstances, original and accidental, in which a people happens to be placed. But these causes are so various, both in kind and degree,—the operation of one is so much affected and modified by that of another, and direct physical becomes so much blended with indirect moral and political influences,—that, whilst it is comparatively an easy matter to determine in what respects the general characters of nations differ, it is exceedingly difficult, not to say impossible, to resolve that of any one into its constituent elements, and to assign to each its due share in the production of the ultimate result. The instrument of analysis which, employed in the investigation of physical laws, has led to the discovery of the most sublime truths, and extended the knowledge and consequently the power of man over the material world, is applicable only in a very limited degree even to the most complex phenomena of mind. Here we possess no manner of control over the subject of our inquiries; we have no power of placing it in new situations, of trying it by a variety of tests, or of submitting it to a course of skilfully contrived experiments. All that we can possibly do is either carefully to watch its manifestations, where these fall under our own notice, or to apply the principles of a sound logic to such observations as have been recorded by others, and thus to endeavour to make the nearest approximation we can to the truth. In such a method of investigation, however, the liability to error must necessarily be great; for, independently of its own obvious imperfection, the subtile nature of the phenomena observed, and the constant transitions and modifications they experience, produce continual mistakes upon the part of the observer; whilst the spirit of system or of theory, which is generally most active where our knowledge is least accurate and extensive, instead of facilitating the correction of such mistakes, contributes rather to render them inveterate, and thus opposes a serious obstacle to the progress of sound inquiry. In attempting to form a judgment of the national character of a people, therefore, it becomes us to be equally on our guard against dogmatism in the statement of facts, and rash generalization in the inferences deduced from them. The former, indeed, are but too frequently stated without the qualifications proper to be applied to them; the latter is almost certain to lead into error and mystification. In cases where physical and moral causes are blended together in their operation; where primary results experience endless modifications from the influence of circumstances and the re-active working of positive institutions; and where we are in possession of no instrument of analysis by which the complex whole can be reduced into its constituent parts or elements; it is manifest that no theory which human ingenuity can invent will ever be sufficient to explain all the phenomena of national character, or to account for the varied and often incongruous phases which it assumes. Some writers, for instance, have amused themselves with referring to the influence of climate all the varieties observable in the characters and institutions of different nations; whilst others, again, have ascribed to the joint effect of moral and political causes, operating under peculiar circumstances, the diversities in question. But it must be obvious, on the slightest consideration, that both these theories are equally untenable, inasmuch as national character is not the result of one cause or set of causes, but of all the causes and influences, of whatever kind, which act, either directly or indirectly, upon the general mind of a people. Instead of attempting to generalize, therefore, where generalization is from the very nature of things inadmissible, let us endeavour simply to point out some of the leading features in the character of that illustrious nation which in ancient times inhabited the territory of Attica, and filled the world with the renown of their achievements both in arts and in arms.

The Athenians surpassed all the other Greeks in physical conformation no less than in mental endowments. Among this people, indeed, strength and symmetry of body were happily united with many of the rarest attributes of mind. For these advantages they were indebted partly to nature, and partly to a system of education, which, apparently limited and imperfect, was nevertheless singularly calculated to develop their peculiar capabilities. Habitual exercise may not be capable of creating beauty of form originally, but it certainly tends greatly to improve it; and in the human frame elegance and grace are seldom divorced from the free and flexible vigour acquired in the palæstra. A similar observation may be applied to the human mind. Admitting that certain tribes or races of men are, taken as a whole, gifted by nature with finer faculties, nicer perceptions, and more acute sensibilities, than others, no one can doubt that these may be prodigiously improved by education; which, in fact, is to the mind what the chisel of the sculptor is to the rude block of marble,—that which fashions it, by scarcely per-

[1] This war lasted ten months. (Xenophon, *Hist. Græc.*, ii. 4, 43.)

ceptible degrees, into the fairest proportions, and gives animation and expression to that which was originally a rude and inert block. The Athenians were early sensible of this important truth; and although, till the age of Pericles, the three principal preceptors of their youth were the grammarian, the teacher of music, and the master of the gymnasium, yet even this limited circle of instructors was not ill adapted to call forth and keep in exercise the peculiar faculties for which they were so remarkably distinguished, and to prepare them for a more extended range of instruction. To the study of music, indeed, they were enthusiastically devoted, because in that delightful art they found a natural scope for the gratification of those nice and delicate perceptions which constituted a prominent characteristic of their minds;[1] nor will its union with the study of grammar be deemed surprising, when we reflect that it was probably this circumstance, aided by an organic and intellectual sensibility altogether unrivalled, "which gave form to the most harmonious language ever spoken among men, and guided invention to the structure of that verse which, even under the gross disguise of modern pronunciation, is still universally charming."[2] But there were other elements in the Athenian character besides a love of music, poetry, and the fine arts, which both nature and education had contributed to form.

Speaking of this people, Plutarch, after describing them as at once passionate and placable, prone to anger, yet easily appeased, goes on to observe, that their minds were not formed for laborious researches; and that, although they seized a subject as it were by intuition, yet they wanted the patience and perseverance requisite for a thorough examination of its various bearings and ramifications. An observation more superficial in itself, and arguing a greater ignorance of the real character of the Athenians, cannot easily be imagined. That they were remarkable for ardour and vivacity of temperament, quickness of sensibility as well as of apprehension, and versatility of feeling as well as of genius, has not been disputed. But there is nothing in all this which necessarily presupposes or implies an incapacity for the prosecution of subjects requiring patient thought and persevering attention. The French, in point of national character, hold nearly the same relative place among the modern nations of Europe that the Athenians held among the states of ancient Greece; yet it is matter of notoriety, that in the cultivation of the natural and the exact sciences, that is, in the prosecution of those subjects where patience and perseverance are pre-eminently indispensable, they have for a considerable time outstripped all competition, and borne the palm alone. This was precisely the case with the Athenians. A love of profound research and curious speculation seems to have been as inherent in their character, and as congenial to their national temperament, as a love of poetry, music, and the fine arts.

Love of speculative inquiries.

The fire which Thales lighted up was never afterwards wholly extinguished amongst the Greeks. He had kindled his torch at the altar of science in Egypt, and it burned brightly in the propitious atmosphere to which it was transferred by the father of Greek philosophy. The Ionian school, of which this philosopher became the founder, was followed in quick succession by the Italian and Eleatic, where the physical and metaphysical sciences were cultivated with equal success; and in the dialogues of Plato, ample evidence may be found of the zeal and ardour with which the laws both of mind and of matter were investigated in Athens, as soon as the violence of political contention had subsided, and a respite from wars and revolutions gave leisure for the discussion of such subjects. God, the Universe, and Man, at once divided and engrossed the whole of their attention. The question first asked was, What is God? and to this various and discordant answers were of course necessarily given. According to Thales, he is the most ancient of all things, for he is without beginning; he is air, said Anaximenes; he is a pure mind, quoth Anaxagoras; he is both air and mind, contended Archelaus. Democritus thought him mind in a spherical form; Pythagoras, a monad, and the principle of good; Heracleitus, an eternal circular fire; Parmenides, the finite and immovable principle, in a spherical form; Melissus and Zeno, one and everything, the only eternal and infinite. But these answers, being all more or less physical, did not satisfy the question; a vacuity was still left; and Necessity, Fate, and Fortune or Accident, were the principles called in to fill it up. The Universe gave rise to another set of disputations. According to some, what is has ever been, and the world is eternal. Others, again, argued that the world is not eternal, but that matter is eternal. And here a multitude of questions arose. Was this matter susceptible of forms, of one or of many? Was it water, or air, or fire, or an assemblage of corpuscular atoms, or an infinite number of indestructible elements? Had it subsisted without movement in the void, or had it an irregular movement? Did the world appear by intelligence communicating its action to it, or did the Deity ordain it by penetrating it with a part of his essence? Did these atoms move in the void, and was the universe the result of their fortuitous concourse? Are there but two elements in nature, earth and fire; and by these are all things produced? or are there four elements, whose parts are united by attraction and separated by repulsion? In a word, "causes and essences; bodies, forms, and colours; production and dissolution; the great phenomena of visible nature—the magnitudes, figures, eclipses, and phases, of the two heavenly luminaries; the nature and division of the sky; the magnitude and situation of the earth; the sea, with its ebbs and flows; the causes of thunder, lightning, winds and earthquakes;—all these furnished disquisitions which were pursued with an eagerness of research and intenseness of application peculiar to the Greeks."[3] Nor did Man form a subject of less interesting and curious speculation than the universe of which he was considered an epitome. All allowed him a soul and an intelligence, but all differed widely in their ideas respecting this soul or intelligence. Some maintained that it was always in motion, and that it moved by itself; others thought it a number in motion; some considered it the harmony of the four elements; others, again, variously represented it as water, fire, blood, a fiery mixture of things perceptible by the intellect, which have globose shapes and the force of fire, a flame emanating from the sun, an assemblage of fiery and spherical atoms, like those subtile particles of matter which are seen floating in the rays of the sun.

Such were a few of the speculations which science had devised for employing the thoughts of the active-minded men in Greece, particularly in Attica; and when to these we add the ethical and political systems of the Academy, the Lyceum, the Porch, and the Gardens, to say nothing of that of the New Academy founded by Arcesilaus, and ably maintained by Carneades, or of the attention paid by almost all the philosophers to the cultivation of pure geometry, some idea may be formed of the extent of Plutarch's misrepresentation of the Athenian mind when he described

[1] What the music of the ancients ever was, we have now little means of judging, as none of it has been transmitted intelligibly to us; but that the Grecian music, even from the earliest times, had extraordinary merit, we have Plato's testimony in very remarkable words (*Minos*, 46; *Convivium*, 333); and Aristotle (*Polit.* l. viii. c. 5) coincides in judgment with his great master. (Mitchell's *Aristophanes*, prel. disc. p. xxxv. xxxvi.)

[2] Mitchell's *Aristophanes*, prel. disc. *ubi supra*.

[3] *Ibid.* p. xli. *et seqq.*

it as incapable of pursuing laborious researches, and as wanting in persevering and continuous attention. The very reverse of this, as has just been shown, was the truth; and, independently of the exemplification of a similar capacity for deep and laborious researches on the part of a modern nation whose character in many particulars resembles that of the ancient Athenians, it is no more than a sound view of the principles of human nature might, anterior to all experience, have led us to anticipate. For, as travellers often reach the same destination by different routes, so men frequently pursue the same course from different motives or impulses. In the prosecution of scientific investigations, for instance, the Frenchman and the German are each persevering and laborious; but the former is impelled by an ardent curiosity and an overmastering ambition which concentrate the whole energies of his mind on the subject which has powerfully attracted his attention, and merge all his feelings and desires in the attainment of one great object. The latter, without enthusiasm, perhaps with no definite object of ambition in view, pursues a similar career, because it belongs to his nature to persevere in whatever he may have undertaken or commenced. The principles by which these inquirers are are set in motion are different, and the rates of advancement consequently unequal; but diligent and persevering labour is nevertheless alike predicable of each. The one travels, so to speak, in a light chariot, and compasses the distance to be travelled over at an accelerated pace; the other trundles it slowly along in a heavy lumbering post-waggon, but in time he also reaches the same destination. This analogy will probably serve to bring out the distinction here pointed at, and which, indeed, it is necessary to keep steadily in view, in order to form a just conception of the Athenian character. The native of Attica may be considered the Frenchman of Greece; quick, lively, sensitive, versatile, inconstant, full of that mercurial spirit which shows itself equally in extreme delicacy of organic perception, and intuitive rapidity of mental apprehension; yet endued with an ardent and unquenchable curiosity, together with an inherent taste for subtile and abstract speculations, under the joint influence of which he was capable of penetrating the most recondite mysteries of science. Much of the excellence attainable in art is doubtless due to superiority of physical constitution and of natural character; but in science, although original genius will always assert its pre-eminence, and distinguish itself by the felicity of its intuitions, unremitting labour is the *conditio sine qua non* of great and signal success; and it is not a little remarkable to find this condition so strikingly exemplified in the character of a people whose more obvious qualities would seem incompatible with steady concentration of thought, and whom a superficial observer has accordingly pronounced incapable of that intense, resolute application, which, in fact, constituted one of their most distinguishing national peculiarities.

Effects of political institutions.

Politically considered, the Athenian character took by reflection the hue of those republican institutions to which it had originally given birth; and this, blending and intermingling with its natural lights and shadows, produced a composite mass, which moral analysis unfortunately has no prismatic power of resolving into its primary elements. Love of liberty, however, as liberty was then understood, formed the ruling principle as well as passion of the people. An equality of political rights, or, in other words, an equal right in all free citizens to aspire to the exercise of political power, constituted the essence of the Athenian form of government. Civil liberty, the benign discovery of modern times, was then unknown, or at least unenjoyed. Political equality was the only species of liberty understood or enjoyed in the ancient republics, and in those of Italy during the middle ages. It was this which had such powerful charms for the citizens of those democracies; it was this of which they were so passionately enamoured; it was this which gave so effective a stimulus to all the faculties of the human mind, and produced those wonders of genius and of art which have exhausted the admiration, and rendered hopeless the rivalry, of succeeding times. The glory of the country in fact formed the glory of every citizen belonging to it; and he felt himself directly participant in all that contributed in any way towards its greatness or renown. For a short time, indeed, an oligarchical usurpation might oppress the people, or the ambition of a fortunate soldier or crafty statesman might prove dangerous to liberty; but a sudden popular explosion might overturn the one, and the ostracism expel the other. The re-action of such a political system upon the national character could not fail to be powerfully marked. Its immediate products were extreme jealousy of those intrusted with power, and an incessant watchfulness over all their proceedings; an intense, passionate detestation of tyrants and tyranny; an ardent and active zeal in defence of public liberty when assailed, whether from within or from without. Factious turbulence, inconstancy, and love of change, may also be numbered amongst the effects of a system of government purely democratical; and, paradoxical as it may seem, these for a time constitute its best if not its only safeguards. Much has been said and written about republican ingratitude, which, indeed, has long been proverbial; but those who declaim on this theme do not reflect, that while the vice in question is not the peculiar reproach of democracy, the essence of that form of government consists in anxiously guarding against the aggrandizement of individuals or classes, and in crushing every aspirant who attempts to raise his head above the common level. Republics have often had occasion to regret their rewards, seldom their punishments.

General results.

If we are not greatly mistaken, these observations furnish a key to the right intelligence of the Athenian character, the leading features of which were unquestionably moulded and fashioned by their political institutions. They were fickle, versatile, liable to sudden gusts of passion, but easily appeased; inconstant in their affections, but not implacable in their hatreds; jealous, factious, turbulent, impatient of command, and prone to resent the assumption of superiority; attentive to the information and instruction afforded them by eminent citizens, yet intolerant of dictation, and, in their best days, ready to repress an overgrown and dangerous reputation; fond of flattery, and too apt to lend a delighted ear to the adulation of sycophants or demagogues, but not insensible to virtue, nor unwilling to listen to those honest patriots who proved their sincerity by courageously exposing the vices and follies of their countrymen; brave in the field, and liable to be excessively elated with victory or depressed with misfortunes, but seldom chargeable with dishonouring success by inhumanity to the vanquished, or deepening the disgrace of defeat by humiliating or abject concessions to the victor; generous in their sentiments; bold and free in their opinions; invariable in their sympathy with and admiration of genius; constant in their love of liberty and their country; and never backward to repair the errors or injustice committed under the influence of pernicious advice, passionate excitement, or the headlong impetuosity of an ardent and uncontrollable temperament. In their private conduct they were courteous, mild, humane, polished, liberal, and enlightened; simple in their manners, frugal in their habits, and but little addicted to any kind of ostentation or parade, even after their victories had brought them in contact with oriental luxury, and when their riches enabled them to rival in costliness and in splendour the nations whom they conquered. All their sumptuousness and magnificence was reserved for and lavished on those public edifices and monuments of art which made Athens the pride of Greece, the envy of the surrounding nations, and the admiration of the world at large. Such was the Athenian Demos in the days of its glory and independence, when, by the mouth of Aristides, it declared to the ambas-

sadors of the Great King, "that it was impossible for all the gold in the world to tempt the republic of Athens, or to prevail with it to sell its liberty and that of Greece," and when public virtue maintained the purity and vigour of public institutions.

Government.

During the period which elapsed from the abolition of royalty till the appearance of Solon in the character of a lawgiver and codificator, the constitution of the Athenian government experienced frequent mutations. To the kings succeeded the hereditary archons, who held their office for life, and were in fact sovereigns under another designation. Of this the nobles grew at length tired; and, accordingly, on the death of Alcmæon (B.C. 752), Charops was raised to the archonship upon the condition of holding it for ten years only. He was followed in succession by six others, who exercised the functions of the office under the same decennial limitation. But on the expiration of the archonship of Eryxias, a further and greater change took place, in 682 B.C. The duration of the office was then limited to a single year, and its duties were divided amongst nine persons, chosen out of the first order of the state, the eupatrids or nobles only. These functionaries all bore the title of archon, but differed in dignity as well as in the particular nature of their duties. The first in rank, called Archon Eponymus, or simply the Archon, represented the majesty of the state, and by his name the year of his magistracy was distinguished; the second bore the title of king, and was the head of the religion of the commonwealth, to the care and protection of which his functions principally related; and the third, or polemarch, was originally a sort of minister at war or commander-in-chief. The six other archons, denominated thesmothetes, presided as judges in the ordinary courts of justice, and formed together a tribunal with a special jurisdiction. The nine together constituted the Council of State. The legislative functions remained with the senate or *boulé* and the assembly of the people; but the whole executive powers of the state, political, military, judicial, and religious, were exercised by the archons.

Legislation of Draco.

This is the substance of the information derived from the ancient authors respecting the Athenian government at the period to which we refer; but as writing had until then been little practised in Greece, and as laws were promulgated orally and preserved by tradition, it was necessarily scanty and imperfect; nor was it possible, under such circumstances, that the sciences of legislation and government should receive any material improvement, or the rights and interests of the many meet with due respect and attention, when the authority of the state was lodged in the hands of an irresponsible few. The commonwealth was distracted by a perpetual scramble for the sovereign power, which, being open to all the principal families, some who could not obtain it by legal sought to grasp by illegal means. Factious ambition and lawless turbulence found equal scope for displaying themselves; and while the people or Demos were fearfully oppressed by the nobles, continual alternations of despotism and anarchy, of usurpation and revolution, the intolerable evils of an unsettled government and an uncertain jurisprudence, became deeply felt and almost universally acknowledged. A remedy was accordingly sought for in a written code which Draco introduced in B.C. 624; but the talents of the legislator were unequal to the task he had undertaken, and the indiscriminate severity of his system speedily defeated its own purpose. He made no attempt to reform the political constitution of his country, the real source of the miseries under which it groaned, but established a new penal code, which denounced the highest punishment against the most trivial offences as well as the most enormous crimes, upon the ground that the slightest breach of any positive law deserved death as treason against the law of the state. A system so revolting to the natural feelings and sentiments of mankind could never be reduced into practice, nor rendered productive of anything but evil; for every principle of reason and of humanity conspired to defeat its operation; and whilst its obvious tendency was to provoke the commission of heinous crimes, it at the same time multiplied the chances of impunity in favour of criminals. The laws of Draco, therefore, instead of applying a remedy to the evils of a defective system of polity, served rather to increase them, and to make the people feel strongly the necessity of a more radical and comprehensive reform than that which had been proposed by this stern and inflexible moralist. Nor was it long ere a change was effected in the constitution of the government, which laid the foundation of the Athenian system of polity properly so called, and which, though it subsequently underwent frequent and considerable alterations, may nevertheless be regarded as the basis of Athenian liberty. This was accomplished by Solon, one of the greatest characters that Greece ever produced, and one of the wisest men of whom any age or country can boast. We now accordingly proceed to give some account of his legislative labours, as these were embodied in the constitution which he reformed and remodelled on a plan suited to the circumstances and wants of his country.

Legislation of Solon.

By the fundamental law of this constitution the sovereign power was vested in the general assembly of the people. But an important question here arises, namely, Who were accounted The People, legally entitled, in their collective capacity, to the exercise of the supreme power of the state, as well as to provide effectually for the exclusion of those upon whom that high privilege had not been conferred? The population of Attica, or, in other words, the component members of the Athenian commonwealth, consisted of three classes, viz., Athenian citizens; resident aliens, or freemen liable to the capitation tax, who had not the rights of Athenian citizens; and slaves in actual bondage: and these classes differed from one another in numbers no less than in rank and condition. The number of citizens has been variously estimated, and, in point of fact, must have differed at different times. According to the census taken in the time of Pericles, they amounted to no more than 14,040 persons. In the first speech of Demosthenes against Aristogeiton, they are, however, reckoned at nearly 20,000; Plato, in his *Critias*, assumes the same amount for the most ancient times, having doubtless transferred the number that was commonly computed in his own day to the earliest periods of the state; and the later Grecian writers, as Libanius, for instance, follow the same statement. But the enumeration made by Demetrius Phalereus gives more precise and definite results. According to this census, which was taken in the year B.C. 309, there were 21,000 citizens, 10,000 resident aliens, and 400,000 slaves; an estimate which, according to the usual statistical rule of taking the adults as a fourth part of the population, would give for the total number of citizens 84,000, and for that of aliens 40,000; whilst the slaves, having no head or status of any kind in the commonwealth, are reckoned absolutely, comprehending under the 400,000 all those in actual bondage, men, women, and children, without distinction of age or sex. But, from various considerations, into which it is unnecessary to enter, Boeckh has shown[1] that this census requires considerable modifications; and, upon grounds which appear to be completely conclusive, he reckons the free inhabitants at 90,000, the resident aliens at 45,000, and the slaves at 365,000, together with women and children, which latter, however, were proportionally few. Assuming this estimate, then, as a pretty close approximation to the truth, it follows that the number of adult citizens was above 22,000, and

Population.

[1] *Public Economy of Athens*, p. 30, *et seqq.* Engl. Transl., 2d Edit. London, 1842.

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that The People, in the political sense of the term, consisted of only about a twenty-third part of the entire population of the country. It is of the greatest importance to keep this fact steadily in view, as it has an immediate bearing upon the whole political system of the Athenians, and serves to reconcile many apparent anomalies by which superficial inquirers have been so often perplexed and misled. Nothing indeed can be more erroneous than the notion, which has been repeatedly promulgated, that the Athenian constitution was purely democratical. On the contrary, it was, in the strictest sense of the term, a republican aristocracy,—the whole power of the state being vested in the privileged class called citizens, who, as we have just seen, constituted but a small portion of the entire population; whilst the two other classes had no recognized political existence whatsoever, and that which was by far the most numerous remained in a state of more abject servitude than the villains under the feudal system, or the serfs in Russia and Poland.

Assembly of the people.

We have already said that, by the fundamental law of the Athenian constitution, the sovereign power was vested in the general assembly of the people. This body consisted of all the citizens, or privileged class, who had attained a certain age; excepting such as had been attainted and rendered infamous by a judicial sentence. Yielding to the temper of the times and the force of circumstances, Solon confirmed to this body an authority universally and uncontrollably absolute; but he at the same time sought to establish a balancing power, capable in some measure of restraining the excesses into which a sovereign multitude is ever ready, on the slightest excitement, to plunge. With this view he made a new division of the people into four ranks or classes, according to the relative value of their possessions or property. The first rank consisted of those whose lands produced annually five hundred medimni of corn, wine, oil, or any other commodity, dry or liquid; and who were hence called *Pentacosiomedimni*. The second rank was composed of persons whose lands yielded at least three hundred measures, and who were denominated *Hippeis*; because, although enjoying the same exemption as the first rank from service in the infantry or on shipboard, they were bound to maintain, at their own charge, a horse for the public, and, within the military age, to serve personally in the cavalry. The third rank, or *Zeugitæ*, consisted of those whose lands produced upwards of 200, but less than 300 measures, and who were bound to serve in the infantry of the line (ὁπλῖται), and to be completely provided with arms for the purpose. The rest of the citizens not possessed of lands yielding 200 measures were comprehended under the name of *Thetes*, and were also liable to military service either in the infantry of the line or among the light troops, according as they chanced to be provided with arms; and when Athens afterwards became a maritime power, it was also from this class that the fleet was principally manned. The diligent researches of Arbuthnot show the extreme difficulty, or rather impossibility, of ascertaining, by modern standards, the precise relative value of an Attic estate in the age of Solon; but it seems to be tolerably clear that the object and intention of the Athenian lawgiver in forming such division, was to give to property a preponderance over numbers, whereas hitherto all political rights had been dependent on birth alone; and, accordingly, by his constitution, it was expressly provided that the magistracies should be filled from the first, second, and third ranks, to the exclusion of the fourth. This constitution, generally called a timocracy, made the democratic element so powerful in the assembly, where every Athenian citizen, even the poorest, had a vote, that in the end it overruled every other power in the state. But, in the legislator's opinion, it was checked by two great councils, the senate of the Four Hundred and the Council of the Areiopagus.

Council of State.

The former consisted of 100 persons chosen out of each of the four wards or districts into which the people of Attica were divided, or 400 in all, but afterwards raised to 500, when the number of wards or districts was increased to ten, and 50 counsellors or senators allotted to each. This reform was introduced by Cleisthenes, in B.C. 510. The common designation of this senate was the *Boulé* or The Council of Five Hundred, or simply *The Five Hundred*. The members were chosen annually by lot from among those who were legally qualified for the office and desirous of obtaining it; but, prior to their admission, they had to undergo, before the existing council, a strict scrutiny, termed *Dokimasia*, concerning their past life, and if anything prejudicial to their character came out in course of the inquiry, they were rejected. The counsellors of each tribe, in turn, for the space of 35 days, enjoyed superior dignity and additional authority under the title of *Prytanes*; and from them the council hall or place of meeting was denominated Prytaneium. The Prytanes officiated in turn as presidents of the council, each holding the office only one day, during which he had the custody of the public seal, with the keys of the treasury and those of the citadel; and the whole assembly formed the Council of State of the commonwealth. This body, partly deliberative and partly executive, had the initiative of all laws; and, in fact, its peculiar and most important function consisted in preparing business for the assembly of the people, where nothing could be proposed which had not previously received the sanction of the council, and where the whole procedure was regulated by functionaries of its appointment. Any measure sanctioned by the *Boulé*, and thus declared to be fit to be brought before the popular assembly was termed a *probouleuma*. Attendance at the popular assemblies was made compulsory on the part of the citizens, and four assemblies were held during the presidency of every Prytaneia, or term of 35 days, for the despatch of public business, which was duly apportioned and subdivided amongst them. The first confirmed or rescinded the appointments of magistrates, received accusations of public offences presented by the thesmothete archons, and heard the catalogue of fines and confiscations for the service of the state; the second enacted laws, and disposed of petitions, public and private; the third gave audience to the ministers of foreign powers; and the fourth regulated such matters as concerned religion. In later times, all citizens who attended in due time received a small recompense or pay from the treasury. The *Epistates*, chairman, speaker, or president of the assembly, was appointed by lot from the nine *Proëdri* or foremen, who were nominated in the same way from the council, that is, one from the counsellors of each tribe whose representatives were not at the time Prytanes; and with these functionaries sat the *Nomophylaces*, otherwise called, from their number, *The Eleven*, whose duty it was to watch over the laws, and to explain to the people the tendency of any proposal which seemed contrary to the spirit of the constitution, as well as to superintend the administration of justice.

Annual revision of the laws enjoined.

Solon took none of those severe precautions to maintain his constitution which were adopted by some other ancient democratical legislators; neither exacting an oath, like Lycurgus, who by a species of artifice sought to render its obligation perpetual, nor ordaining, like Charondas, that whosoever proposed to abrogate an old law or enact a new one, should come into the assembly of the people with a halter about his neck. On the contrary, aware that regulations, however well adapted to the circumstances of the commonwealth at one period, might prove wholly unsuitable to its circumstances at another, and that time, the great innovator, rendered certain changes and modifications necessary, he even went so far as to enjoin an annual revision of the laws, and to prescribe the form in which this might with most propriety be effected. If the assembly of the people declared alteration in any point necessary, a committee was to be appointed, with directions to consider the

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change proper to be made; and if a new law was in consequence prepared, five officers were at the same time named to defend the old one before the assembly, which then decided between them. The persons composing such a committee were denominated *Nomothetes*, and in later times amounted to so many as a thousand: the persons nominated to defend an old law had the name of Syndics. This was the only form in which it was safe, or indeed constitutional, to propose any alteration in the existing law at Athens. But as the passing of a law by the assembly without the regular formalities of previous publication, or of one couched in ambiguous and fallacious terms, or contrary to a former law, subjected the proposer to penalties, it became usual to repeal the old law before any new measure was brought forward; and the delay occasioned by this double procedure served as an additional security to the constitution, which was equally guarded against rash innovation on the one hand, and the danger resulting from the absence of all improvement or amelioration on the other.

Mode of enacting a law.

The regular and ordinary mode of enacting a law at Athens may be very shortly described. As the council had the initiative of all laws, so it was their duty to frame the bills which were to be submitted to the general assembly of the people. But any citizen having aught to propose for public consideration, might address it to the Prytanes, whose duty it was to receive all petitions, suggestions, and communications, and to transmit them to the council. When the matter had been there approved and digested into proper form, it became a *probouleuma* or bill, and being written on a tablet, was exposed during several days for public perusal and consideration. At the next assembly it was read to the people, after which the question was asked by the public crier, "Who of those above fifty years of age chooses to speak?" And these, if any were so disposed, having delivered their sentiments, the crier again proclaimed, "Any Athenian, not disqualified by law, may now speak." The circumstances absolutely disqualifying were flight in battle, a large amount of debt to the commonwealth, and conviction for a crime inferring infamy; but the Prytanes had the privilege of enjoining silence at discretion, although the injunction was not effectual unless ratified or acquiesced in by the assembly. When the debates had ended, the suffrages were taken by a show of hands, which was the ordinary way of voting; but in extraordinary cases, particularly where the question to be determined related to alleged mal-administration on the part of magistrates, the votes were given by casting pebbles into vessels prepared for the purpose by the Prytanes, who, after the foremen had examined the suffrages, and declared the majority, dismissed the assembly. Such was the legislative mechanism of the Athenian constitution.

Court of Areiopagus.

But Solon hoped to provide a further and more powerful restraint against aberration in the Court of Areiopagus, by improving its regulations, and extending its powers. We have no account of the origin of this celebrated tribunal, which, indeed, the partiality of succeeding ages carried too far back into the fabulous ages to be now discovered. It was composed of those who, having executed the office of archon with credit, and passed the *euthyne* or scrutiny concerning their conduct while in power, were considered best qualified, by their experience and integrity, for being admitted members of this tribunal; and, in order to place them above being influenced either by fear or favour, they held their offices not for a year, which was the ordinary official term in the Athenian commonwealth, but for life. The powers of the court of Areiopagus were very great indeed. It is said to have been the first which adjudged the punishment of death for murder; and capital offences amongst the Athenians were for the most part cognizable by it alone. It was the only court from which there lay no appeal to the assembly of the sovereign people. It had power to stay execution of all judicial decrees, not excepting those pronounced by the general assembly itself, and to annul an acquittal or to extend mercy to the condemned; it directed all issues from the public treasury; in its censorial capacity it punished impiety, immorality, and all disorderly conduct, and exercised a general superintendence over the morals and behaviour of the people; it required every citizen to account to it annually for his means of livelihood, and to show that he earned his subsistence by honest industry in his particular calling; lastly, it took a fatherly care of the youth of the republic, and provided that all should receive an education suitable to their rank and fortune. For the despatch of judicial business the court of Areiopagus sat only during the night, and in perfect darkness, that the members, it is said, might be the less liable to prepossessions either for or against the accused; and, on the same precautionary principle, advocates were required to confine themselves to a simple narrative of facts and statement of the law, without digressing into rhetorical embellishment, or attempting to influence the understandings by appealing to the passions of the judges. In a word, this celebrated institution formed a sort of State Inquisition, and seems to have been organized for the double purpose of checking that constant tendency to excess which is inherent in all purely popular governments, and of maintaining that public and private virtue which has rightly been pronounced the principle of democracy.

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Other courts.

Besides the Areiopagus, which ought properly to be regarded as constituting part of the machine of government, there were several courts of judicature at Athens. Before the time of Solon the archons officiated as supreme and sole judges in nearly all manner of suits; but these functionaries being appointed by lot, and often very ill qualified for discharging so important a duty, it had become usual for each to choose two persons learned in the law to assist him; and the latter, under the name of *paredroi* or assessors, were at length recognized as regular constitutional officers, and appointed with the same formalities as the archons themselves. Solon, however, discerned the inconveniencies of this system, and reformed it altogether. "That," said he, "is, in my opinion, the most perfect government, where an injury to any one is the concern of all." The principle from which he set out was therefore to give to all an immediate concern in the administration of justice. With this view he ordained, that all causes should be tried by select bodies of men, resembling modern juries, and called to perform nearly the same functions; the archons merely superintending the preparation of causes, and presiding at the trial of them in the manner of our judges. All questions of law or of practice were judicable solely by the latter; but in all questions of fact, or in the general issue of guilty or not guilty, the jury were the exclusive judges; and it was the bounden duty of the presiding magistrate to give immediate effect to their decision, whatever it might be. Any Athenian above thirty years of age, and not under legal disqualification, was eligible as a juryman, on delivering his name and condition to the thesmothete archons; but as the attendance in these courts drew the citizens away from their ordinary occupations, it was only fair to indemnify them by a small payment for their attendance; this custom, however, was not introduced until the time of Pericles. From the general list of those who voluntarily tendered their services, the thesmothete archons appointed by ballot juries to their different courts; and these appear to have officiated for a definite period in each, somewhat in the manner of the Roman *judices*, who were, to all intents and purposes, a species of standing jury. It thus appears that the honour of inventing jury trial is due to the great Athenian lawgiver; and that, in his hands, the institution reached a degree of perfection which it has not yet attained among many modern nations, who affect the greatest admiration for the ancient jurisprudence, and boast of having transfused into their codes its wisest rules and provisions. It is necessary to add, that, in order to save the inhabitants of the country

the trouble and expense of resorting to Athens for justice in cases of inferior importance, itinerant judges, called from their number *The Forty*, were appointed to make regular circuits through the towns or boroughs of Attica, with full powers to judge and determine in all actions of petty assault, and in all disputes about property under a certain value.

Religion.

In all countries, and throughout all ages, religion and civil government have, with few exceptions, been so intimately, or rather so inseparably connected, that an exposition of the one would be incomplete and even unintelligible without some account of the other. The magistrate has almost everywhere sought the alliance of the priest; and the hopes and fears arising from a supposed dependence on superior power or a belief in a future state of existence have been employed as useful auxiliaries in governing men and managing their affairs in the present life. The possibility of ruling nations by means of their reason alone, and by a due regard to their secular interests, without any reference to their religious opinions or observances, is an idea which seems never to have entered the mind of any ancient legislator, and which even now, when the mighty volume of past experience is unfolded for our instruction, is considered by many as little better than downright political heresy. It was deemed alike impious and impracticable to attempt to establish any form of polity of which religion or the church did not constitute one of the main pillars, or to seek to promote the happiness of men in society without at the same time prescribing by law the mode in which they ought to worship the gods. In the Athenian constitution, as settled by Solon, religion and government, the church and the state, were so intimately connected, and became so indissolubly blended together, that, without any sensible error, we may at will consider the religion as part of the government, or the government as part of the religion, and both as alike the creatures of positive enactment or legislative ordination.

The religion of the Athenians and the Greeks generally seems to have arisen out of a strong sympathy with the various powers and agencies manifested in the visible world. To the imaginative Greek no part of nature was absolutely passive or inert; all the objects around him either impressed upon him the idea of life, or he readily imparted it to them from the fulness of his imagination. "This was, in fact, the popular mode of thinking and feeling, cherished, no doubt, by the bold forms, abrupt contrasts, and all the natural wonders, of a mountainous and sea-broken land. The teeming earth, the quickening sun, the restless sea, the rushing stream, the irresistible storm, in short, every display of superhuman power, roused in the mind of the Greek a distinct sentiment of religious awe. Everywhere he found deities, which, however, may not for a long time have been distinguished by name from the objects in which their presence was manifested. In this manner it may be supposed, the Pelasgians, or earliest inhabitants of Greece, worshipped the powers which, according to primitive notions, animated the various forms of the visible world. Herodotus, who attempts to trace the steps by which this simple belief in the divine powers of nature was transformed into the complicated system of Greek mythology, assumes two great causes of the change: first, the introduction of foreign divinities and rites; and, secondly, the inventive imagination of the Greek poets. In regard to the first point he believes, that nearly all the names of the Greek gods had been imported into Greece from Egypt; but this supposition, which was formerly adopted without scruple, and was believed in as firmly as the establishment of Egyptian colonies in Greece, has in modern times been the subject of very earnest controversies; and although it is not to be denied, that eastern nations, and even Egypt, present some striking coincidences with the religion and rites of the Greeks, yet the accounts contained in Herodotus and others who followed him are little more than dreams. As to the second point, Herodotus says that Homer and Hesiod were the authors of the Greek theogony, gave titles to the gods, distinguished their attributes and functions, and described their forms. But this opinion can be regarded as reasonable only on the supposition, that Homer and Hesiod were viewed by the historian as the representatives of a whole line of poets who were the organs and interpreters of the popular creed, and thus gradually determined its permanent form." The religion of the Greeks was in all essential points of purely native origin, but their mythology, as we now have it, must have passed through two important processes of formation. The one was that of personifying the powers of nature and conceiving them as distinct beings; the other was that by which divinities which had at first enjoyed only local worship in certain districts, or among certain tribes, were raised to the rank of national divinities, and of members of the one great family of gods. Both these processes may have been going on simultaneously, but it must certainly have taken a long period before they produced those results which we term the mythology of Greece. Although the groundwork of the Greek religion was the worship of nature and her powers, it cannot be denied that among several tribes we meet with divinities that were neither personified powers of nature, nor personified abstractions, but represented the general consciousness of man's dependence on beings of a higher order. As, however, the gods were conceived as beings with human forms, the belief that they were subject to the same passions and frailties as mortal men was a very natural consequence. But notwithstanding this, it was believed that they punished men for their offences and negligences, both in this world and in the world to come; and in this respect, it cannot be denied that the religion of the Greeks exercised a salutary moral influence. The belief in a future state was very general among the Greeks, but even the life of the blessed in the other world was not conceived by a Greek as an enviable condition at all.

Genius of this religion.

At the same time it was a system of show and parade, of festivals and ceremonies, of rites and observances, and, as such, singularly adapted to take a powerful hold of the popular mind, more especially when it became intimately blended with the literature as well as with the political institutions of the country. It imposed no particular set of doctrines, and exacted no peremptory compliances, but, addressing itself exclusively to the senses and the imagination, it was acquiesced in without inquiry, and maintained without persecution. As the religion of the state, an outward respect was due to it and required; but crimes against this religion were only punished as they affected the state, and not on the abstract grounds of impiety or sacrilege. Socrates was condemned to death, not because he revered the deity and taught a purer faith than that entertained by his countrymen, but because he attacked the religion of the state as by law established, and closely interwoven with the whole system of national policy; and even this sacrifice to the violated law was speedily and deeply repented; for the genius of polytheism was essentially tolerant. Hence mere raillery, when general and not directed against positive institutions, seldom or never incurred the animadversion of the magistrate, and was often highly relished by the people. Aristophanes, for example, made as free with the gods as he did with the great, and lashed the supposed foibles of the former with as little mercy as the vices and follies of the latter; yet his wit produced no inconvenience to its author, and was even loudly applauded by his countrymen. Æschylus, indeed, incurred some danger from a suspicion of having betrayed the secrets of Eleusis; but as this was always considered a crime of the greatest magnitude, and as it imported a violation of the most sacred human obligations, as well as of the public policy of the state in a matter where the sanctions of its laws were peculiarly severe, no inference can justly be drawn from this against the general toleration ex-

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ercised, viz., when its sallies were directed only against the public religion.

Priesthood.

Another circumstance deserving of notice is, that the ministers of religion were not confined exclusively to the service of its altars. The sacerdotal dignity was indeed incompatible with the exercise of any regular profession, and for this reason the priests had a fixed revenue secured to them; but they were eligible to the most important offices in the state, and might, if so inclined, serve as soldiers in the field. Their salaries were in general proportioned to the dignity of their functions and the rank of the deities whom they served; and these were paid out of the sacred revenues, which were derived partly from fines that individuals were condemned to pay for various offences, partly from the produce of lands consecrated to the gods, or appropriated to defray the expense of sacrifices offered in the name of the republic, partly from particular grants, and partly from a tithe of the spoils taken in war, although the last were commonly considered the exclusive property of Athena. These, with the produce of accidental confiscations, formed the regular sources of income; but the credulity of the people supplied an inexhaustible fund, which enriched the temples of Delos and Eleusis, and supported the magnificence and splendour amidst which the Delphic oracle was enshrined. The solemn festivals, such as the Dionysiac and Panathenaic, which indeed constituted the greater part of this religion, and contributed alike to maintain its hold of the popular mind and to nourish a taste for the arts, were celebrated at the expense of the choragi or leaders of the choruses, of which each tribe furnished one; and the richest citizens only were appointed to the office, which, though ruinous, was eagerly solicited, as it paved the way to more substantial honours, and formed a passport to the favour of a people ever ready to reward him who ministered profusely to their pleasures. Hence the privilege enjoyed by the choragus who had proved victorious in the scenic contests, of inscribing his name on the tripod erected by his tribe, or of perpetuating the memory of his success by a choragic monument, was not the only recompense looked for by those who had incurred the expense of ministering to the pleasures of the people. Lastly, although Athens had a state religion, it had no sacerdotal hierarchy. The priests did not, as in Egypt and in other countries, form a distinct order or caste, which, indeed, would have been incompatible with a democratical form of government. They were not a separate body united by peculiar laws under a chief whose authority extended over all its inferior members. The dignity of supreme pontiff was unknown, and each priest served his particular shrine unconnected with his brethren. The temples of the principal divinities, indeed, such as those of Athena, Poseidon, Demeter, and Persephone, had each a high priest who presided over its service; and the number of subaltern ministers employed was commonly in proportion to the rank of the particular deity, and the wealth accumulated at his shrine: but the pontifical dignity was altogether local; and the priests of one temple formed a society wholly distinct from those of another. Hence the ministers of the gods at Athens were not judges in matters of religion, nor authorized to take cognizance of or to punish crimes against the deity. This, as we have already said, was exclusively within the competency of the civil magistrate; and, accordingly, we find that it was in consequence of a civil sentence alone, and not in virtue of any power or authority in themselves, that the Eumolpidæ launched their anathemas against Alcibiades, and that Socrates was condemned to die.

Public economy. Prices.

The subject of the public economy of the Athenian state—embracing inquiries concerning prices, wages, and the interest of money; the administration of finance and the public expenditure; the ordinary and extraordinary revenues; and the peculiar financial measures of the Greeks—is too vast and complicated to be treated here at full length. In Boeckh's learned and laborious work, however, there will be found a prodigious accumulation of curious facts relative to all these branches of the subject; and although the science of the author is greatly inferior to his erudition, and his conclusions are frequently at variance with sound principle, yet he has furnished abundant means for the correction of his own errors, and collected a body of information, the value and importance of which it is difficult to over-estimate. A large part of his first book is dedicated to an enumeration of the various prices of commodities in Attica, by comparing which with the actual prices of the same commodities in different countries, he endeavours to determine the relative wealth of Attica according to modern standards. But although this collection is equally interesting and valuable, the utility of such a comparison may be fairly questioned, upon the ground that no certain inference can be drawn from the similarity or dissimilarity of ancient and modern prices. The proportion between the value of any given commodity, and that of gold or silver, may be a safe enough criterion in the same place and for short periods of time; but for distant ages and countries such a comparison can lead to no result upon which any reliance can be placed; and for this plain reason, that we have no common or invariable standard to which we can refer. For a comparison with prices in other countries at the same time, and for such a purpose as that to which Boeckh has applied it in examining the statement of Polybius respecting the valuation of Attica, his list of prices may be used with safety and advantage; but whether the precious metals, labour, or any other standard, be adopted as a medium of comparison between the prices of commodities in ancient Greece and in modern Europe, the result must, for the reason already stated, be equally fallacious and nugatory. The standard employed, whatever it may be, is itself indeterminate; or, in other words, the measure assumed and the thing to be measured by it are equally uncertain.

Attica.

Interest of money.

Again, with regard to the interest of money, it is evident that no sound conclusion can be drawn as to its rate from a consideration of the ναυτικὸς τόκος or interest of money lent on bottomry, which Boeckh takes as a criterion; because this was doubtless a most hazardous species of investment, on account of the imperfect state of nautical science, the dangerous navigation of the Greek seas, and, worse than all, the insecurity of the laws and the corruption of the tribunals; and the premium paid by the borrower to the lender would of course be in some measure commensurate with the risk to which the capital of the latter was exposed. Nor is this all. For, if the rate of interest be that sum which the lender receives and the borrower pays for the use of a certain amount of monied capital, without any consideration for trouble in the collection of the income, or for risk as to the punctual repayment of the interest or principal at stipulated periods, it may fairly be doubted whether there was anything which can justly be considered as a general or an established rate of interest at Athens. There were no public securities, no means of investing money under the guarantee of the national credit; whilst, from the continual dread of revolution or foreign invasion, the insecurity of property was such, that the punctual repayment of interest or principal at stipulated periods must have been liable to very great, but at the same time very variable, risks; a state of things wholly incompatible with a general or an established rate of interest. And with respect to money lent on mortgage or land-pledge, which, in the settled communities of modern times, approaches nearest to the public securities in point of safety, the tenure of land in Attica was, from the causes already mentioned, so precarious and insecure that, in this case also, a large yet variable indemnification, in the name of interest, must have been paid, and consequently no particular rate could have been general or common.

Revenue.

Some historians have accused the Athenian state of ne-

Attica ‖ Atticus.

glect in the administration of its finances, but without reason, as Boeckh has most conclusively shown. Of all charges, indeed, the government of Athens is the least open to that of want of diligence in exacting the utmost farthing of revenue which its available resources could by any artifice of taxation be made to afford. The ordinary revenues of the Athenian state consisted chiefly of duties arising from lands, houses, and similar property of the state, or from companies and temples; of the produce of the mines, which were public property, though commonly let in fee-farm under certain conditions, including the payment of a twenty-fourth part of the gross produce in the name of rent, and over and above the *grassum* or fine which the tenant originally paid for the lease; of customhouse-duties; of harbour-duties and market-tolls; of tithes, poll-taxes, taxes upon industry, protection-money, taxes on slaves, and taxes on prostitutes; of judicial fines and fees; of appeal-money, and fines in general; of confiscations, and tribute of various kinds; to say nothing of a variety of minor sources which it would be tedious to enumerate. The extraordinary revenues were of course variable, but arose principally from a species of property-tax, which was laid on in seasons of great emergency, when increased means were required for the defence of the state, or for the assertion of its dignity and independence. The spoils of war were also included under this head.

Mode of letting property.

Property of all kinds appears to have been commonly let upon lease; and all leases were sold by auction to the highest bidder. For this purpose the conditions of lease were previously engraved upon stone and fixed up in public. The names of the lessees were subsequently added, and the document which had been originally exhibited then became a regular contract of lease; or if not, a fresh agreement was afterwards set up. A proposal or advertisement of this kind, copied from the original document engraved on stone, is preserved in the British Museum.[1]

Attica ‖ Attorney at-Law.

The history of Greece, and in particular that of Attica, has been treated of late years with greater ability, more learning, and sounder views, than at any previous period since the revival of letters. German scholars have produced innumerable treatises upon all subjects connected with the history of Attica, but at no time and in no country has ancient Greece found historians equal to Thirlwall and Grote. The work of the former appeared first in Lardner's *Cabinet Cyclopædia*, in 8 vols. 12mo; a second and improved edition in 8 vols. 8vo, appeared in London, 1845–52. Of Mr Grote's history only 11 vols. have as yet been published, but a 12th, carrying the history down to the death of Alexander the Great, will complete the work. Niebuhr's *Lectures on Ancient History* (edited by Dr L. Schmitz, London, 1852, in 3 vols.) are, like all Niebuhr's Lectures, of the highest interest and importance. In regard to the literature of Greece, the work of Colonel Mure, of which 3 vols. have already appeared, will be a worthy companion to the works of Bishop Thirlwall and Mr Grote. (J. B—E.) (L. S.)

ATTICUS, Herodes, an opulent citizen of Athens, in the time of the Antonines, celebrated for the vast sums he expended in the decoration of that and other cities. He built a stadium at Athens, 600 feet in length, of Pentelican marble, capable of containing at once the whole population; and erected a new theatre or odeion in honour of his deceased wife Regilla. The aqueduct of Troas in Asia was completed by him at an expense of more than L.100,000 sterling; at Corinth he built a theatre, and richly decorated the temple of the Isthmean Neptune. The stadium at Delphi was another of his works; as were the baths of the hot-springs at Thermopylæ; and a fine aqueduct at Canusium in Italy. Many cities of Peloponnesus, Bœotia, Epirus, Thessalia, and Eubœa have, by numerous inscriptions, testified their gratitude to him, their munificent benefactor. See *Mem. de l'Acad. des Inscrip.* xxx., and Gibbon's *Hist.* i.; Stuart's *Athens*, where its dimensions and plan are given.

Atticus, *Titus Pomponius*, one of the most distinguished Romans of his time, who, without in any degree compromising his neutrality, preserved the esteem and affection of all parties. His strict friendship with Cicero did not prevent him from being at the same time on terms of great intimacy with Hortensius. He steadily declined any interference in public affairs, though his talents and immense wealth might have secured him the highest dignities of the state. The contests at Rome between Cinna's party and that of Marius induced him to retire to Athens, where he continued for a considerable time. From this circumstance, and his thorough acquaintance with Greek learning, he derived his surname of *Atticus*. His passion for books led him to the collection of a magnificent library, in which he kept a number of copyists constantly employed. He wrote, besides other pieces, *Annals*, or *A History of Rome*, embracing (as we learn from Cicero) a period of 700 years; but none of his writings are extant. At the age of 77 he anticipated the consummation of an incurable disease, by abstaining from food, in consequence of which he died upon the fifth day, B.C. 32.—Cornelius Nepos; Cicero *ad Att.*

ATTIGNY, a small town of France, in the department of Ardennes, on the left bank of the river Aisne, 22 miles S.W. of Mezieres. It was a place of some celebrity at an early period, from its being usually selected as the summer residence of the kings of France. Pop. 1365.

ATTILA, king of the Huns. See Roman History.

ATTLEBOROUGH, a market-town in the hundred of Shropham, county of Norfolk, 14 miles from Norwich. It is said to have been formerly a large city, the capital of the county, and at one time had a college. Pop. of parish in 1851, 2324.

ATTOCK, a celebrated town and fort of Hindustan, in the Punjaub, on the eastern bank of the Indus, in Long. 72. 20. Lat 33. 54. The locality is of importance, both in a military and commercial point of view, as the Indus is here crossed by the great route which, proceeding from Cabool eastward, through the Kyber pass into the Punjaub, forms the main line of communication between Afghanistan and Northern India. The river was here repeatedly crossed by the British armies during the late military operations in Afghanistan; and, according to the general opinion, it is the place where Alexander, Tamerlane, and Nadir Shah crossed the river in their respective invasions of India. The Emperor Akbar built the present fortress in 1851. (E. T.)

ATTORNEY-AT-Law is one who is put in the place, stead, or *turn* of another (*attornatus*), to manage or conduct his law proceedings or affairs. The term is used in England to denote the class of legal practitioners whose functions are preparatory to those of the barrister or advocate. See Agent.

Before the statute of Merton, 28th Hen. III., c. 10, which authorized any freeman to make attorney, every suitor was obliged to appear in person to prosecute or defend his suit (according to the old Gothic constitution), unless by special license under the king's letters-patent; and at present it is the common course for the plaintiff and defendant to appear by attorney, upon the principle of convenience, in the same manner as, according to Justinian, took place

[1] This inscription was first published by Chandler from a most inaccurate transcript, together with a Latin version, also very indifferently executed. It was afterwards given by Boeckh, in the appendix, to his *Staatshaushaltung der Athener*, where he corrected many of Chandler's errors; and he has since repeated it with some additional improvements in his Corpus of Greek Inscriptions, p. 141. The date, mutilated at the end, is either Olymp. 114. 4, or 115. 3.

Attorney-at-Law || Attraction.

in the Roman law. But an infant, a married woman, or an idiot, cannot appear by attorney, but in person or by guardian, according to the nature of the case, although an attorney be employed on their behalf.

By the 6th and 7th Vict., c. 73, the qualifications necessary for admission on the rolls of attorneys and solicitors are :—1*st*, The due execution of a proper contract in writing with some practising attorney or solicitor for the term of five years, or of three years if the clerk be a graduate of the universities of Oxford, Cambridge, Dublin, London or Durham, or of the Queen's University, Ireland (14th and 15th Vict., c. 88); 2*d*, The payment of the stamp-duty on such contract, amounting to L.120; 3*d*, The registry or enrolment of the contract within six calendar months; 4*th*, Actual service for the prescribed period in the proper business of an attorney and solicitor, but one year may be served with the London agent, and, where the service is for five years, another year with a barrister or certificated special pleader; 5*th*, Due notices of the application to be admitted; 6*th*, Fitness and capacity ascertained upon examination, and certified by the examiners; 7*th*, Taking the prescribed oaths, and being admitted and enrolled; 8*th*, The certificate of the registrar of attorneys that he is duly enrolled, and the stamped certificate of the annual payment of the duty.

Persons admitted in one court, may be admitted in any other court, on producing the necessary certificates, and signing the roll of the other court.

No attorney is to have more than two articled clerks at one time, nor to take or retain any clerk after discontinuing business, nor whilst clerk to another; and in case the attorney should become bankrupt, or be imprisoned for 21 days, the court may direct the articles of clerkship to be discharged or assigned; and where the master dies the clerk may enter into a fresh contract for the residue of the term.

Under section 29 of the act, applications to strike attorneys off the roll for defect in their articles, are to be made within 12 months after admission, but in case of fraud, the application may be made at any subsequent period.

Attorney-General || Attraction

Attorneys, if prisoners, are not to commence, prosecute, or defend any suit or action in any court of law or equity, or matter in bankruptcy, and offenders are to be deemed guilty of a contempt of court, and unable to recover their fees; nor are they to act as agents for unqualified persons, and if so acting, they are liable to be struck off the roll. (R. M—M.)

ATTORNEY-GENERAL is a great officer under the crown, made by letters-patent, and is generally chosen from Her Majesty's counsel learned in the law. It is his place to exhibit informations, and prosecute for the crown, in matters criminal; and to file bills in the exchequer, for anything concerning the crown in inheritance or profits.

The attorney-general, under the royal mandate of 14th Dec., 1813, has place and audience before the premier serjeant. In 1834, the lord advocate of Scotland claimed precedence in the House of Lords of the attorney-general. The point was decided in favour of the attorney-general, but it was admitted that the lord advocate was entitled to precedence of the solicitor-general.

His proper place in court, upon any special matters of a criminal nature, is under the judges, on the left hand of the clerk of the crown; but usually he sits in the face of the court and the centre of the inner bar of Queen's counsel. (R. M—M)

ATTRACTION.

THE word Attraction is used to denote what we observe when one body approaches another, or tends to approach it, without any apparent impulse or other cause to which the motion can be ascribed.

General observations.

We have instances of attraction when iron approaches the magnet, when certain bodies are placed near an excited electric, and when a stone falls to the earth. We say likewise that the earth attracts the moon; by this mode of expression meaning no more than that the moon is continually deflected towards the earth, from the rectilineal course which it would otherwise pursue. It is likewise in this sense that we must be understood when we say that the sun attracts all the planets.

In the instances already mentioned, attraction extends to a distance. In other cases it is confined within limits so extremely narrow as to become imperceptible at an interval which cannot be appreciated by the senses. Of this kind is the attraction which takes place between the particles of the same fluid, as is apparent from the round figure of small drops. To this class likewise belongs the attraction between fluid and solid bodies; whence originate the very interesting appearances observed in capillary tubes, and other kindred phenomena. An attraction between the small elementary particles of all solid bodies is manifest from the force with which they cohere or resist an endeavour to separate them. In many cases the intensity of this force is prodigiously great in contact or at the nearest distances; while it ceases to act upon making the smallest separation between the parts. Lastly, chemistry developes innumerable instances of attraction between the molecules of the bodies about which it is conversant; insomuch that it is to this principle, under the name of affinity, that we must ultimately ascribe the various decompositions and new combinations which occur in that science.

All these phenomena, although very different from one another in other respects, have yet this in common, that we observe in certain bodies a tendency to approach one another, and to resist a separation, with some degree of force. The facts are certain, and are attended with no ambiguity; and it is to express these facts that the term *attraction* is used in physics.

We likewise observe, in some bodies, a tendency to fly off from one another when they are brought near. This is called *repulsion*.

The word *force* has, in general, some degree of obscurity. It is used to denote the cause of motion; but we have no direct knowledge of it, and we judge of its intensity by the effect which we suppose it to produce. In all our reasoning concerning forces, it is the changes of motion which we measure and compare together, and which are really the subjects of our thoughts. Attraction and repulsion are forces or principles of motion, known to us only by the phenomena we observe; but the circumstance of their implying action at a distance is an additional source of obscurity in which other kinds of force do not participate.

It certainly is inconceivable that motion should be produced at a distance, when no connection can be traced between the body moved and that which is supposed to produce the motion. We are strongly impressed with the prejudice, that a body cannot act but where it is; and we find difficulty in admitting that the mere presence of two bodies, without the intervention of any mechanical means, can be a satisfactory cause of motion. On this account attraction has been classed by some with the occult qualities of the schools; and the favourers of this doctrine have been reproached with reviving exploded notions in philosophy. Impulse is a principle of motion more familiar to us, and to which we are not disposed to make equal objection. Whenever the communication of motion can be traced to this source, we are satisfied that the effect is justly explained. Hence many philosophers have been of opinion, that impulse is the only cause of motion that ca

Attraction. be admitted in physical science; and many attempts have accordingly been made to reduce to this principle all cases in which distant bodies act on one another. With regard to these attempts, it will be sufficient to remark here, that they are all built upon hypothesis. No evidence is adduced to prove that such things exist as the elastic ether or gravific matter which they set out with supposing. And, as far as such systems have no other object than to obviate the difficulty of action at a distance, this argument alone is sufficient to confute them, without adverting to the difficulties that attend each of them separately, their inconsistency with the received laws of motion, and the innumerable contradictions and improbabilities to which they are liable on every side.

A little reflection is sufficient to show that, in reality, we have no clearer notion of impulse as the cause of motion than we have of attraction. We can as little give a satisfactory reason why motion should pass out of one body into another on their contact, as we can, why one body should begin to move, or have its motion increased, when it is placed near another body. It is equally impossible in both cases to prove that there is a necessary connection between the related facts; and in this respect both the phenomena are alike inexplicable.

When motion is produced by impulse, it is probably the circumstance of contact apparently taking place which leads us to think that the effect is so clearly explained. It is in this manner only, or by actual contact, that we ourselves can move external objects. We have no power of producing motion in distant bodies, except by the intervention of other bodies on which we act immediately. Impulse is, therefore, a cause of motion familiar to us, and strikes us as the plainest and most satisfactory ultimate principle at which we can arrive. On the other hand, when one body attracts another at a distance, there is nothing familiar to us with which we can compare it; our curiosity is excited, and we are led to seek out some hidden connection between them.

But it may be doubted whether there is actual contact in any case of the communication of motion. When a body is impelled by the air, it will hardly be affirmed that the particles of that elastic fluid are in contact with one another, since there is no space, however small, within which a given bulk of it may not be compressed, by applying an external force sufficiently great. The particles of air, therefore, act on one another at a distance; and the same thing must be true of all other elastic fluids. And, by the way, what is here said is sufficient to prove, that no scheme, founded on the hypothesis of an elastic ether, will enable us to account for attraction; because such a contrivance can do nothing more than substitute one species of action at a distance instead of another. There is good reason to think that absolute contact never takes place in the component parts of the hardest and most compact solid bodies. This seems to be an unavoidable consequence of the fact, well established by experience, that all bodies contract in their bulk by cold, and expand by heat. It is therefore not only not impossible, but it is even in some degree probable, that the communication of motion may, in every instance, be a case of action at a distance.

If, then, we are apt to think that impulse is a clearer physical principle than attraction, there is in reality no good ground for the distinction; it has its origin in prejudice, and in our mistaking the proper object of natural philosophy. All our researches in nature are confined to the phenomena we observe, and to the laws by which they are regulated. A physical cause is no other than a general fact discovered by a careful observation and an attentive comparison of many particular and subordinate facts. We have no evidence, independent of experience, that any consequence, deduced from a physical cause, will actually take place. There is in this case no necessary connection from which we can, with absolute certainty, infer the expected event. If, then, we regard impulse and attraction as principles founded in fact, and regulated by laws confirmed by observation and experiment, they are both equally entitled to be classed as physical causes, and they ought both to be admitted as of equal authority in explaining the phenomena of the universe. Attraction.

If we turn our attention to the different kinds of attraction enumerated above, and inquire what progress has been made in the investigation of their laws of action, we shall find that, generally speaking, this branch of physics has been little advanced. We are very imperfectly acquainted with magnetical and electrical attraction. We know still less of those attractive powers which take place at small distances, and which are confined within such narrow limits that their mode of action escapes the observation of our senses. Attraction is, indeed, much used by philosophers to account for many important natural phenomena; but their explanations are often vague, and destitute of that precision which ought always to be aimed at in physical science. There is only one class of phenomena in which the laws of attraction have been fully developed. We allude to gravitation, that principle which occasions the fall of heavy bodies at the surface of the earth, and which retains the planets and comets in their orbits. Referring the other species of attraction, which are little susceptible of general discussion, to their several heads, we shall now confine our attention to gravitation

Discovery of the law of gravitation.

Traces of the principle of gravitation are to be found in writers of great antiquity; but their speculations on this subject do not go beyond a vague notion of a tendency which the planets have to one another, or to a common centre. It would contribute little either to entertainment or instruction to collect all the passages of ancient authors that speak of this principle. The revival of the true system of the world by Copernicus introduced the most admirable simplicity in the explanation of the planetary motions, and likewise led to more just conjectures concerning the laws by which they are upheld. Copernicus himself attributed the round figure of the planets to a tendency which their parts possess of uniting with one another, thus extending to all the planets that attraction which we observe at the surface of the earth. He stopt short indeed at this point, conceiving attraction to be confined to the matter of each planet, without making it extend from one planet to another, so as to actuate all the bodies of the system. This step was made by the bold and systematic genius of Kepler. Adopting the opinion of Dr Gilbert of Colchester, that the earth is a great magnet, Kepler formed to himself a notion of attraction, in some respects remarkably just. He says that the earth and moon attract one another, and, were it not for some powers which retain them in their orbits, they would move towards one another, and would meet in their common centre of gravity. He attributes the tide to the moon's attraction (*virtus tractoria quæ in luna est*), which heaps up the waters of the ocean immediately under her. But in many respects his notions of attraction were fanciful and extravagant; a more perfect knowledge of the laws of motion than had been attained to in his time, and a new geometry, were both wanting in order to guide him in this research without danger of wandering. Yet he was able to penetrate so far into the causes of the planetary motions, as to foresee that they would not long continue latent; and he tells us, he was persuaded that "the full discovery of those mysteries was reserved for the next age, when God

Attraction. would reveal them." So full an exposition of a physical system of the world as is contained in the writings of Kepler could not fail to draw the attention of succeeding philosophers. Many remarks concerning the principle of gravitation are to be found in the writings of Fermat, Roberval, Borelli, and other authors; but no one before Newton entertained so clear and systematic a view of the doctrine of universal gravitation as Dr Robert Hooke. In his work on the motion of the earth, published in 1674, twelve years before the appearance of Newton's *Principia*, he lays down these three positions as the foundations of his system, viz.:—

"1*st*, That all the heavenly bodies have not only a gravitation of their parts to their own proper centre, but likewise that they mutually attract each other within their spheres of action.

"2*dly*, That all bodies having a simple motion will continue to move in a straight line, unless continually deflected from it by some extraneous force, causing them to describe a circle, or an ellipse, or some other curve.

"3*dly*, This attraction is so much the greater as the bodies are nearer."

The principle of universal gravitation is here very precisely enunciated. Dr Hooke seems to have clearly perceived that the planetary motions are the result of an attraction towards the sun, and of a rectilineal motion produced by a projectile force. Not having discovered the law according to which the force diminishes as the distance from the sun increases, he contrived experiments to elucidate his theory. Having suspended a ball by means of a long thread, he placed another ball upon a table immediately under the point of suspension, and he caused the suspended ball to revolve round the stationary one. When the movable ball was pushed laterally with a force properly adjusted to its deviation from the perpendicular, it described an exact circle round the ball on the table: in other cases it described an ellipse, or an oval resembling an ellipse, having the other ball in the centre. Dr Hooke observed, that although this experiment in some measure illustrated the planetary motions, yet it did not represent them accurately; because the ellipses which the planets describe have the sun placed in one focus, and not in the centre. Thus, at the appearance of Newton, many things were known, or rather surmised, that prepared the way for the discovery of the principle which regulates the celestial motions. This does not detract in any degree from the glory of Newton, who, discarding the conjectures of his predecessors, proposed to himself to investigate, with mathematical strictness, the law of the attractive force, and to ascertain with precision its sufficiency to retain the planets in their orbits. He invented a new kind of geometry, which was necessary to enable him to accomplish his purpose. With this help, and by admitting nothing without the sanction of the established principles of Dynamics, he deduced from the motions of the celestial bodies the law of universal gravitation, the most important and the most general truth hitherto discovered by the industry and the sagacity of man, viz. "that all the particles of matter attract one another, directly as their masses, and inversely as the squares of their distances."

Having arrived at a principle which belongs to every part of matter, another inquiry comes into view. Setting out from this principle, it is now necessary to proceed in an inverted order, and deduce from it, by synthetical reasoning, the phenomena which we observe in the universe. The first step in this process is to find out the attractive force of the planets, which arises from the united attractions of their component parts. Two things only are involved in this investigation, viz. the known law of attraction between the particles of matter, and the figure of the attracting bodies. This is a subject of great importance, and it is connected with some principal points of the system of the world, with the theory of the figure of the planets, that of the tides, and many other phenomena. It is but imperfectly discussed in Newton's immortal work; and there is no part of his philosophy which has been improved more slowly by the labours of his followers. We now propose to treat of it at some length, endeavouring to lay before our readers as complete a view of this part of science as the nature of our work will permit. Attraction.

We begin with laying down some definitions, and demonstrating some properties, of elliptical spheroids. Definition and properties of elliptical spheroids.

Def. 1. A solid generated by the revolving of an ellipse about either axis is called a spheroid of revolution. If the ellipse revolve about the less axis, the spheroid is oblate; if about the greater axis, it is oblong.

Let k and k' denote the two axes of the spheroid, k being that of revolution; and let x and y be two co-ordinates of a point in the surface of the spheroid, having their origin in the centre, x being parallel to the axis of revolution, and y perpendicular to it; then the equation of the spheroid, whether oblate or oblong, will be

$$\frac{x^2}{k^2} + \frac{y^2}{k'^2} = 1.$$

Def. 2. An elliptical spheroid, in general, or an ellipsoid, is a solid bounded by a finite surface of the second order. Let ACB and ADE (Plate CI. fig. 1: this figure represents one eighth of an ellipsoid contained in one of the solid angles formed by the three principal sections) be two ellipses that have the same axis AO, the same centre O, and their planes perpendicular to one another: from any point K in the common axis, let there be drawn ordinates in both ellipses, as KC and KD; then, having described an ellipse of which KC and KD are the semiaxes, the periphery DMC of that ellipse will be in the surface of the ellipsoid. This solid figure has a centre, three axes crossing one another at right angles in the centre, and three principal sections made by planes passing through every two of its axes.

Let k, k', k'', denote the three semiaxes, viz. $k = \mathrm{OB}$, $k' = \mathrm{OE}$, $k'' = \mathrm{OA}$; and let x, y, z, denote three rectangular co-ordinates of a point M in the surface, the co-ordinates being parallel to the axes, and having their origin in the centre, viz. $\mathrm{MN} = x$, $\mathrm{NK} = y$, and $\mathrm{OK} = z$; then the equation of the surface will be $\frac{x^2}{k^2} + \frac{y^2}{k'^2} + \frac{z^2}{k''^2} = 1$; as it is easy to prove from the foregoing construction.

The ellipsoid becomes a sphere when all the three axes are equal: it becomes a spheroid of revolution when two of them are equal.

1. *If any plane cut an elliptical spheroid, the section will be an ellipse. In the spheroid of revolution, a section made by a plane perpendicular to the axis of revolution is a circle.* All this follows so easily from the nature of the solids, that we need not stop to give a formal demonstration.

2. *If a straight line cut two concentric ellipses that are similar and similarly situated, the parts of it between the outer and inner peripheries are equal to one another.*

Let AHBK and MDNC (Plate CI. fig. 2) be two similar and similarly situated ellipses that have the same centre O; and let the straight line AB cut them both; then AC and BD are equal. Bisect CD in L, and through L and the common centre draw the straight line HMNK to cut both ellipses. Because the ellipses are similar and similarly situated, and that CD is an ordinate of the diameter MN, it is plain that AB will be an ordinate of the diameter HK; wherefore, AB and CD being both bisected in L, AC is equal to BD.

Attraction. 3. *If there be two ellipses, one within the other, such that, any straight line being drawn to cut them, the parts of it between their peripheries are equal to one another, these ellipses are concentric, similar, and similarly situated.*

Let D (fig. 2) be any point in the inner ellipse, and through D draw EF, terminating in the outer ellipse: then, if we make FG = DE, G must be a point in the inner ellipse. Hence all the points of the inner curve are determined when the outer ellipse and the point D are given: wherefore there cannot be two different curves, both passing through D, that will answer the conditions. But an ellipse described through D, concentric with the outer ellipse, and similar to it, and similarly situated, will answer the conditions (2). Wherefore the two ellipses are concentric, and similar, and similarly situated.

4. *If a straight line be drawn to cut two elliptical spheroids that have the same centre, and are similar and similarly situated, the part of it between the outer and inner surfaces will be equal to one another.*

Conceive a plane, which contains the straight line, to pass through the common centre of the solids: the sections made by the plane will be concentric ellipses (1); and these will be similar and similarly situated, because the solids are so: wherefore the parts of the straight line between the surfaces are equal (2).

5. *If two elliptical spheroids that have the same centre, and are similar and similarly situated, be cut by a plane, the two sections will be concentric ellipses that are similar and similarly situated.*

For the sections are ellipses (1); and, any straight line being drawn to cut them, the parts of it between the peripheries will be equal (4). Wherefore the ellipses are concentric, similar, and similarly situated (3).

6. *Let ADE and CFG* (fig. 3) *be two concentric ellipses that are similar and similarly situated; let AO and CO, in the same straight line, be two of their axes, and let DE, drawn through C, be perpendicular to AO; then if CF and CG be two chords of the interior ellipse that make equal angles with the axis CO, and if the chords DM and DN of the exterior ellipse be drawn respectively parallel to CF and CG; the sum of CF and CG will be equal to the sum or difference of DM and DN, according as they both fall on the same side, or on different sides of DE.*

For draw EP parallel to CF, and it will likewise be parallel to DM. Because CF and CG are equally inclined to CO and to DE, it is plain that DN and EP, which are parallel to CF and CG, are likewise equally inclined to DE: consequently DN = EP. Draw a straight line through the common centre to bisect DM in L, and that straight line will likewise bisect EP, parallel to DM, in H: and because the ellipses are similar and similarly situated, the same straight line will likewise bisect the chord CF of the interior ellipse, in K. Because DC = CE, therefore DL + EH = 2CK = CF. Wherefore DM + DN = 2DL + 2EH = 2CF = CF + CG.

The demonstration of the other case, when DM and DN fall on different sides of DE, is entirely similar.

Some general Properties, resulting from the Law of Attraction that obtains in Nature.

7. *Let AB and EF* (fig. 4) *be two indefinitely slender pyramids, that are similar to one another, and both composed of the same homogeneous matter, which attracts in the inverse proportion of the square of the distance: the attractions of the pyramids upon particles placed at the vertices A and E are proportional to the length of the pyramids.*

Conceive each of the pyramids to be divided into an indefinitely great number of thin slices of equal thickness, by planes parallel to its base; then, if CD and GH be any two of these slices, their attractions upon particles placed at A and E will be proportional to $\frac{CD}{AC^2}$ and $\frac{GH}{EG^2}$: Now, Attraction. these are equal; for the solids CD and GH having the same thickness, they are proportional to the sections CM and GN, that is, to AC^2 and EG^2, because the pyramids are similar. Wherefore the attraction of any one of the slices in the pyramid AB, upon a particle placed at A, is equal to the attraction of any one of the slices in EF upon a particle placed at E. Consequently, the whole attraction of the pyramid AB is to the whole attraction of the pyramid EF as the number of slices in AB to the number of slices in EF, that is, as the length AB to the length EF.

Cor. 1. The attractions of any portions of the pyramid are as the lengths of the portions. For the attractions are proportional to the number of slices in the portions, that is, as the lengths.

Cor. 2. If the pyramids have different densities, their attractions are proportional to the lengths multiplied by the densities. For, in this case, the attraction of each slice will be proportional to its density; wherefore the attractions will be as the densities multiplied by the number of slices, or as the densities multiplied by the lengths.

8. *If there be two similar solids composed of the same homogeneous matter, which attracts in the inverse proportion of the square of the distance; any two particles of matter, similarly situated with regard to the solids, will be attracted by them with forces that are proportional to any of the homologous lines of the solids.*

Because the solids are similar, they may be resolved into an indefinitely great number of slender pyramids, and frustums of pyramids, that are similar to one another, and similarly placed in the solids; each pyramid having its vertex at one of the attracted particles. The direct attractions of any corresponding pair of pyramids will have constantly the same ratio to one another; for they will be as the lengths of the pyramids or frustums (7); that is, because the solids are similar, as any two homologous lines of the solids. Wherefore the whole attractive forces, compounded of all the direct attractions which act in directions that make the same angles with one another, will likewise have to one another the proportion of any two of the homologous lines of the solids.

Cor. If the two solids have different densities, their attractions will be proportional to the densities multiplied by any homologous lines of the solids (7, *Cor.* 2).

9. *If there be two concentric elliptical spheroids that are similar and similarly situated, a particle placed anywhere within the inner surface will be in equilibrium, or will be urged equally in all opposite directions by the shell of homogeneous matter contained between the two surfaces, supposing the law of attraction to be that of the inverse proportion of the square of the distance.*

Let P (Plate CI. fig. 5) be a particle placed within such a shell, and let a slender double pyramid, having P for the common vertex, be extended to meet the surfaces of the solid on both sides of P. The portions of the pyramid AGHB and CEFD between the surfaces on opposite sides of P, will have equal lengths (4); wherefore these portions will attract a particle placed at P with equal forces (7, *Cor.* 1). The same thing may be proved of all the pyramids which have their vertices at P, and fill the spheroids. Wherefore P is attracted equally in all opposite directions by the homogeneous matter contained between the surfaces of the spheroids.

10. *To find the attractive force of an indefinitely slender prism, acting in a direction parallel to the prism, upon a particle of matter placed anywhere.*

Let BC (Plate CI. fig. 6) be a prism of homogeneous matter, upon the indefinitely slender base CH, and

Attraction. let a particle of matter be placed at A; draw AB and AC to the extremities of the prism, and AE to any point in it; and draw AD perpendicular to BC. Let S = base CH, and put AD = a, DE = x; the element of the prism is = S × dx, the element of the attraction in the direction AE is = $\frac{S \times dx}{AE^2}$, and the element of the attraction in the direction parallel to the prism is = $\frac{S \times dx}{AE^2} \times \frac{DE}{AE} = \frac{S \times x dx}{(a^2+x^2)^{\frac{3}{2}}}$.

Now, $\int \frac{S \times x dx}{(a^2+x^2)^{\frac{3}{2}}} = \text{Const.} - \frac{S}{\sqrt{a^2+x^2}} = \text{Const.} - \frac{S}{AE}$; and the constant quantity is determined by making the fluent begin at the end of the prism nearer to A; wherefore the whole attractive force of the prism, in the direction parallel to the prism, is

$$= S \times \left\{ \frac{1}{AB} - \frac{1}{AC} \right\}.$$

Cor. In like manner may the attractive force of the prism be found, when the attraction of the particles is proportional to any function of the distance.

Let AB = f, AC = f'; suppose that $\varphi(f)$ is the function of the distance that expresses the law of attraction; and put $\int df \cdot \varphi(f) = \Psi(f)$; then the attraction parallel to the prism is

$$= S \times \pm [\Psi(f) - \Psi(f')],$$

observing that the attraction is always positive.

ATTRACTION OF SPHERES.

Attraction of spheres. 11. *Spheres of the same homogeneous matter attract particles placed on their surfaces with forces proportional to their radii.*

Spheres being similar solid figures, this proposition is no more than a particular case of what was before proved (8).

Cor. If the spheres have different densities, the attractions at their surfaces are proportional to their radii multiplied by their densities. (8, Cor.)

12. *The force with which a particle, placed anywhere within a sphere of homogeneous matter, is urged towards the centre, is proportional to its distance from the centre.*

Conceive a concentric sphere to be described, which contains the attracted particle in its surface; the matter between the two surfaces will exert no force on the particle (9), which will therefore be urged to the centre, only by the attraction of the inner sphere, in the surface of which it is placed; but this force is proportional to the radius of the sphere, or to the distance of the particle from the centre (11).

13. *Let PNQ and ABC* (fig. 7) *be two spheres of the same homogeneous matter, which attracts in the inverse proportion of the square of the distance; let the centres of the spheres be at M and D, and take MR equal to the radius of the sphere ABC, and ED equal to the radius of the sphere PNQ; the attractions of the spheres upon particles placed at R and E are to one another as the squares of the radii of the spheres.*

In the spheres draw two great circles perpendicular to the diameters PQ and AC, that pass through the points R and E; and let PpQ and AbC be two great circles, making equal indefinitely small angles NMp and BDb with the great circles PNQ and ABC. Let HK and FG, parallel to PQ and AC, be any two chords of the circles PpQ and AbC, that subtend similar arcs, or arcs containing the same number of degrees; and through HK and FG let planes perpendicular to the circles PpQ and AbC, be drawn to cut the portions of the spheres contained in the angles NMp and BDb; join RH, RK, MH, MK, DF, DG, EF, EG. Because the arcs subtended by HK and FG are like parts of their circumferences, it is plain that the angle RMH = EDF, and RMK = EDG. And because ED = MH = MK, and RM = DF = DG (*hyp.*), therefore RH = EF, and RK = EG.

Conceive the chords HK and FG, together with the planes passing through them, to change their place a little, so as to describe two slender prisms, or elements of the portions of the spheres contained in the angles NMp and BDX. It is plain that MX and DO, the distances of the chords HK and FG from the centres of their circles, are constantly proportional to MN and DB, the radii of the spheres; wherefore XT and OS, the perpendicular sections of the small prisms, are similar figures, and have to one another the same ratio that MX² has to DO², or MN² to DB². Now, the attraction of the prism HK urging a particle at R to the centre M, is

$= XT \times \left(\frac{1}{RH} - \frac{1}{RK}\right)$, (10); and the attraction of the prism FG urging a particle at E to the centre D, is $= OS \times \left(\frac{1}{EF} - \frac{1}{EG}\right)$. But in consequence of what was proved, $\frac{1}{RH} - \frac{1}{RK} = \frac{1}{EF} - \frac{1}{EG}$; wherefore the attractions of the prisms are to one another as XT to OS, or as MN² to DB². The same thing may be proved of all the elements of the two portions of the spheres contained in the angles NMp and BDb; wherefore those portions attract particles at R and E with forces proportional to the squares of the radii of the spheres. But because the small angles NMp and BDb are equal, each of the spheres may be divided into an equal number of such portions; wherefore the attractions of the whole spheres upon particles placed at R and E are proportional to the squares of the radii of the spheres.

Cor. This proposition is true when the particles of matter attract one another with forces proportional to any proposed function of the distance.

Let RH = EF = f, and RK = EG = f'; then, adopting the same notation as before (10, *Cor.*), the attractions of the prisms urging particles placed at R and E to the centres M and D, are respectively XT × ± $[\Psi(f) - \Psi(f')]$, and OS × ± $[\Psi(f) - \Psi(f']$: consequently, those attractions have the same proportion that XT has to SO, or MN² to DB². Wherefore the attractions of the whole spheres are in the same proportion.

14. *A particle placed anywhere without a sphere of homogeneous matter which attracts in the inverse proportion of the square of the distance, will be urged to the centre of the sphere with a force that is inversely proportional to the square of the particle's distance from the centre.*

Let ABC (Plate CI. fig. 8) be the sphere, O its centre, and P a particle without the sphere: conceive a concentric sphere PMN, of the same homogeneous matter with the sphere ABC, to be described with the radius PO. Then, by the last proposition, the attraction of the sphere ABC upon the particle P is to the attraction of the sphere PMN, upon a particle placed at A, as AO² to PO². But the attraction of the sphere PMN upon a particle placed at A is equal to the attraction of the sphere ABC upon the same particle; for the attraction of the matter between the two spherical surfaces exerts no force upon a particle at A (9). Wherefore, in the proportion set down above, the two middle terms are con-

Attraction. stantly the same wherever the point P is placed without the sphere ABC; consequently the first term of the proportion must follow the inverse ratio of the last term; that is, the attraction of the sphere ABC upon the external particle at P is inversely proportional to PO^2.

15. *The same law of attraction being supposed, a homogeneous sphere will attract a particle placed without it, with the same force as if all the matter of the sphere were collected in the centre.*

Let f denote the distance of the particle from the centre; then it follows, from the last proposition, that the attraction of the sphere upon the particle will have for its measure $\frac{A}{f^2}$; A denoting a constant quantity that will be determined by any particular case; that is, by the actual attractive force corresponding to any determinate distance from the centre. Let r denote the radius of the sphere, and M its mass; then no part of the matter of the sphere being nearer the attracted particle than $(f-r)$, and none of it more remote than $(f+r)$, the attraction of the sphere on the particle will be greater than $\frac{M}{(f+r)^2}$, and less than $\frac{M}{(f-r)^2}$. Therefore $\frac{A}{f^2}$ is always contained between those limits, which requires that A = M. For, if A were greater than M, such values of f might be found as would make $\frac{A}{f^2}$ equal to or greater than $\frac{M}{(f-r)^2}$; and if A were less than M, such values of f might be found as would make $\frac{A}{f^2}$ equal to or less than $\frac{M}{(f+r)^2}$. Therefore A = M; and the attraction of the sphere is equal to $\frac{M}{f^2}$, or the same as if all the matter were collected in the centre.

If the radius of the sphere = r, the density of the matter contained in it = d; then the mass, or M, = $\frac{4\pi r^3 d}{3}$ (π being the circumference of the circle whose diameter is unit), and the attraction of the sphere at the distance f from the centre = $\frac{4\pi r^3 d}{3f^2}$. This is still true at the surface of the sphere when $f = r$, so that the attraction at the surface = $\frac{4\pi r d}{3}$; which expression, with the help of what is proved in (12), enables us to compare the intensities of the attractions of homogeneous spheres, at all distances from the centre, without or within the surfaces.

Cor. 1. A shell of homogeneous matter contained between two concentric spherical surfaces, will attract a particle placed without it, with the same force as if all the matter of the shell were collected in its centre.

For the attractive force of such a shell is equal to the difference of the attractions of two concentric spheres of the same homogeneous matter with the shell.

Cor. 2. A sphere composed of concentric shells, that vary in their densities according to any law, will attract a particle placed without it, with the same force as if all the matter were collected in the centre.

For this having been proved of one shell (*Cor.* 1), it must be true of any number of shells.

If $\varphi(r)$ denote the density at the distance r from the centre, the quantity of matter in the sphere will be $= 4\pi \cdot \int \varphi(r) \cdot r^2 dr$; and the attraction on a particle without the sphere at the distance f from the centre = $\frac{4\pi \cdot \int \varphi(r) \cdot r^2 dr}{f^2}$. Attraction.

16. *Two spheres, each composed of concentric shells of variable density, attract one another with the same force as if all the matter of each were collected in its centre.*

For the attraction of a sphere A upon every particle of another sphere B will remain the same, if we suppose all the matter of A to be collected in its centre (15). But the attraction of any particles of matter placed in A's centre upon the sphere B is equal and opposite to the attraction of B, upon the same matter so placed; and again, the attraction of B upon all the particles placed in the centre of A, will remain unchanged, if we suppose the matter of B to be collected in its centre. Wherefore A attracts B with the same force as if the matter of each were collected in its centre.

17. *Supposing that the particles of matter attract with a force proportional to the distance, a body of any shape will attract a particle of matter placed anywhere with the same force, and in the same direction, as if all the matter of the body were collected in its centre of gravity.*

Suppose that the attracted particle is placed at P (fig. 9), and the centre of gravity of the attracting body at G; join PG, and let any plane pass through that line. Let L be a small part, or element of the body, and from L draw LK perpendicular to the plane passing through PG, and KF perpendicular to PG; join PL and PK. Put dm to denote the quantity of matter, or the mass of the element L; then its attractive force, urging the particle in the direction PL, is = PL × dm, which, by the resolution of forces, is equivalent to the two forces PK × dm and KL × dm; and again, the single force PK × dm is equivalent to the two forces FK × dm, and PF × dm = PG × dm + GF × dm. Wherefore, the attraction of the element L upon the particle at P is equivalent to these four separate forces, viz. PG × dm, GF × dm, FK × dm, KL × dm, which urge the particle P respectively in the directions PG, GF, FK, KL. But, from the nature of the centre of gravity, the sum of all the forces, KL × dm, that urge the particle P to one side of the plane passing through PG, is just equal to the sum of the forces that urge it to the other side of the same plane; and the sum of all the forces, FK × dm, that urge P to one side of the line PG, is just equal to the sum of the forces that urge it to the other side of the same line; and the sum of all the forces, GF × dm, that urge P towards the point G, is just equal to the sum of the forces that urge it from the same point. Wherefore all the preceding forces mutually destroy one another, excepting the forces PG × dm, the sum of which, when extended to all the elements of the attracting body, is = PG × mass of the body. Wherefore the whole attraction upon P is the same as if all the matter of the body were collected in its centre of gravity.

Cor. Supposing that the particles of matter attract with a force proportional to the distance, a homogeneous sphere will attract a particle placed anywhere, in the same manner as if all the matter of the sphere were collected in the centre.

For the centre of gravity of a homogeneous sphere is the same as the centre of its figure. This corollary is likewise true of a sphere composed of concentric shells of variable density; and it is easy to apply the demonstration of (16) to prove that, in this law of attraction, two spheres, each composed of concentric shells of variable density, will attract one another with the same force as if the matter of each were collected in its centre.

18. *To investigate what are the laws of attraction in re-*

Attraction. *gard to the distance according to which a shell of homogeneous matter, contained between two concentric spherical surfaces, will attract a particle placed without it, in the same manner as if all the matter of the shell were collected in the centre.*

It has been proved that this property actually belongs to homogeneous shells in the law of attraction which obtains in nature, and likewise when the particles of matter attract with a force proportional to the distance; but it is interesting to know whether it is confined to these two cases alone, or extends to other laws of attraction. This can only be discovered by a direct analysis.

Let $r = PC$ (fig. 10), the distance of the attracted point from the centre of the shell; $u = CA$, the radius of the inner surface of the shell; $f = PM$, the distance of P from any point in the surface. Having drawn the diameter AD through P, let AMD and AND be two great circles, making with one another an indefinitely small angle $MAN = dq$; and let two small circles BMG, *bmg*, indefinitely near one another, of which A and D are the poles, meet the former circles in M, N, *m*, *n*; and draw MS, NS to the centre of the circle BMG. Put θ for the measure of the arc AM; then $MS = u \sin.\theta$; $MN = dq.u \sin.\theta$; $Mm = ud\theta$; and the quadrilateral space $MNnm = u^2.dq.d\theta \sin.\theta$. We may suppose the thickness of the shell indefinitely small, since, if the property belong to an elementary shell indefinitely thin, it will be true of one of a determinate thickness, which can be resolved into such elements. Suppose the thickness of the shell to be $= du$; then the quantity of matter in the part standing upon the quadrilateral space $MNnm = u^2du.dq.d\theta \sin.\theta$. Let $\varphi(f)$ represent the direct attraction of a particle at M in the direction PM; then its attraction directed to the centre $C = \varphi(f) \times \frac{PS}{PM} = \frac{r-u\cos.\theta}{f} \times \varphi(f)$; and the attraction of the element of the shell in the same direction $= u^2du.dq.d\theta \sin.\theta \times \frac{r-u\cos.\theta}{f}.\varphi(f)$. This expression is proportional to dq, when θ and f remain constant; and therefore (denoting by π the circumference of the circle whose diameter is unit) the attraction of the whole zone contained between the small circles BMG, *bmg*, will be $= 2\pi.u^2du.d\theta \sin.\theta.\frac{r-u\cos.\theta}{f}.\varphi(f)$; and the attractive force of the whole shell will be

$$2\pi.u^2du\int d\theta \sin.\theta.\frac{r-u\cos.\theta}{f}.\varphi(f);$$

the fluent to be extended from $\theta = 0$ to $\theta = \pi$.

Again, the quantity of matter in the shell is $= 4\pi.u^2du$; and the attraction of this matter placed in the centre, at the distance r from P, is $= 4\pi.u^2du.\varphi(r)$.

If now we equate the attraction of the shell to the attraction of its matter placed in the centre, and leave out the factors common to both, we shall get

$$2\varphi(r) = \int d\theta \sin.\theta.\frac{r-u\cos.\theta}{f}.\varphi(f),$$

the limits of the integral being the same as before.

But $f^2 = r^2 - 2ru\cos.\theta + u^2$; then $d\theta \sin.\theta = \frac{fdf}{ru}$; also $r-u\cos.\theta = \frac{f^2+r^2-u^2}{2r}$; wherefore, by substitution, we get

$$4.r^2\varphi(r).u = \int(f^2+r^2-u^2).df.\varphi(f);$$

or, which is equivalent, $4.r^2\varphi(r).u =$

$$(f^2+r^2-u^2).\int df.\varphi(f) - 2\int fdf\int df.\varphi(f),$$

the limits of this integral being from $f = r-u$ to $f = r+u$, which correspond to $\theta = 0$ and $\theta = \pi$.

Now let $\int df.\varphi(f) = \Psi(f)$; and $\int fdf\int df.\varphi(f) =$ Attraction. $\int fdf.\Psi(f) = \Psi'(f)$; then, by taking the fluents between the proper limits, we get

$$4.r^2\varphi(r).u = 2r.[(r+u)\Psi(r+u) - (r-u)\Psi(r-u)] - 2[\Psi'(r+u) - \Psi'(r-u)].$$

If we develope the binomial functions in the last expression, all the even powers of u will disappear, and the odd powers only will remain; these last terms being all contained in this general formula,

$$\text{viz. } \frac{4}{1.2.3\ldots 2n+1}.\left\{r.\frac{d^{2n+1}r\Psi(r)}{dr^{2n+1}} - \frac{d^{2n+1}\Psi'(r)}{dr^{2n+1}}\right\}.u^{2n+1};$$

and, observing that $\frac{d.\Psi'(r)}{dr} = r\Psi(r)$, the same expression will become $\frac{4}{1.2.3\ldots.2n+1}$.

$$\left\{r.\frac{d^{2n+1}r\Psi(r)}{dr^{2n+1}} - \frac{d^{2n}r\Psi(r)}{dr^{2n}}\right\}.u^{2n+1};$$

which, again, is more simply expressed thus, viz.

$$\frac{4r^2}{1.2.3\ldots.2n+1}.\frac{d.\left\{\frac{1}{r}.\frac{d^{2n}r\Psi(r)}{dr^{2n}}\right\}}{dr}.u^{2n+1}.$$

Wherefore, by substituting the development instead of the functions, and then dividing by $4r^2u$, we get

$$\varphi(r) = \frac{d.\Psi(r)}{dr} + \frac{1}{1.2.3.}.\frac{d.\left\{\frac{1}{r}.\frac{d^2r\Psi(r)}{dr^2}\right\}}{dr}.u^2 + \frac{1}{1.2.3.4.5}.\frac{d.\left\{\frac{1}{r}.\frac{d^4r\Psi(r)}{dr^4}\right\}}{dr}.u^4 + \&c.$$

From the nature of the function $\Psi(r)$, we get $\varphi(r) = \frac{d.\Psi(r)}{dr}$; wherefore each of the remaining terms must be separately equal to nothing; hence

$$d.\left\{\frac{1}{r}.\frac{d^2r\Psi(r)}{dr^2}\right\} = 0;$$

from which we find $r\Psi(r) = \frac{1}{2}Ar^3 + A'r - A''$, A, A', A'' being arbitrary constant quantities; and this value of $r\Psi(r)$, it is plain, will likewise render all the succeeding terms of the development evanescent. Wherefore

$$\varphi(r) = \frac{d.\Psi(r)}{dr} = Ar + \frac{A''}{r^2}.$$

Thus the most general expression of the law of attraction, that possesses the property in question, is a combination of the two laws above mentioned, with each of which it coincides, according as we make the one or other of the constant quantities equal to nothing. We have, therefore, a direct proof that the law of nature is the only one which will make the attraction decrease as the distance increases, and in which a spherical shell, or a sphere, will attract in the same manner as if all the matter were collected in the centre.

Laplace has arrived at the same conclusion by a different process. (*Méc. Céleste*, livre ii. chap. 2, No. 12, Rem. part.)

ATTRACTION OF SPHEROIDS OF REVOLUTION.

19. *APBQ* (Plate CII. fig. 11) *and CMDN be two concentric ellipses similar to one another, and similarly situated, of which AB and CD are either the greater or less* Attraction of spheroids of revolution.

Attraction. *axes; and let PCQ be perpendicular to AB. Conceive the ellipses to revolve about PQ, so as to describe an indefinitely small angle; then, supposing the law of attraction to be inversely proportional to the square of the distance, the thin solid of homogeneous matter described by the ellipse APBQ will attract a particle placed at P, in a direction perpendicular to any plane passing through PQ, with the same force that the thin solid of the same matter described by the ellipse CMDN, will attract a particle placed at C perpendicularly to the same plane.*

From C draw CM, CN, making equal angles with CD, and PR, PT respectively parallel to CM, CN; and let C*m*, C*n*, P*r*, P*t*, be drawn in the same manner, and indefinitely near the former lines. While the ellipses revolve about PQ, the small sectors will describe pyramids that have their vertices at C and P. It is manifest that the pyramids so described are similar; for their angels at C and P in the planes of the ellipses are equal; and their other angles, described by revolving about PQ, are likewise equal, because the sectors are equally inclined to that axis. Wherefore the direct attractions of all the small pyramids upon the particles P and C are proportional to the lengths PR, PT, CM, CN (7); and consequently the forces that urge the particles P and C in a direction at right angles to any plane passing through PQ are proportional to the perpendiculars let fall upon that plane from R, T, M, N. But because PR, PT, CM, CN are equally inclined to PQ, they will make equal angles with any plane passing through PQ; wherefore the perpendiculars drawn to the plane from R, T, M, N, will be respectively proportional to PR, PT, CM, CN. But CM + CN = PR + PT (6); wherefore the sum of the perpendiculars drawn to the plane from M and N will be equal to the sum of the perpendiculars drawn to it from R and T. Consequently the force of the pyramids PR and PT, which urges the particle P at right angles to the plane, is equal to the force of the pyramids CM and CN, which urges the particle C in a parallel direction. The same thing is true of all the small pyramids that make up the thin solids described by the ellipses APBQ and CMDN; and it is therefore true of the whole solids.

It is to be observed that when the pyramids PR and PT fall on opposite sides of PQ, it is the difference of their attractions which is equal to the sum of the attractions of CM and CN; and it is the difference of the perpendiculars let fall from T and R on opposite sides of the plane, which is equal to the sum of the perpendiculars let fall from M and N.

20. *Let APBQ be a spheroid of revolution, PQ the axis of revolution, and ACB a plane through the centre perpendicular to PQ* (Plate CII. fig. 12). *If D be a particle in the surface of the spheroid, and DL perpendicular to the plane ACB; then the attraction of a spheroid on a particle placed at the pole P, will be to the force with which a particle placed at D is attracted in the direction DL, as PC is to DL.*

Through D draw a plane parallel to the plane ACB, and let the plane so drawn cut the axis PQ in F; draw the straight line DFE to terminate in the spheroid, and describe another spheroid through F, having the same centre with the spheroid APBQ, and similar to it, and similarly situated. Conceive an indefinitely great number of planes, making indefinitely small angles with one another, to be drawn through DE, so as to divide the two spheroids into an indefinitely great number of thin solids or slices; then the sections which every one of the planes make with the spheroids will be similar ellipses, having the same centre (5); and it is manifest that a straight line drawn through F at right angles to DE, in any one of the planes, will pass through the centre of the two ellipses contained in it, and will coincide with an axis of each. Wherefore the force with which every one of the slices or elements of the spheroid APBQ attracts a particle placed at D in the direction DL, is equal to the force with which the corresponding slice or element of the spheroid GFHK attracts a particle placed at F in the direction FC (19). Wherefore, the whole attraction of the spheroid APBQ upon a particle at D, in the direction DL, is equal to the whole attraction of the spheroid GFHK upon a particle at F. But the attractions of the spheroids APBQ and GFHK upon particles placed at P and F, are to one another as PC to FC (8). Wherefore, the attraction of the spheroid APBQ upon a particle at P, is to the force with which the same spheroid attracts a particle at D, in the direction DL, as PC is to FC or DL. Attraction.

21. *Let APBQ be a spheroid of revolution, and PQ the axis of revolution as before. If D be a particle in the surface, ADPB* (fig. 13) *a section through D, and the axis PQ and DL perpendicular to PQ; the attraction of the spheroid upon a particle at A will be to the force with which a particle at D is attracted, in the direction DL, as AC is to DL.*

Through D draw a plane perpendicular to AB, which cuts the section ADB in the straight line DFE; and let a spheroid FGHK be described through F, having the same centre with the spheroid APBQ, and similar to it, and similarly situated. Then, conceiving the two spheroids to be divided into an indefinitely great number of thin slices by planes passing through DE, the force with which every slice or element of the spheroid APBQ attracts a particle at D in the direction DL, will be equal to the force with which the corresponding slice or element of the spheroid FGHK attracts a particle at F (19). But the attractions of the spheroids APBQ and FGHK upon particles placed at A and F are to one another as AC to CF (8). Wherefore, the attraction of the spheroid APBQ upon a particle at A is to the force with which the same spheroid attracts a particle at D, in the direction DL, as AC to FC or DL.

The two last propositions will enable us to find both the direction and the intensity of the attraction of a homogeneous spheroid of revolution upon a particle placed anywhere on the surface, when we have ascertained the attractive forces at the poles and at the circumference of the circular section made by a plane through the centre perpendicular to the axis. For the whole attraction at any point is the compound force arising from the attractions perpendicular to the axis, and parallel to it. The next object of our research is, therefore, to determine the two forces above mentioned, viz. the attraction at the poles, and at the circular section equally distant from both poles.

22. *Let ABD be an indefinitely slender pyramid, of which the base BD is perpendicular to the edge AD* (fig. 14); *let B=base BD, and f=length AD; then* $\frac{B}{f}$ *= the attraction of the whole matter of the pyramid upon a particle placed at the vertex A.*

Let AM $= x$, then the section MN parallel to the base BD $= \frac{B.x^2}{f^2}$, and MP = element of the prism $= \frac{B.x^2dx}{f^2}$, and the attraction of the element upon a particle placed at A $= \frac{MP}{AM^2} = \frac{B.dx}{f^2}$, the fluent of which is $= \frac{Bx}{f^2}$ = attraction of the pyramid AM upon a particle at A. And, when $x = f$, this becomes $= \frac{B}{f}$ = attraction of the pyramid AD upon a particle placed at A.

Attraction. 23. *To investigate the attraction of a homogeneous spheroid of revolution upon a particle placed at the pole.*

Let P (fig. 15) be the pole, PCQ the axis of revolution, and APBQ a section of the spheroid by a plane passing through PQ, and any point M, in the surface; draw PM, Pm indefinitely near PM, and Mm perpendicular to Pm. Conceive the plane PMQ to revolve about PQ, so as to describe the indefinitely small angle BCO; then the small triangle MPm will describe a slender pyramid, having its vertex at P, and of which the base is a rectangle, contained by Mm and RT; for the point M moving parallel to R, it will describe a line equal and parallel to that described by R, namely, to RT.

Let PM $= f$, and the angle KPM, which PM makes with a perpendicular to the axis, $= \theta$, and the indefinitely small angle BCO $= d\varphi$. Then $Mm = f d\theta$, RT $=$ CR $\times d\varphi = f \cos.\theta \,.\, d\varphi$, and B, the base of the slender pyramid described by the triangle MPm, $= d\varphi \,.\, d\theta \cos.\theta \,.\, f^2$; wherefore the direct attraction of the pyramid on a particle at P $= \frac{B}{f}(22) = d\varphi \,.\, d\theta \cos.\theta \,.\, f$, and the elementary attraction of the spheroid in the direction PC $=$ direct attraction of the pyramid $\times \frac{PS}{PM} = d\varphi \,.\, d\theta \cos.\theta \sin.\theta \,.\, f$.

Again, let MR $= x$, CR $= y$, PC $= k$, AC $= k'$; then $y = f\cos.\theta$, $x = k - f\sin.\theta$: if we substitute these values in the equation of the solid (Def. 1) we get

$$\frac{(k - f\sin.\theta)^2}{k^2} + \frac{f^2\cos.^2\theta}{k'^2} = 1; \text{ whence}$$

$$f = \frac{2k'^2k}{k^2} \cdot \frac{\sin.\theta}{\cos.^2\theta + \frac{k'^2}{k^2}\sin.^2\theta}.$$

By substituting the value of f just found in the preceding expression of the elementary attraction of the spheroid, it will become

$$\frac{2k'^2k}{k^2} d\varphi \cdot \frac{d\theta \cos.\theta \,.\, \sin.^2\theta}{\cos.^2\theta + \frac{k'^2}{k^2}\sin.^2\theta};$$

which must be integrated from $\varphi = 0$ to $\varphi = 2\pi$, and from $\theta = 0$ to $\theta = \frac{\pi}{2}$, π denoting always the half-circumference when radius is unit.

In an oblate spheroid, k is less than k': put $k'^2 - k^2 = k^2 \,.\, e^2$, and $z = \sin.\theta$; then the element of the attractive force will become, by substitution,

$$\frac{2k'^2k}{k^2} d\varphi \cdot \frac{z^2dz}{1 + e^2z^2} = \frac{2k'^2k \,.\, d\varphi}{k^2e^3} \cdot \left\{ edz - \frac{edz}{1 + e^2z^2} \right\};$$

and by integrating from $z = 0$ to $z = 1$, we get

$$\frac{2k'^2k \,.\, d\varphi}{k^2e^3} \cdot [e - \text{arc. tan. } e]$$

for the force with which the matter between the planes PBQ and POQ urges the particle P to the centre. Wherefore the whole attractive force of the spheroid upon a particle at P is $=$

$$\frac{4\pi \,.\, k'^2k}{k^2e^3} \cdot [e - \text{arc. tan. } e].$$

And because $\frac{4\pi \,.\, k'^2k}{3} =$ mass of the spheroid $= M$, we get the measure of the attraction of the oblate spheroid upon a particle placed at the pole equal to

$$k \cdot \frac{3M}{k^3e^3} \cdot [e - \text{arc. tan. } e].$$

In an oblong spheroid, k is greater than k'; put $k^2 - k'^2 = k^2e^2$, then the element of the attractive force will become, by substitution, Attraction.

$$\frac{2k'^2k}{k^2} d\varphi \cdot \frac{z^2dz}{1 - e^2z^2} = \frac{2k'^2k \,.\, d\varphi}{k^2e^3} \left\{ \frac{edz}{1 - e^2z^2} - edz \right\};$$

whence, by proceeding as before, we get the measure of the attractive force of the oblong spheroid on a particle placed at the pole equal to

$$k \cdot \frac{3M}{k^3e^3} \cdot \left\{ \frac{1}{2} \text{ hyp. log. } \frac{1 + e}{1 - e} - e \right\}$$

Cor. In an oblate spheroid differing little from a sphere, e^2 will be a very small fraction, of which we may reject the higher powers. When this is done, the preceding expression of the polar attraction, viz.

$$\frac{4\pi \,.\, kk'^2}{k^2e^3} \cdot (e - \text{arc. tan. } e),$$

will be $= 4\pi k \,.\, (1 + e^2) \,.\, (\frac{1}{3} - \frac{1}{5}e^2) = \frac{4\pi k}{3}\left(1 + \frac{2}{5}e^2\right)$.

And, if $k' = k + r = k\sqrt{1 + e^2}$ be the radius of the equator, then $2\frac{r}{k} = e^2$, so that the attraction at the pole will be

$$\frac{4\pi k}{3} \cdot \left(1 + \frac{4}{5} \cdot \frac{r}{k}\right).$$

24. *To investigate the attraction of a homogeneous spheroid of revolution on a particle placed in the circumference of the circular section made by a plane through the centre, at right angles to the axis of revolution.*

Let P (Plate CII. fig. 16) be the pole, PC the axis of revolution, A a point in the circular section AOB, made by a plane through the centre perpendicular to PC. Let M be any point in the surface of the spheroid, AMO a section through A and M by a plane perpendicular to to AOB, Am a line in that plane indefinitely near AM, and Mm perpendicular to Am, MR perpendicular to AO, and RS to AB. Conceive the plane AMO to revolve about A, so as to describe an indefinitely small angle OAQ; then the triangle AMm will describe a slender pyramid, having its vertex at A, and of which the base is equal to a rectangle contained by Mm and RT; for the point M moving parallel to the point R, it will describe a line equal to that described by R, namely, to RT.

Let AM $= f$, the angle MAR $= \theta$, and the angle OAQ $= d\varphi$; then $Mm = f d\theta$, and TR $=$ AR $\times d\varphi = f\cos.\theta \,.\, d\varphi$. Wherefore B $=$ base of the pyramid described by MAm $= d\varphi \,.\, d\theta \cos.\theta \,.\, f^2$, and the direct attraction of the pyramid in the direction AM $= \frac{B}{f}(22) = d\varphi \,.\, d\theta \cos.\theta \,.\, f$. Wherefore the elementary attraction of the spheroid in the direction AC $=$ direct attraction of the pyramid $\times \frac{AR}{AM} \times \frac{AS}{AR}$ $= d\varphi \cos.\varphi \,.\, d\theta \cos.^2\theta \,.\, f$.

Again, let MR $= x$, RS $= y$, CS $= z$, CP $= k$, and AC $= k'$; then (Def. 1)

$$\frac{x^2}{k^2} + \frac{y^2 + z^2}{k'^2} = 1.$$

But $x = f \sin.\theta$, $y =$ AR $\,.\, \sin.\varphi = f\cos.\theta \sin.\varphi$, and $z = k' - f\cos.\theta\cos.\varphi$; wherefore, by substitution, we get

$$\frac{f^2\sin.^2\theta}{k^2} + \frac{f^2\cos.^2\theta\sin.^2\varphi}{k'^2} + \frac{(k' - f\cos.\theta\cos.\varphi)^2}{k'^2} = 1.$$

From this equation we get

$$f = 2k' \cdot \frac{\cos.\theta\cos.\varphi}{\cos.^2\theta + \frac{k'^2}{k^2}\sin.^2\theta}.$$

Let this value of f be substituted in the expression of the elementary attraction of the spheroid before found, and it will become

Attraction.

$$2k' \cdot d\varphi \cos.^2 \varphi \cdot \frac{d\theta \cos.^3 \theta}{\cos.^2 \theta + \frac{k^2}{k^2} \sin.^2 \theta};$$

which expression, when integrated from $\varphi = 0$ to $\varphi = \pi$, and from $\theta = 0$ to $\theta = \frac{1}{2}\pi$, will give the attraction of half the spheroid: and the double of it, viz.

$$4k' \cdot d\varphi \cos.^2 \varphi \cdot \frac{d\theta \cos.^3 \theta}{\cos.^2 \theta + \frac{k^2}{k^2} \sin.^2 \theta},$$

being integrated between the same limits, will give the whole attraction of the spheroid.

In the oblate spheroid, k is less than k': Let $k'^2 - k^2 = k^2e^2$, and $z = \sin. \theta$; and, by substitution, the element of the attractive force will become

$$4k' \cdot d\varphi \cos.^2 \varphi \cdot \frac{dz(1 - z^2)}{1 + e^2z^2} =$$

$$4k' \cdot d\varphi \cdot \cos.^2 \varphi \cdot \frac{1 + e^2}{e^3} \cdot \left\{ \frac{edz}{1 + e^2z^2} - \frac{edz}{1 + e^2} \right\}.$$

And by integrating from $z = 0$ to $z = 1$, we get

$$4k' \cdot d\varphi \cos. \varphi \cdot \frac{1 + e^2}{e^3} \cdot \left\{ \text{arc. tan. } e - \frac{e}{1 + e^2} \right\};$$

for the force with which the matter between the sections that contain the angle OAQ attracts the particle A to the centre. But $\int d\varphi \cos.^2 \varphi = \int \frac{d\varphi}{2} \cdot (1 + \cos. 2\varphi)$ $= \frac{\varphi}{2} + \frac{1}{4} \sin. 2\varphi$; the value of which, between the limits $\varphi = 0$, and $\varphi = \pi$, is $= \frac{\pi}{2}$: wherefore the attraction of the spheroid on a particle at A is equal to

$$2\pi \cdot k' \frac{1 + e^2}{e^3} \cdot \left\{ \text{arc. tan. } e - \frac{e}{1 + e^2} \right\}.$$

Because $\frac{4\pi \cdot k'^2k}{3} = \frac{4\pi \cdot k^3 \cdot (1 + e^2)}{3} = \text{M}$; we get $2\pi \cdot (1 + e^2) = \frac{3\,\text{M}}{2k^3}$: wherefore the measure of the attractive force of the oblate spheroid on a particle placed anywhere in the circumference of the circular section made by a plane through the centre at right angles to the axis, is equal to

$$k \cdot \frac{3\,\text{M}}{2k^3 \cdot e^3} \cdot \left\{ \text{arc. tan. } e - \frac{e}{1 + e^2} \right\}.$$

In the oblong spheroid, k is greater than k'; put $k'^2 - k^2 = k^2 \cdot e^2$, then the element of the attractive force will become, by substitution,

$$4k' \cdot d\varphi \cos.^2 \varphi \cdot \frac{dz(1 - z^2)}{1 - e^2z^2} = 4k' \cdot d\varphi \cos.^2 \varphi \cdot \frac{1 - e^2}{e^3} \cdot \left\{ \frac{edz}{1 - e^2} - \frac{edz}{1 - e^2z^2} \right\}:$$

whence, by proceeding as before, we get the measure of the attractive force of the oblong spheroid upon a particle placed anywhere in the circumference of the circular section made by a plane through the centre at right angles to the axis, equal to

$$k' \cdot \frac{3\,\text{M}}{2k^3 \cdot e^3} \cdot \left\{ \frac{e}{1 - e^2} - \frac{1}{2} \text{ hyp. log. } \frac{1 + e}{1 - e} \right\}.$$

Cor. In an oblate spheroid, differing little from a sphere, the higher powers of e^2 may be neglected. The expression of the attractive force at the equator, viz.

$$2\pi \cdot k' \cdot \frac{1 + e^2}{e^3} \cdot \left\{ \text{arc. tan. } e - \frac{e}{1 + e^2} \right\},$$

will then become

$$2\pi \cdot k' \cdot (1 + e^2) \left(\frac{2}{3} - \frac{4}{5} e^2 \right) = \frac{4\pi k'}{3} \cdot (1 - \frac{1}{5} e^2).$$

And if k', the radius of the equator, $= k + r$; then $\frac{2r}{k} = e^2$ (23, *Cor.*); and the attraction at the equator will be equal to

$$\frac{4\pi k}{3} \cdot \left(1 + \frac{r}{k}\right) \cdot \left(1 - \frac{2}{5} \cdot \frac{r}{k}\right) = \frac{4\pi k}{3} \cdot \left(1 + \frac{3}{5} \cdot \frac{r}{k}\right).$$

25. *An oblate spheroid of revolution being given, it is required to find the measures of the attractive forces that urge a particle placed anywhere in the surface, in a direction perpendicular to the axis, and in a direction parallel to it.*

Let k and k' be the semiaxes of the ellipse, by the revolution of which the spheroid is described, k being the axis about which it revolves; and let b be the perpendicular distance of the particle from the axis, and a its distance from the plane, drawn through the centre at right angles to the axis: then, from what was proved in (20) and (21), the attractions sought will be found by multiplying the attractions at the pole, and at the circular section equally distant from both poles, by $\frac{a}{k}$ and $\frac{b}{k'}$.

Thus we get the attraction in the direction of a equal to

$$a \times \frac{3\,\text{M}}{k \cdot e^3} \cdot [e - \text{arc. tan. } e],$$

and the attraction in the direction of b equal to

$$b \times \frac{3\,\text{M}}{2k^3 \cdot e^3} \cdot \left\{ \text{arc. tan. } e - \frac{e}{1 + e^2} \right\}.$$

The same formulæ likewise serve for finding the attractions upon a particle placed anywhere within the spheroid. For the attraction upon a particle within the spheroid is equal to the attraction of a similar concentric spheroid, which contains the particle in its surface (9); and it is evident that the co-efficients which multiply a and b in the above expressions depend only upon the proportion of k and k', and they are therefore the same for all similar spheroids.

If we denote by A and B the co-efficients of a and b in the expressions of the attractive force found above, the whole attraction of the spheroid, which is compounded of the forces $a \cdot \text{A}$ and $b \cdot \text{B}$, will be $= \sqrt{a^2\text{A}^2 + b^2\text{B}^2}$. And if Ψ denote the angle which the direction of this force makes with a, or with the axis of the spheroid; then $\tan. \Psi = \frac{b \cdot \text{B}}{a \cdot \text{A}}$.

Cor. In the very same manner we may determine the attractions of an oblong spheroid of revolution, upon a point in the surface, or within the solid.

26. *If k, k', k', the semiaxes of a homogeneous ellipsoid, be related to h, h', h'', those of another ellipsoid of the same matter, so that $k'^2 - k^2 = h'^2 - h^2$ and $k''^2 - k^2 = h''^2 - h^2$, the attractions perpendicular to the planes of the principal sections, which the first ellipsoid* (Plate CII. fig. 17) *exerts upon a point determined by the co-ordinates $h \sin. m$, $h' \cos. m \sin. n$, $h'' \cos. m \cos. n$, respectively parallel to h, h', h'', will be to the attractions which the second ellipsoid exerts upon a point determined by the co-ordinates $k \sin. m$, $k' \cos. m \sin. n$, $k'' \cos. m \cos. n$, respectively parallel to h, h', h'', in the direct proportion of the areas of the principal sections to which the attractions are perpendicular.*

This proposition is an extension to all elliptical spheroids of what was proved of the sphere in (13). It is here enunciated of the ellipsoid, because the demonstration is not more difficult for that solid than for spheroids of revolution.

Let ABDM be an ellipsoid, the semiaxes of which are $\text{BC} = k$, $\text{EC} = k'$, and $\text{AC} = k''$; and *abdm* another ellipsoid, of which the semiaxes are $bc = h$, $ec = h'$, and $ac = h''$; those quantities being so related that $k'^2 - k^2 = h'^2 - h^2$, and $k''^2 - k^2 = h''^2 - h^2$. Also, let G be a point about the ellipsoid ABDM, so determined that GH, parallel to BC, $= h \sin. m$; HK, parallel to CE, $= h' \cos. m$

Attraction. sin. n; and CK $= h''$ cos. m cos. n; and let g be a point about the ellipsoid $abdm$, so determined that gh, parallel to bc, $= k$ sin. m; hk, parallel to ce, $= k'$ cos. m sin. n; and $ck = k''$ cos. m cos. n. Then the force with which the ellipsoid ABDM attracts a particle placed at G in the direction GH, will be to the force with which the ellipsoid $abdm$ attracts a particle placed at g in the direction gh, as the area of the section AEDM to the area of the section $aedm$, or as $k'\,k''$ to $h'\,h''$.

Let RP $= k$ sin. θ; PO $= k'$ cos. θ sin. φ; and CO $= k''$ cos. θ cos. φ; which suppositions are allowable, because they satisfy the equation of the ellipsoid (Def. 1), whatever be the angles θ and φ. Draw CPM through the centre, and CN indefinitely near it; then CP $=$ cos. $\theta \sqrt{k'^2 \sin.^2 \varphi + k''^2 \cos.^2 \varphi}$; and when cos. $\theta = 1$, CM $= \sqrt{k'^2 \sin.^2 \varphi + k''^2 \cos.^2 \varphi}$; wherefore $\frac{\text{CP}}{\text{CM}} =$ cos. θ.

Let the angle DCM $= \Psi$; then tan. $\Psi = \frac{\text{PO}}{\text{CO}} = \frac{k'}{k''}$ tan. φ; and, by taking the fluxions, $\frac{d\Psi}{\cos.^2 \Psi} = \frac{k'}{k''} \cdot \frac{d\varphi}{\cos.^2 \varphi}$; but

$$\frac{1}{\cos.^2 \Psi} = 1 + \tan.^2 \Psi = \frac{k'^2 \sin.^2 \varphi + k''^2 \cos.^2 \varphi}{k''^2 \cos.^2 \varphi} = \frac{\text{CM}^2}{k''^2 \cos.^2 \varphi};$$

wherefore $d\Psi$. CM^2 $=$ twice the sector MCN $= k'\,k''$. $d\varphi$.

And, in like manner, in the other ellipsoid, if $rp = h$ sin. θ; $po = h'$ cos. θ sin. φ; and $co = h''$ cos. θ cos. φ: then $\frac{cp}{cm}$ $=$ cos. θ, and twice the sector $mcn = h'\,h''\,d\varphi$.

It is plain, from what has been shown, that, when θ varies and φ remains constant in the expressions of the co-ordinates, the points P and p will move along CM and cm, so that, in every position, $\frac{\text{PC}}{\text{MC}} = \frac{pc}{mc}$. Let Q and q be indefinitely near P and p; and through P and Q draw lines parallel to MN, and through p and q draw lines parallel to mn. Let S denote the quadrilateral contained between the parallels drawn through P and Q, and S$'$ that contained between the lines drawn through p and q: Then $\frac{\text{S}}{\text{MCN}} = \frac{\text{QC}^2 - \text{PC}^2}{\text{MC}^2}$, and $\frac{\text{S}'}{\text{MCN}} = \frac{qc^2 - pc^2}{mc^2}$; wherefore, since $\frac{\text{PC}}{\text{MC}} = \frac{pc}{mc}$, and $\frac{\text{QC}}{\text{MC}} = \frac{qc}{mc}$, it is manifest that $\frac{\text{S}}{\text{S}'} = \frac{\text{MCN}}{mcn} = \frac{k'\,k''}{h'\,h''}$.

Upon the quadrilaterals S and S$'$ let upright prisms RS and rs be erected, and be prolonged to meet the surfaces of the spheroids; join GR, GS, gr, gs. Then,

$$\text{GR}^2 = (h \sin. m - k \sin. \theta)^2 + (h' \cos. m \sin. n - k' \cos. \theta \sin. \varphi)^2 + (h'' \cos. m \cos. n - k'' \cos. \theta \cos. \varphi)^2;$$

$$gr^2 = (h \sin. m - k \sin. \theta)^2 + (k' \cos. m \sin. n - h' \cos. \theta \sin. \varphi)^2 + (k'' \cos. m \cos. n - h'' \cos. \theta \cos. \varphi)^2;$$

And, by expanding these expressions, we get

$$\text{GR}^2 = [(h^2 + (h'^2 - h^2) \cos.^2 m \sin.^2 n + (h''^2 - h^2) \cos.^2 m \cos.^2 n) + (k^2 + (h'^2 - k^2) \cos.^2 \theta \sin.^2 \varphi + (h''^2 - k^2) \cos.^2 \theta \cos.^2 \varphi) - 2 (hk \sin. m \sin. \theta + h'\,k' \cos. m \cos. \theta \sin. n \sin. \varphi + h''\,k'' \cos. m \cos. \theta \cos. n \cos. \varphi)];$$

and $gr^2 = [(k^2 + (k'^2 - k^2) \cos.^2 m \sin.^2 n + (k''^2 - k^2) \cos.^2 m \cos.^2 n) + (h^2 + (h'^2 - h^2) \cos.^2 \theta \sin.^2 \varphi + (h''^2 - h^2) \cos.^2 \theta \cos.^2 \varphi) - 2 (hk \sin. m \sin. \theta + h'\,k' \cos. m \cos. \theta \sin. n \sin. \varphi + h''\,k'' \cos. m \cos. \theta \cos. n \cos. \varphi)]$.

These expressions are equal, because $k'^2 - k^2 = h'^2 - h^2$, and $k''^2 - k^2 = h''^2 - h^2$; wherefore RG $= rg = f$. And, in like manner, it is shown, that GS $= gs = f'$.

Now, the attraction of the prism RS urging a particle at G in the direction GH, is equal to S $\times \left\{\frac{1}{f} - \frac{1}{f'}\right\}$ (10); and the attraction of the prism rs urging a particle at g in the direction gh, is $= \text{S}' \times \left\{\frac{1}{f} - \frac{1}{f'}\right\}$: wherefore these attractions are to one another as S to S$'$, or as $k'\,k''$ to $h'\,h''$. The same thing may be proved of all the elementary prisms that make up the two portions of the ellipsoids contained between the planes BCM, BCN, and bcm, bcn; wherefore those portions attract particles placed at G and g, with forces proportional to $k'\,k''$ and $h'\,h''$. But the two ellipsoids may be divided into an equal number of such portions; wherefore the ellipsoids attract particles placed at G and g, in the directions GH and gh, with forces proportional to $k'\,k''$ and $h'\,h''$, or to the sections AMDE and $amde$.

Cor. 1. This proposition is true when the law of attraction is expressed by any function of the distance. The demonstration is the same as in the corollary of (13).

Cor. 2. If the two ellipsoids be so placed that their centres, and the planes of their principal sections, shall coincide, the surface of the one will be entirely within the other. Also the point which one ellipsoid attracts will be in the surface of the other, as is plain from the expressions of the co-ordinates. And hence the attraction of one ellipsoid upon a point without the surface is made to depend upon the attraction of another ellipsoid upon a point within the surface.

Cor. 3. When the ellipsoids become spheroids of revolution, the two principal sections through the axis of revolution become equal, and will be represented by any two sections whatever passing through the axis at right angles to one another. But, in this case, the attractions of the spheroids on the points may be reduced to two, one acting perpendicular to the axis, and one parallel to it; and it is plain that these attractions will be to one another as the areas of the sections perpendicular to their directions.

27. *To find the attraction of an oblate spheroid upon a particle placed without the surface.*

Let k' be the radius of the equator, and k the axis of revolution; and let a be the perpendicular distance of the point without the spheroid from the plane of the equator, and b its distance from the axis. In the first place, it is necessary to determine the semiaxis of another oblate spheroid that shall contain the given point in its surface, and such, that it shall have the same centre, and its equator in the same plane, as the given spheroid; and likewise the difference of the squares of its semiaxes equal to the difference of the squares of the semiaxes of the given spheroid. Let h' denote the radius of the equator, and h the semiaxis of the required spheroid; then, because the attracted point is to be in the surface of the solid, we have $\frac{a^2}{h^2} + \frac{b^2}{h'^2} = 1$; and, because $h'^2 - h^2 = k'^2 - k^2 = \varepsilon^2$, we get

$$\frac{a^2}{h^2} + \frac{b^2}{h'^2 - \varepsilon^2} = 1:$$

Whence,

$$2h^2 = a^2 + b^2 - \varepsilon^2 + \sqrt{(a^2 + b^2 - \varepsilon^2)^2 + 4a^2 \varepsilon^2};$$

and when h is determined, then $h' = \sqrt{h^2 + \varepsilon^2}$.

In consequence of the equation $\frac{a^2}{h^2} + \frac{b^2}{h'^2} = 1$, we may suppose $a = h$ sin. m, and $b = h'$ cos. m; let $a' = k$ sin. m, and $b' = k$ cos. m; or $a' = \frac{k}{h} a$, and $b' = \frac{k'}{h} \times b$: then the point determined by the co-ordinates a' and b' will be in the surface of the given spheroid, and consequently

Attraction. it will be within the surface of the other spheroid. Let M′ denote the mass of the spheroid of which the axis is h; and let $e^2 = \frac{h^2 - k^2}{h^2} = \frac{k'^2 - k^2}{k'^2}$: then (25) the attractions of this spheroid upon the point within its surface, determined by the co-ordinates a and b, are these, viz.

That perpendicular to the equator, equal to

$$a' \times \frac{3M}{h^3 e^3} \cdot [e' - \text{arc. tan. } e'];$$

and that perpendicular to the axis, equal to

$$b' \times \frac{3M'}{2h^3 e^3} \cdot \left\{ \text{arc. tan. } e' - \frac{e'}{1 + e'^2} \right\}.$$

But (26, Cor. 3) the attractions of the given spheroid, whose semiaxes are k and k', upon the point without its surface determined by the co-ordinates a and b, will be found by multiplying the preceding expressions respectively by $\frac{k^2}{k'^2}$ and $\frac{kk'}{kk'}$. Let M be the mass of the given spheroid; then $\frac{M}{M'} = \frac{k'^2 k}{k'^2 h}$; consequently $\frac{k^2}{k'^2} = \frac{M}{M'} \cdot \frac{h}{k} = \frac{M}{M'} \cdot \frac{a}{a'}$; and $\frac{kk'}{kk'} = \frac{M}{M'} \cdot \frac{k'}{k} = \frac{M}{M'} \cdot \frac{b}{b'}$: wherefore the attractions of the given oblate spheroid upon a point without the surface determined by the co-ordinates a and b, are as follows, viz.

The attraction perpendicular to the equator, equal to

$$a \times \frac{3M}{h^3 e^3} [e' - \text{arc. tan. } e'];$$

and that perpendicular to the axis, equal to

$$b \times \frac{3M}{2h^3 e^3} \left\{ \text{arc. tan. } e' - \frac{e'}{1 + e'^2} \right\}.$$

Cor. In the very same manner we may determine the attractions of an oblong spheroid of revolution upon a point without the surface.

ATTRACTIONS OF ELLIPSOIDS.

Attractions of ellipsoids.

28. *Let AMBN be one of the principal sections of an ellipsoid, C the centre, AB and MN the axes, D a point in the periphery of the section, and DO perpendicular to MN* (Plate CII. fig. 18); *the attraction of the ellipsoid upon a particle placed at the pole A is to the force with which a particle placed at D is attracted in the direction DO, as AC to DO.*

Draw DFG perpendicular to AB, and through F describe an ellipsoid similar to the given ellipsoid, and similarly situated, and having the same centre. Conceive an indefinitely great number of planes, making indefinitely small angles with one another, to be drawn through DG, so as to divide the two ellipsoids into an indefinitely great number of thin solids or slices; then the sections of the ellipsoids made by every one of the planes will be similar and concentric ellipses, each of them having an axis perpendicular to DG (5). Wherefore the attractions of the elements of the ellipsoid FHKL, upon a particle at F, are respectively equal to the attractions of the elements of the ellipsoid AMBN, upon a particle at D in the direction DO (19). Wherefore the whole attraction of the ellipsoid FHKL, upon a particle at F, is equal to the attraction of the ellipsoid AMBN, upon a particle at D, in the direction DO. But the attractions of the ellipsoids AMBN and FHKL, upon particles at A and F, are to one another as AC to CF (8). Wherefore the attraction of the ellipsoid AMBN, upon a particle at the pole A, is to the force with which it attracts a particle at D in the direction DO, as AC to DO.

29. *The attractions of ellipsoids upon particles placed in the surface, urging them in directions perpendicular to any of the principal sections, are proportional to the distances of the particles from that section.* Attraction.

Let AMBN be one of the principal sections of an ellipsoid, C the centre, AB and MN the axes of the section, and P a point in the surface of the solid: the attraction of the ellipsoid upon a particle at the pole A (Pl. CII. fig. 19) is to the force with which a particle at P is attracted in a direction parallel to AB, as the semiaxis AC is to the distance of P from the principal section perpendicular to AC.

Draw PDQ perpendicular to the section AMBN, and let it meet the surface again in Q; through D describe an ellipsoid similar to AMBN, similarly situated, and having the same centre; and through P draw a section SPRQ perpendicular to AB. As before, divide the solids into an indefinitely great number of thin slices, by planes drawn through PQ: the sections made by every one of those planes will be similar, and concentric ellipses having an axis of each perpendicular to PQ (5). Wherefore the attractions of the elements of the ellipsoid AMBN, upon a particle at P, in a direction perpendicular to the plane PRQS, are respectively equal to the attractions of the elements of the ellipsoid FHKL upon a particle at D, in a direction perpendicular to the same plane (19). Wherefore the attraction of the ellipsoid AMBN, upon a particle at P, in a direction parallel to the axis AB, is equal to the attraction of the ellipsoid FHKL upon a particle at D in the same direction. But the ellipsoids AMBN and FHKL being similar, their attractions upon particles at A and F are to one another as AC to CF (8); and the attraction of the ellipsoid FHKL, upon a particle at the pole F, is to its attraction upon a particle at D, in a direction parallel to AC, as FC to CN (28). Wherefore (*ex æquali*) the attraction of the ellipsoid AMBN, upon a particle at the pole A, is to the force with which it attracts a particle at P, in the direction AC, as AC to CN.

This proposition will enable us to find the attractions of an ellipsoid on all points on the surface, or within the solid, when the attractions at the poles are determined.

30. *To investigate the differential expressions of the attractions at the poles of an ellipsoid.*

Let APD be an ellipsoid; C the centre; AC, CE, and PC, the semiaxes; and PMB a section made by a plane through PC and any point M in the surface: draw PM (fig. 20) Pm indefinitely near PM, and Mm perpendicular to Pm; also MR perpendicular to the plane ADB, MS perpendicular to PC, and RH perpendicular to AD. Conceive the plane PCB to revolve about PC, so as to describe an indefinitely small angle BCO; and let PM $= f$; the angle KPM which PM makes with a perpendicular to the axis $= \theta$; and the angle DCB $= \varphi$: then, by proceeding as in (23), it will be found that the attraction of the small pyramid described by the triangle MPm, urging a particle at P to the centre of the ellipsoid, is $= d\varphi \cdot d\theta \cos. \theta \sin. \theta \cdot f$.

Again, let MR $= x$, HR $= y$, CH $= z$; also let PC $= k$, AC $= k'$, CE $= k''$; then $x = k - f \sin. \theta$; $y = f \cos. \theta \sin. \varphi$; $z = f \cos. \theta \cos. \varphi$; and if we substitute these values in the equation of the ellipsoid (Def. 2), we shall get

$$\frac{(k - f \sin. \theta)^2}{k^2} + \frac{f^2 \cos.^2 \theta \sin.^2 \varphi}{k'^2} + \frac{f^2 \cos.^2 \theta \cos.^2 \varphi}{k''^2} = 1$$

whence

$$f = \frac{k}{k^2} \cdot \frac{2 \sin. \theta}{\frac{\sin.^2 \theta}{k^2} + \frac{\cos.^2 \theta \sin.^2 \varphi}{k'^2} + \frac{\cos.^2 \theta \cos.^2 \varphi}{k''^2}}.$$

This is the value of f at the pole of k; and, by a like procedure, its values at the poles of k' and k'' may be found, viz.

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$$f = \frac{k'}{k'^2} \cdot \frac{2 \sin.\theta}{\frac{\sin.^2\theta}{k'^2} + \frac{\cos.^2\theta \sin.^2\varphi}{k^2} + \frac{\cos.^2\theta \cos.^2\varphi}{k''^2}},$$

$$f = \frac{k''}{k''^2} \cdot \frac{2 \sin.\theta}{\frac{\sin.^2\theta}{k''^2} + \frac{\cos.^2\theta \sin.^2\varphi}{k^2} + \frac{\cos.^2\theta \cos.^2\varphi}{k'^2}}.$$

Suppose that k is the least of the semiaxes; and let $k'^2 = \frac{k^2}{m}$, and $k''^2 = \frac{k^2}{n}$; then the values of f at the poles of k, k', k'', will be respectively

$$f = \frac{2k \sin.\theta}{\sin.^2\theta + m\cos.^2\theta \sin.^2\varphi + n\cos.^2\theta \cos.^2\varphi},$$

$$f = \frac{2k' \sin.\theta \times m}{m\sin.^2\theta + \cos.^2\theta \sin.^2\varphi + n\cos.^2\theta \cos.^2\varphi},$$

$$f = \frac{2k'' \sin.\theta \times n}{n\sin.^2\theta + \cos.^2\theta \sin.^2\varphi + m\cos.^2\theta \cos.^2\varphi}.$$

Now let A, A′, A″, denote the attractions of the spheroid upon particles placed at the poles of k, k', k''; then, by substituting the values of f just found in the foregoing differential expression, we get

$$A = k \times \iint \frac{2\, d\varphi . d\theta \cos.\theta \sin.^2\theta}{\sin.^2\theta + m\cos.^2\theta \sin.^2\varphi + n\cos.^2\theta \cos.^2\varphi},$$

$$A' = k' \times \iint \frac{m \times 2d\varphi . d\theta \cos.\theta \sin.^2\theta}{m\sin.^2\theta + \cos.^2\theta \sin.^2\varphi + n\cos.^2\theta \cos.^2\varphi},$$

$$A'' = k'' \times \iint \frac{n \times 2d\varphi . d\theta \cos.\theta \sin.^2\theta}{n\sin.^2\theta + \cos.^2\theta \sin.^2\varphi + m\cos.^2\theta \cos.^2\varphi},$$

the limits of the integrals being from $\theta = 0$ and $\varphi = 0$ to $\theta = \frac{\pi}{2}$ and $\varphi = 2\pi$.

31. *To reduce the expressions of the polar attractions to the most simple integrals.*

Let us consider the general expression

$$\iint \frac{d\varphi . d\theta \cos.\theta \sin.^2\theta}{\alpha \sin.^2\theta + \beta \cos.^2\theta \sin.^2\varphi + \gamma \cos.^2\theta \cos.^2\varphi},$$

which includes all the formulas found in (30). Let $p = \alpha \sin.^2\theta + \beta . \cos.^2\theta$, and $q = \alpha \sin.^2\theta + \gamma \cos.^2\theta$; then the above expression will become

$$\iint \frac{d\varphi . d\theta \cos.\theta \sin.^2\theta}{p \sin.^2\varphi + q \cos.^2\varphi}.$$

Suppose $\sqrt{\left(\frac{q}{p}\right)} \cdot \frac{\sin.\varphi}{\cos.\varphi} = \frac{\sin.u}{\cos.u}$; then the preceding expression will become, by substitution,

$$\iint \frac{du . d\theta \cos.\theta \sin.^2\theta}{\sqrt{p \cdot q}};$$

the limits of u being from 0 to 2π; wherefore, by integrating with regard to u, and restoring the values of p and q, the integral becomes

$$2\pi . \int \frac{d\theta . \cos.\theta \sin.^2\theta}{\sqrt{(\alpha \sin.^2\theta + \beta \cos.^2\theta) . (\alpha \sin.^2\theta + \gamma \cos.^2\theta)}}$$

and, by putting $x = \sin.\theta$, the integral, which is to be taken from $\theta = 0$ to $\theta = \frac{\pi}{2}$, or from $x = 0$ to $x = 1$, will become

$$2\pi . \int \frac{x^2\, dx}{\sqrt{[\beta + (\alpha - \beta)x^2] . [\gamma + (\alpha - \gamma)x^2]}}.$$

If now we take α, β, γ, so as to make the assumed expression coincide with the quantities A, A′, A″, respectively, we shall get

$$A = 4\pi k . \int \frac{x^2\, dx}{\sqrt{[m + (1-m)x^2] . [n + (1-n)x^2]}}$$

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$$A' = 4\pi k' . \int \frac{m . x^2\, dx}{\sqrt{[1 + (m-1)x^2] . [n + (m-n)x^2]}}$$

$$A'' = 4\pi k'' . \int \frac{n . x^2\, dx}{\sqrt{[1 + (n-1)x^2] . [m + (n-m)x^2]}}$$

These expressions have the inconvenience of containing different factors in the denominators; but they may be reduced to others having the same factors, by putting $x = \frac{\tau}{\sqrt{m + (1-m)\tau^2}}$ in the second, and $x = \frac{\tau}{\sqrt{n + (1-n)\tau^2}}$ in the third; we thus get

$$A = 4\pi k . \int \frac{x^2\, dx}{\sqrt{[m + (1-m)x^2] \cdot [n + (1-n)x^2]}}$$

$$A' = 4\pi k' . \int \frac{m . \tau^2\, d\tau}{[m + (1-m)\tau^2]^{\frac{3}{2}} . [n + (1-n)\tau^2]^{\frac{1}{2}}}$$

$$A'' = 4\pi k'' . \int \frac{n . \tau^2\, d\tau}{[n + (1-n)\tau^2]^{\frac{3}{2}} . [m + (1-m)\tau^2]^{\frac{1}{2}}}$$

Now let

$\frac{1-m}{m} = \frac{k'^2 - k^2}{k^2} = \lambda^2$, and $\frac{1-n}{n} = \frac{k''^2 - k^2}{k^2} = \lambda'^2$:

Also let the mass of the ellipsoid $= M = \frac{4\pi k k' k'}{3}$ $= \frac{4\pi k^3}{3\sqrt{mn}}$; then $\frac{3M}{k^3} = \frac{4\pi}{\sqrt{mn}}$: wherefore, by substitution, we get

$$A = k \cdot \frac{3M}{k^3} \cdot \int \frac{x^2\, dx}{\sqrt{(1 + \lambda^2 x^2) \cdot (1 + \lambda'^2 x^2)}},$$

$$A' = k' \cdot \frac{3M}{k^3} \cdot \int \frac{x^2\, dx}{[1 + \lambda^2 x^2]^{\frac{3}{2}} \cdot [1 + \lambda'^2 x^2]^{\frac{1}{2}}},$$

$$A'' = k'' \cdot \frac{3M}{k^3} \cdot \int \frac{x^2\, dx}{[1 + \lambda^2 x^2]^{\frac{1}{2}} \cdot [1 + \lambda'^2 x^2]^{\frac{3}{2}}},$$

the integrations extending from $x = 0$ to $x = 1$.

These integrals cannot be expressed in finite terms. When λ and λ', or the eccentricities of the ellipsoid, are small, the values of the integrals may easily be found to a sufficient degree of exactness by series. They may likewise be all expressed by means of this fluent, viz.

$$F = \int \frac{dx}{\sqrt{(1 + \lambda^2 x^2) \cdot (1 + \lambda'^2 x^2)}}$$ (from $x = 0$ to $x = 1$) and its partial fluxions. Thus we have, in general,

$$\int \frac{x^2\, dx}{\sqrt{(1 + \lambda^2 x^2) \cdot (1 + \lambda'^2 x^2)}} =$$

$$\frac{x^3}{\sqrt{(1 + \lambda^2 x^2) \cdot (1 + \lambda'^2 x^2)}} + \frac{1}{\lambda} \cdot \left(\frac{dF}{d\lambda}\right) + \frac{1}{\lambda'} \cdot \left(\frac{dF}{d\lambda'}\right).$$

Wherefore, making $x = 1$, we get

$$A = k \cdot \frac{3M}{k^3} \cdot \left\{ \frac{1}{\sqrt{(1+\lambda^2) \cdot (1+\lambda'^2)}} + \frac{1}{\lambda}\left(\frac{dF}{d\lambda}\right) + \frac{1}{\lambda'} \cdot \left(\frac{dF}{d\lambda'}\right) \right\}$$

$$A' = k' \cdot \frac{3M}{k^3} \cdot \frac{1}{\lambda} \cdot \left(\frac{dF}{d\lambda}\right).$$

$$A'' = k'' \cdot \frac{3M}{k^3} \cdot \frac{1}{\lambda'} \cdot \left(\frac{dF}{d\lambda'}\right).$$

32. *To find the forces with which a homogeneous ellipsoid attracts a particle placed in the surface, or within the solid, in directions perpendicular to the principal sections.*

Let k, k', k'', denote the semiaxes of an ellipsoid, and a, b, c (respectively parallel to k, k', k'') the perpendicular distances of a particle placed in the surface, or within

Attraction. the solid, from the principal sections: then, from what is proved in (29), the attractions we are seeking will be found by multiplying the polar attractions by $\frac{a}{k}, \frac{b}{k'}, \frac{c}{k''}$. Wherefore the forces that urge the particle in the directions of a, b, and c, are respectively $a \times \frac{3M}{k^3}$.

$$\left\{\frac{1}{\sqrt{(1+\lambda^2)\cdot(1+\lambda'^2)}} + \frac{1}{\lambda}\cdot\left(\frac{dF}{d\lambda}\right) + \left(\frac{dF}{d\lambda'}\right)\right\};$$

$$b \times \frac{3M}{k^3}\cdot\frac{1}{\lambda}\cdot\left(\frac{dF}{d\lambda}\right);$$

$$\text{and } c \times \frac{3M}{k^3}\cdot\frac{1}{\lambda'}\cdot\left(\frac{dF}{d\lambda'}\right):$$

Which formulas serve both for points in the surface and within the solid, for the reason already explained in (25).

33. *To find the attractions of an ellipsoid upon a particle placed without the surface.*

Let k, k', k'', be the semiaxes of the ellipsoid, and a, b, c (respectively parallel to k, k', k'') the co-ordinates of a particle without the surface. Let h, h', h'', so related to k, k', k'', that $h^2 - k^2 = k^2 - k^2$ and $h''^2 - h^2 = k''^2 - k^2$, denote the semiaxes of another ellipsoid, which contains the attracted point in its surface, and has its principal sections in the same planes as the given ellipsoid: then, because the attracted point is in the surface, we have (Def. 2)

$$\frac{a^2}{h^2} + \frac{b^2}{h'^2} + \frac{c^2}{h''^2} = 1;$$

and, because $h'^2 - h^2 = k'^2 - k^2 = \varepsilon^2$, and $h''^2 - h^2 = k''^2 - k^2 = \varepsilon'^2$, we get

$$\frac{a^2}{h^2} + \frac{b^2}{h^2+\varepsilon^2} + \frac{c^2}{h^2+\varepsilon'^2} = 1.$$

This equation now contains only one unknown quantity; and it is plain that one value of h, and only one, can be found from it. For, when $h = 0$, the function on the left hand side is infinitely great; and while h increases from 0 *ad infinitum*, the same function decreases continually from being infinitely great to be infinitely little. When h is found, then $h' = \sqrt{h^2+\varepsilon^2}$, and $h'' = \sqrt{h^2+\varepsilon'^2}$. Because a, b, c, are the co-ordinates of a point in the surface of the ellipsoid, we may suppose $a = h \sin. m$, $b = h' \cos. m \sin. n$, $c = h'' \cos. m \cos. n$; let $a' = k \sin. m$, $b' = k' \cos. m \sin. n$, $c' = k'' \cos. m \cos. n$; or $a' = \frac{k}{h} \times a$, $b' = \frac{k'}{h'} \times b$, $c' = \frac{k''}{h''} \times c$; then a', b', c', will be the co-ordinates of a point in the surface of the given ellipsoid, and consequently it will be within the other solid. Let M' denote the mass of the ellipsoid of which h, h', h'', are the semiaxes; also let $\lambda^2 = \frac{h^2-k^2}{k^2} = \frac{h'^2-k'^2}{k'^2}$; and $\lambda'^2 = \frac{h''^2-k^2}{k^2} = \frac{h''^2-k'^2}{k'^2}$; then, F denoting the same fluent as before, the attractions of this ellipsoid upon the point within it, determined by the co-ordinates a', b', c', in the directions of those co-ordinates, are (32) respectively equal to

$$a' \times \frac{3M'}{k^3}\left\{\frac{1}{\sqrt{(1+\lambda^2)(1+\lambda'^2)}} + \frac{1}{\lambda}\cdot\left(\frac{dF}{d\lambda}\right) + \frac{1}{\lambda}\cdot\left(\frac{dF}{d\lambda'}\right)\right\},$$

$$b' \times \frac{3M'}{k^3} \times \frac{1}{\lambda}\cdot\left(\frac{dF}{d\lambda}\right), \text{ and}$$

$$c' + \frac{3M'}{k^3} \times \frac{1}{\lambda'}\cdot\left(\frac{dF}{d\lambda'}\right).$$

Now, the attractions of the given ellipsoid upon the Attraction. point without the surface, determined by the co-ordinates a, b, c, will be found (26) by multiplying the preceding expressions respectively by $\frac{k'k''}{h'h''}, \frac{k\,k''}{h\,h''}, \frac{k\,k'}{h\,h'}$. Let M be the mass of the given ellipsoid; then $\frac{M}{M'} = \frac{k\,k'\,k''}{h\,h'\,h''}$; consequently $\frac{k'k''}{h'h''} = \frac{M}{M'}\cdot\frac{h}{k} = \frac{M}{M'}\cdot\frac{a}{a'}$; $\frac{k\,k''}{h\,h''} = \frac{M}{M'} \times \frac{b}{b'}$; and $\frac{k\,k'}{h\,h'} = \frac{M}{M'} \times \frac{c}{c'}$; wherefore the attractions of the given ellipsoid upon the point without the surface, determined by a, b, c, in the directions of those co-ordinates, are respectively equal to $a \times \frac{3M}{k^3} \times$

$$\left\{\frac{1}{\sqrt{(1+\lambda^2)(1+\lambda'^2)}} + \frac{1}{\lambda}\left(\frac{dF}{d\lambda}\right) + \frac{1}{\lambda'}\cdot\left(\frac{dF}{d\lambda'}\right)\right\},$$

$$b \times \frac{3M}{k^3} \times \frac{1}{\lambda}\cdot\left(\frac{dF}{d\lambda}\right), \text{ and}$$

$$c \times \frac{3M}{k^3} \times \frac{1}{\lambda'}\cdot\left(\frac{dF}{d\lambda'}\right).$$

The preceding propositions contain a complete theory of homogeneous elliptical spheroids. They enable us to compute the attractive force with which a solid of this kind urges a particle placed anywhere in the surface, within the solid, or without it. It remains, indeed, to find the exact value of the function F in its general form, to which we can do no more than approximate by series; but this is an analytical difficulty which it is impossible to overcome, because the nature of this function is such that it cannot be expressed in finite terms by the received notation of analysis.

In the preceding investigations we have followed the method of Maclaurin for points situated in the surface of a spheroid or within the solid. This method has always been justly admired; but neither its inventor, nor, as far as we know, any other geometer, has applied it, excepting to spheroids of revolution; and it is here, for the first time, extended to ellipsoids. In regard to points without the surface, we have employed the method first given by Mr Ivory, in the *Philosophical Transactions* for 1809. The combination of these two methods has enabled us to derive the attractions of an ellipsoid on a point placed anywhere from the attractions at the poles. Thus, this extremely complicated problem has, by geometrical reasoning of no great difficulty, been reduced to the investigation of the polar attractions, which are the only cases that require a direct computation.

34. *Of the attractions of spheroids composed of elliptical shells that vary in their densities and figures according to any law.*

When a spheroid is composed of concentric elliptical shells of variable density and figure, we may consider every shell as the difference of two homogeneous spheroids of the same density with the shells, and having their surfaces coinciding with the surfaces of the shell. The attractions of the spheroids being computed by the preceding methods, their difference will be equal to the attractions of the shell, and the integral obtained by summing the attractions of all the shells will give the attractions of the heterogeneous spheroid. This case, therefore, gives rise to no new difficulties, except such as are purely mathematical, and depend upon the law according to which the densities and figures of the shells are supposed to vary. (J. I.)

Attribute || Atwood.

ATTRACTION OF MOUNTAINS. See MOUNTAINS.

ATTRIBUTE, in a general sense, is that which may be predicated of a person or thing as a determining characteristic, inherent quality or accident, the negation of which involves either a falsehood, a contradiction, or an absurdity. Thus understanding is an attribute of mind, and extension an attribute of matter. That attribute which the mind conceives as the foundation of all the rest is called its *essential attribute*; thus extension is by some, and solidity by others, considered the essential attribute of matter.

ATTRIBUTES, in *Theology*, the several qualities or perfections of the divine nature.

ATTRIBUTES, in *Logic*, are the predicates of any subject, or what may be affirmed or denied of any thing.

ATTRIBUTIVES, in *Grammar*, are words which are significative of attributes; and thus include adjectives, verbs, and particles, which are attributes of substances, together with adverbs, which denote the attributes only of attributes. Mr Harris, who introduced this distribution of words, denominates the former *attributives of the first order*, and the latter *attributives of the second order*.

ATTRUCK, a river of Persia, which has its rise in a branch of the Elburz Mountains that borders on the northern deserts of Khorassan. It collects the streams of an extensive valley, and of several subordinate glens, and conveys in a westerly direction to the desert a large body of water, which being joined by several other streams, falls into the Caspian Sea at Kooroo-Soofee, 40 or 50 miles to the north of Asterabad.

ATTU, or ATTOO, one of the Aleutian Islands, about 60 miles in length, mountainous, and covered with snow, but inhabited. It is 215 miles east of Behring's Island. Long. 172. E. Lat. 54. N.

ATWOOD, GEORGE, an author celebrated for the accuracy of his mathematical and mechanical investigations, and considered particularly happy in the clearness of his explanations, and the elegance of his experimental illustrations, was born in the early part of the year 1746. He was educated at Westminster school, where he was admitted in 1759. Six years afterwards he was elected *off* to Trinity College, Cambridge. He took his degree of bachelor of arts in 1769, with the rank of third *wrangler*; Dr Parkinson of Christ's College being senior of the year. This distinction was amply sufficient to give him a claim to further advancement in his own college, on the list of which he stood the foremost of his contemporaries; and in due time he obtained a fellowship, and was afterwards one of the tutors of the college. He became master of arts in 1772, and in 1776 was elected a fellow of the Royal Society of London.

The higher branches of the mathematics had, at this period, been making some important advances at Cambridge, under the auspices of Dr Waring, and many of the younger members of the university became diligent labourers in this extensive field. Mr Atwood chose for his peculiar department the illustration of mechanical and experimental philosophy, by elementary investigations and ocular demonstrations of their fundamental truths. He delivered, for several successive years, a course of lectures in the observatory of Trinity College, which were very generally attended and greatly admired. In the year 1784 some circumstances occurred which made it desirable for him to discontinue his residence at Cambridge; and soon afterwards Mr Pitt, who had become acquainted with his merits by attending his lectures, bestowed on him a patent office, which required but little of his attendance, in order to have a claim on the employment of his mathematical abilities in a variety of financial calculations, to which he continued to devote a considerable portion of his time and attention throughout the remainder of his life.

Atwood.

The following, we believe, is a correct list of Mr Atwood's publications:—1. A Description of Experiments to illustrate a Course of Lectures; about 1775 or 1776, 8vo. 2. This work was reprinted, with additions, under the title of An Analysis of a Course of Lectures on the Principles of Natural Philosophy. Cambridge, 1784, 8vo. 3. A General Theory for the Mensuration of the Angle subtended by two objects, of which one is observed by rays after two reflections from plane surfaces, and the other by rays coming directly to the spectator's eye, Phil. Trans. 1781, p. 395. 4. A Treatise on the Rectilinear Motion and Rotation of Bodies, with a Description of Original Experiments relative to the subject. Cambridge, 1784, 8vo. 5. Investigations founded on the Theory of Motion for determining the Times of Vibration of Watch Balances. Phil. Trans. 1794, p. 119. 6. The Construction and Analysis of Geometrical Propositions, determining the positions assumed by homogeneal bodies, which float freely, and at rest, on a fluid's surface; also determining the Stability of Ships, and of other Floating Bodies. Phil. Trans. 1796, p. 46. 7. A Disquisition on the Stability of Ships. Phil. Trans. 1798, p. 201. 8. A Review of the Statutes and Ordinances of Assize which have been established in England from the 4th year of King John, 1202, to the 37th of his present Majesty. Lond. 1801, 4to. 9. A Dissertation on the Construction and Properties of Arches. Lond. 1801, 4to. 10. A Supplement to a Tract entitled a Treatise on the Construction and Properties of Arches, published in the year 1801; and containing Propositions for determining the Weights of the several Sections which constitute an Arch, inferred from the Angles. Also containing a Demonstration of the Angles of the several Sections, when they are inferred from the Weights thereof. To which is added, a Description of Original Experiments to verify and illustrate the Principles in this Treatise. With occasional Remarks on the Construction of an Iron Bridge of one Arch, proposed to be erected over the river Thames at London. Part II. By the author of the first part. Lond. 1804, 4to. Dated 24th November 1803. 11. A Treatise on Optics is mentioned by Nichols as having been partly printed by Bowyer in 1776, but never completed.

It may be very truly asserted that several of these works of Mr Atwood have materially contributed to the progress of science, by multiplying the modes of illustration which experimental exhibitions afford for the assistance of the instructor; at the same time they can scarcely be said to have extended very considerably the bounds of human knowledge, or to have demonstrated that their author was possessed of any extraordinary talent or energy of mind in overcoming great difficulties or in inventing new methods of reasoning. The *Analysis of a Course of Lectures* has been little read; and it bears evident marks of having been composed before Mr Atwood had acquired a habit of accurate reasoning on physical subjects. In the first page, for example, the forces of cohesion and gravitation are completely confounded; and in the third we find the idea of perfect spheres touching each other in a greater or less number of points, notwithstanding the appearance of precision which the author attempts to maintain in his language.

The object of the paper on *Reflection* is, to illustrate and improve the construction of Hadley's quadrant; and Mr Atwood proposes, for some particular purposes in practical astronomy, two new arrangements of the speculums, by which the rays are caused to move in differen planes, and which he considers as affording greater accuracy for the measurement of small angles than the common form of the instrument, although not of general utility, nor very easily adjusted for observation.

The treatise on *Rectilinear Motion and Rotation* exhi-

Atwood. bits a good compendium of the elementary doctrines of mathematical mechanics; but it shows a great deficiency in the knowledge of the higher refinements which had been introduced into that science by Daniel Bernoulli, and Euler, and Lagrange. The properties of simply accelerated and retarded motion are first discussed, and the phenomena of penetration experimentally examined; the laws of varying forces are then investigated, and the properties of the pendulum demonstrated; the vibrations of an elastic chord are calculated, "considering the whole mass to be concentrated in the middle point," as an approximation; and then, instead of imitating and simplifying the elegant but complicated demonstrations of the continental mathematicians, the author most erroneously repeats, in the words of Dr Smith, the exploded doctrine, that "the string, during any instant of its vibration, will coincide with the harmonic curve." The subject of a resistance, varying as the square of the velocity, is next examined; and some useful experiments on the descent of bodies in water are stated in confirmation of the theory. On this occasion, the author observes, with regard to the formation of the different strata of the earth, that bodies disposed to break into large masses, though specifically lighter, may easily have descended more rapidly through a fluid, than denser but more brittle bodies, so that the natural order of densities may thus have become inverted. He next examines the theory of rotation, and relates some very interesting experiments on rectilinear and rotatory motions; and he shows that Emerson and Desaguliers were totally mistaken in asserting that "the momentum produced is always equal to the momentum which produces it." The last section of the work, which is devoted to the subject of free rotation, is the most elaborate of the whole; but it exhibits no material extension of the earlier investigations of the Bernoullis and Professor Vince; nor does it contain the important proposition of Segner, relating to the existence of three axes of permanent rotation, at right angles to each other, in every body, however irregular.

Notwithstanding these partial objections, the work may still, in many respects, be considered as classical. The paper on *Watch-balances* is principally intended to show the advantages which may be obtained, in Mr Mudge's construction, from the effect of subsidiary springs in rendering the vibrations isochronous, their actions being limited to certain portions of the arc of motion. If the author has here again omitted to follow the continental mathematicians in some of their refinements of calculation, it must be confessed that his view of the subject has, in this instance, not only the advantages of simplicity, but also that of a nearer approach to the true practical state of the question, than is to be found in the more complicated determinations which had been the result of the labours of some of his predecessors.

But, whatever may be the merits of these investigations, they appear to be far exceeded in importance by the papers on *Ships*, the first of which obtained for its author the honour of a Copleian medal. Its principal object is to show how much the stability of a ship will commonly vary, when her situation with respect to the horizon is materially altered; and how far the assumptions of theoretical writers, respecting many others of the forces concerned in naval architecture, will generally differ from the true state of these forces when they actually occur in seamanship. In the second part of the investigation, some errors of Bouguer and of Clairbois are pointed out; and the theoretical principles of stability are exemplified by a detailed calculation, adapted to the form and dimensions of a particular vessel, built for the service of the East India Company.

The latter years of our author's life do not appear to have been productive of any material advantage to science. His application to his accustomed pursuits was unremitting, but his health was gradually declining. He had no amusement except such as was afforded by the continued exercise of his mind, with a change of the object only; the laborious game of chess occupying, under the name of a recreation, the hours which he could spare from more productive exertions. He became paralytic some time before his death; and although he partially recovered his health, he did not live to complete his 62d year. Atwood's Machine ‖ Atys.

His researches concerning the history of the *Assize of Bread* must have required the employment of considerable diligence and some judgment in the discovery and selection of materials, although certainly the subject was not chosen for the purpose of affording a display of talent. His opinion respecting the operation of the assize, as favourable to the community, may by some be thought to be justified by the want of success which has hitherto attended the experiment on its suspension; but the advocates of that measure would certainly not admit the trial of a year to be sufficient for appreciating its utility.

The title-pages of the works on *Arches* explain the occasion on which they were brought forward, and at the same time exhibit a specimen of the want of order and precision which seems to have begun to prevail in the author's faculties; while the works themselves betray a neglect of the fundamental principles of mechanics, which is inconceivable in a person who had once reasoned with considerable accuracy on mathematical subjects. An anonymous critic, who is supposed to have been the late Professor Robison (*British Critic*, vol. xxi. January 1804) very decidedly, and at the same time very respectfully, asserted Mr Atwood's error in maintaining that there was no manner of necessity for the condition, that the general curve of equilibrium of an arch should pass through some part of every one of the joints by which it is divided; and in fact we may very easily be convinced of the truth of this principle, if we reflect that the curve of equilibrium is the true representative of the direction of all the forces acting upon each of the blocks, and that, if the whole pressure be anywhere directed to a point situated beyond the limit of the joint, there can be nothing whatever to prevent the rotation of the block on the end of the joint as a centre, until some new position of the block shall have altered the direction of the forces, or until the whole fabric be destroyed. The critic has also very truly remarked that the effects of friction have never been sufficiently considered in such arrangements; but a later author, in an anonymous publication, has removed a considerable part of this difficulty by showing that no other condition is required for determining these effects than that every joint should be perpendicular to the direction of the curve of equilibrium, either accurately or within the limit of a certain angle, which is constant for every substance of the same kind, and which he has termed the angle of repose. (T. T.)

ATWOOD'S MACHINE, an ingenious contrivance for illustrating the doctrine of accelerated motion. See MECHANICS.

ATYS, or ATTYS, in *Greek Mythology*, a beautiful shepherd of Phrygia, beloved by Cybele, who emasculated himself during a fit of madness into which he had been thrown by that goddess in revenge for his infidelity to her. The story is related by Ovid, *Fast.* iv. 221, and differently by other writers. In Pausanias (vii. 17, § 5) may be found the story of Atys killed by a wild boar.

ATYS, a Latin chief, son of Alba, and father of Capys,

Aubagne ‖ Aubigné.

from whom Augustus was said to be descended on the mother's side. This name was also borne by a son of Crœsus, slain by Adrastus.

AUBAGNE, a town of France, department of Bouches-du-Rhone, on the Veaune, ten miles E. of Marseilles. Manufactures of earthenware. Pop. in 1846, 3887.

AUBAINE (probably a corruption of *alibi natus*), an ancient right vested in the king of France, by virtue of which he claimed the inheritance of all foreigners that died within his dominions, notwithstanding any testamentary settlement made by the deceased. An ambassador was not subject to the right of aubaine; and the Swiss, Savoyards, Scots, and Portuguese, were also exempted. This ancient privilege was abolished in 1819.

AUBE, a department of France, watered by the rivers Seine and Aube, from the latter of which it receives its name. It is bounded on the N. by the department of Marne; N.W. by Seine-et-Marne; W. by Yonne; S. by Cote-d'Or; and E. by Haute-Marne. Area about 1,603,500 English acres, of which nearly two-thirds are arable, about one-eighth forest, and somewhat less than one-sixteenth meadow-land. Its general inclination from S.E. to N.W. presents little variety of surface; the N. and N.W. parts are dry and sterile; but the S. and E. districts are very fertile, particularly the valleys, which are admirably adapted for the cultivation of the vine. The principal productions are wheat, rye, oats, potatoes, and wine, of which last about one-half is exported. Chalk and clay are abundant; and there are also quarries of marble, lithographic stone, and building-stone. It is divided into five arrondissements, 26 cantons, and 447 communes. Pop. in 1851, 265,247. The arrondissements, with their populations, are as follows:—Troyes, 95,878; Arcis-sur-Aube, 36,364; Nogent-sur-Seine, 35,211; Bar-sur-Aube, 44,347; Bar-sur-Seine, 53,447. Its manufactures are cotton, linen, and woollen goods, glass, earthenware, paper, sugar, ropes, &c. The capital is Troyes.

AUBENAS, a town of France, department of Ardeche, near the river of that name, 14 miles S.W. of Privas. It is beautifully situated on the slope of a hill, but its streets generally are crooked, narrow, and filthy. It is surrounded by a ruinous wall flanked with towers, and has an old castle. Manufactures, silk and woollen. Pop. 4262.

AUBIGNÉ, Théodore-Agrippa D', the bold, able, but somewhat irascible historian of the French Huguenots, was born at St Maury, in the province of Saintonge, in 1550. From his father, who fell fighting in the cause of religious liberty, he inherited an ardent attachment to the Protestant cause; and while still a youth, escaping from his guardians, he took part in the third religious war of that period. He had the good fortune to survive the massacre of St Bartholomew's day, and fled to the court of the king of Navarre, afterwards Henry IV.; but though his services, both in the council and the field, were esteemed by Henry, D'Aubigné more than once retired in disgust from court, where his temper had created many enemies. Yet the king appears always to have had a high opinion of his integrity; and, contrary to the advice of his friends, intrusted him with the custody of the king's formidable rival, Cardinal Bourbon, when a prisoner. He was faithful to his trust in his castle of Maillezais, to the government of which he was promoted by Henry, and whither he retired on the conversion of the king in 1593. There he wrote several able controversial dissertations, and composed his principal work, *L'Histoire Universelle*, which the Catholic party used every means to suppress, and the parliament of Paris ordered to be burnt by the executioner in 1620. The government made many attempts to induce him to resign his stronghold; and finding it no longer tenable, he in that year resigned it into the hands of the Duc de Rohan, the leader of the Huguenots, and retired to Geneva, where he died in 1630, at the age of 80. (T. S. T.)

Aubigny ‖ Auch.

AUBIGNY, or Avigny, a town of France, in the department of Cher and arrondissement of Sancerre. Pop. 2381. It gives a title to the Duke of Richmond.

AUBREY, John, descended from an ancient family in Wiltshire, was born in 1626. He made the history and antiquities of England his peculiar study, and contributed considerable assistance to the *Monasticon Anglicanum*. He succeeded to several good estates; but law-suits and other misfortunes consumed them all, and reduced him to absolute want. In this extremity he found a valuable benefactress in the Lady Long of Draycot in Wilts, who gave him an apartment in her house, and supported him till his death, which took place at Oxford in 1697. He was a man of considerable ability, learning, and application, but credulous, and tinctured with superstition. He wrote *Miscellanies*, and *A Perambulation of the County of Surry*, in 5 vols. 8vo. In 1813, his *Lives of Eminent Men*, and a *Collection of Letters*, were published from the originals preserved in the Bodleian Library, in 3 vols. 8vo. The Lives are replete with curious matter; and that of Hobbes, in particular, is very full and elaborate.

AUBURN properly signifies the colour produced by scorching, being derived from *brennan, burn*. As applied to hair, it denotes brown with a tinge of red or russet.

Auburn, the capital of the county of Cayuga, in the state of New York. It is remarkable for its great penitentiary or state prison, in which the experiment of solitary confinement for crimes was made, but abandoned after two years' experience of its injurious effects on the minds and bodies of the prisoners. After this the silent system was adopted. (See Roscoe *on Penal Jurisprudence*.) The building is an oblong of 1000 by 500 feet, and is surrounded by a wall 3000 feet in length, and 30 feet high. A Presbyterian theological seminary was founded here in 1821, and is now in a very flourishing condition. There are also several churches and schools, two academies, a museum, two banks, and manufactures of woollen and cotton stuffs, leather, &c. Pop. in 1850, 9548.

AUBUSSON, an arrondissement in the department of Creuse, in France. Area, 802 square miles. It is divided into 10 cantons, and 104 communes. Pop. in 1851, 106,619. The capital, of the same name, is on the banks of the river Creuse. Pop. 5586. Its manufactures are silk, carpets, and cloths.

AUCH, one of the most ancient cities of France, capital of the department of Gers, and of the arrondissement of the same name. In Cæsar's time this was the capital of the Ausci. It was afterwards the capital of Gascony; and when that district was divided into counties, it became the capital of Armagnac. The site of the modern town does not exactly coincide with that of the ancient, being on the opposite (the left) bank of the river Gers. It was probably destroyed by the Saracens about A.D. 724, and was afterwards rebuilt in its present picturesque situation on the slope of a hill. On the opposite side of the river, and occupying the site of the ancient city, is a considerable suburb, which is connected with the town by a bridge. The streets are generally regular and well built, and a fine promenade in the upper part of the town affords a magnificent view of the surrounding country. Auch is the seat of an archbishopric; tribunals of commerce and primary jurisdiction; and has a royal college; an agricultural society; a theological seminary, with a museum and a library of 15,000 volumes; a small public library; a theatre, &c. The cathedral of St Mary, one of the most magnificent in France, was commenced in the reign of Charles VIII. (1489), and finished in that of Louis XV. It exhibits several styles of architecture, and contains many elegant monuments. The hotel of the prefecture, formerly the archiepiscopal palace, is a vast and noble edifice. The principal manufactures are hats, various kinds of linen and cotton stuffs, leather, &c., and there is a considerable trade, especially in the brandies of Armagnac.

Auchterarder || Auction.

Pop. in 1851, 9935. The arrondissement of the same name contains 6 cantons, 84 communes, and 61,925 inhabitants.

AUCHTERARDER, a town and parish of Scotland, county of Perth, 15 miles W.S.W. of Perth. The town consists of a single street about a mile in length. It was formerly a royal burgh, but is now disfranchised. Near it is an ancient castle, said to have been a hunting-seat of Malcolm Canmore. Pop. of town in 1851, 2520.

AUCHTERMUCHTY, a royal burgh and parish of Scotland, county of Fife, 8 miles W.S.W. of Cupar. The town is irregularly built on an elevated site, and is divided by the Leverspool, a rapid streamlet which runs down its centre. The principal manufacture is linen. It formerly sent a member to parliament, but now votes in returning the member for the county. It is governed by three bailies and fifteen councillors. Pop. of burgh in 1851, 2673.

AUCKLAND, the capital of New Zealand, which see.

AUCKLAND–BISHOPS, a market-town in the ward of Darlington and county of Durham, ten miles from the city of Durham. It is beautifully situated on an eminence near the confluence of the rivers Wear and Gaunless. The descent on each side is partly formed into hanging gardens, the houses occupying the brow and remainder of the declivity. The palace of the Bishop of Durham stands at the north angle of the town. The parish church, a Gothic structure, is one mile distant, at Auckland St Andrews. Manufactures, muslins and other cotton goods. Pop. in 1851, 4400.

AUCKLAND *Islands*. See AUSTRALASIA.

AUCTION, a well-known mode of selling property, in open competition, to the highest offerer, by means of an agent or auctioneer. When the property is of considerable value, a person is sometimes appointed to superintend the sale, who is denominated judge of the roup, and acts as an arbiter in settling any disputes that may arise. The terms of the sale may be regulated at the will of the exposer, provided they are distinctly announced to the public beforehand. The party offering the highest price is declared the purchaser. When formal articles of sale are employed, they commonly regulate how much each offer shall exceed the previous one; whether the exposer shall be allowed to make an offer, or to withdraw the subject, if the highest offer does not amount to a given sum; and sometimes it is declared that an instalment of the price shall be payable instantly, or that security shall be found within a stipulated period; failing which the immediately preceding offerer is preferred. Secret contrivances, either to raise or depreciate the price, are unlawful. The seller must not attempt to practise any imposition on the public; neither are the bidders permitted to adopt any unfair means to prevent the natural operation of free competition. Where any such thing is detected, not only is the sale vitiated, but reparation is due to the injured party. For example, the secret employment by the seller of a friend to raise the price by making a fictitious offer is fraudulent, and entitles the highest offerer, on detecting it, to repudiate the transaction, or (in case he has been outbidden by such fictitious party) to demand the property at the price which he fairly offered. On the other hand, the obligation on the part of the public to act fairly is equally stringent. Accordingly, if two or more individuals combine to withhold their biddings that one of their number may purchase cheaply in order to divide among them the expected profit, or if a bidder were to give money to others to induce them to refrain from bidding, the exposer is entitled to have the sale declared void; on the ground that such a secret combination or paction obviously deprived him of the advantage which he expected from that competition which a public sale is intended to secure.

Formerly a duty was payable to government on the price realized; but at present it is only required that an annual license, which costs L.10, be taken out by the auctioneer.

Aude || Auditor.

AUDE, a southern department of France, forming part of the old province of Languedoc, bounded on the E. by the Mediterranean, N. by the departments of Herault and Tarn, N.W. by Upper Garonne, W. by Ariege, and S. by that of Eastern Pyrenees. It lies between Lat. 42. 40. and 43. 30. N.; is 80 miles in length from E. to W., and 60 miles in breadth from N. to S. Area, 2341 square miles.

The department of Aude is traversed on its western boundary from south to north by a mountain range of medium height, which unites the Pyrenees with the Southern Cevennes; and its northern frontier is occupied by the Black Mountains, the most western part of the Cevennes chain. The Corbieres, a branch of the Pyrenees, runs in a S.W. and N.E. direction along the southern district. The Aude, its principal river, has its entire course in this department, except a small part towards its source in the Eastern Pyrenees. Flowing first northwards, at Carcassonne it turns abruptly to the E., and continues in that direction till it reaches the sea on the confines of the department of Herault. Its principal affluents on the left are the Rebenti, Cougain, Lou, Rougeane, Orbiel, Argent-Double, and Ceysse; on the right, the Guette, Salse, and Orbieu. The canal of Languedoc, which unites the Atlantic with the Mediterranean, traverses the department from E. to W. The lowness of the coast causes a series of large lagunes; the chief of which are those of Bages, Lijean, Narbonne, Palme, and Leucate. Various kinds of wild animals, as the chamois, bear, wild boar, wolf, fox, and badger, inhabit the mountains and forests; game of all kinds is plentiful; and the coast and lagunes abound in fish. It has mines of iron, copper, lead, manganese, cobalt, and antimony. Besides the beautiful marbles of Cascastel and Caunes, there are quarries of lithographic stones, gypsum, limestone, and slate. At Tuchan and Durban are two coal mines of excellent quality, but the veins are not thick. The mountains contain many mineral springs, both cold and thermal.

The agriculture of this department is in a very flourishing condition, more than four-ninths of the soil being under grain, and about one-twelfth in vineyards. About a ninth part is occupied by woods and forests; more than two-sevenths are waste land; and the meadows are extensive and well watered. The grain produce considerably exceeds the consumption, but the vine constitutes the principal agricultural wealth. Olives are also extensively cultivated, and the honey of Aude is much esteemed. Besides important manufactures of cloths, combs, jet ornaments, and casks, there are paper-mills, distilleries, tanneries, and extensive iron and salt works.

This department contains 4 arrondissements, 31 cantons, 433 communes. The population in 1851 was as follows:—

	Cantons.	Pop.
Carcassonne	12	94,970
Limoux	8	75,229
Narbonne	6	64,400
Castelnaudary	5	55,148
	31	289,747

AUDEBERT, JEAN-BAPTISTE, an eminent naturalist and delineator of animals, born at Rochefort in 1759, died in 1800. He introduced a new era in the art of depicting animals, and acquired great celebrity by the illustrations he furnished for several well-known works on subjects of natural history. His first folio, *Histoire Naturelle des Singes et des Makis, &c.*, is a beautiful and valuable work; but his *Histoire des Colibris, des Oiseaux-mouches, des Jacamars et des Promerops*, published in folio at Paris in 1802, is superb, and is also remarkable for the masterly style of the diagnosis and descriptions.

AUDITOR, in a general sense, a hearer, or one who listens or attends to anything.

AUDITOR, *in English Law*, is an officer of the

Auditors ‖ Audæus.

some other great person, who, by examining yearly the accounts of the under officers, makes up a general book, which shows the difference between their receipts and charges, and their several allowances.

Auditors of the Imprest were the officers of the exchequer, who had formerly the charge of auditing the great accounts of the customs, naval and military expenses, &c. Their patents were vacated by the 25th Geo. III. cap. 52, and a compensation granted of L.7000 per annum (§ 3). The duties of the office were transferred to the *commissioners for auditing the public accounts*, appointed by § 4.

The commissioners were at first *five* in number, of whom *two* were required to be the comptrollers of the army accounts, and continued to be commissioners so long only as they held that office. Their tenure of office is expressed to be *quamdiu se bene gesserint*. Power was then given by the 45th Geo. III. cap. 91, for the appointment of *three* commissioners as an additional board for examining and auditing the public extraordinary accounts under the direction of the treasury, such commissioners not to be members of parliament (§ 7). But afterwards, by the 46th Geo. III. cap. 141, the number was increased to *ten*, who should hold their office "during good behaviour," with a salary to the chairman of L.1500, and to the other commissioners of L.1200 per annum. And it was also provided that the comptrollers of army accounts should cease to be auditors of public accounts, and that no commissioner should be a member of parliament; and in case of a vacancy, the appointment thereto could not be made without the authority of parliament, unless the number should be reduced to five or less. Five of the commissioners constitute a general board.

The powers and duties of the commissioners have been from time to time augmented. The various statutes by which these changes have been effected, and the several offices brought under their audit, are as follow:—

The three offices of *auditors of the Land Revenue* on the respective deaths of the then holders: 39th Geo. III., cap. 83, § 1.

The accounts of the receipts and expenditure of *Colonial Revenues* in the islands of Ceylon, Mauritius, Malta, Trinidad, and the settlements of the Cape of Good Hope: 2d Will. IV. cap. 26. It appears that under the 54th Geo. III. cap. 184, three commissioners were appointed for this purpose, at salaries of L.1000, and two at L.800 each, whose powers were continued by the 59th Geo. III. cap. 67, and the 1st Geo. IV. cap. 65, and rendered perpetual by the 1st and 2d Geo. IV. cap. 121.

The powers and duties of the *commissioners of public accounts in Ireland:* 2d and 3d Will. IV. cap. 99.

The duties of auditing and passing *sheriff's* accounts: 3d and 4th Will. IV. cap. 99, § 8.

The audit of the accounts of all moneys which by any act of parliament are under the control of the *commissioners of Her Majesty's woods and forests:* 7th and 8th Vict. cap. 89; of the accounts of the *treasurers of the county courts:* 9th and 10th Vict. cap. 95, § 45; and of the *excise revenue*, on the abolition of the office of auditor of the excise, which was created by the 4th Vict. cap. 20, § 14; 12th Vict. cap. 1.

Under the Municipal Corporations Act, 5th and 6th Will. IV. cap. 76, the burgesses annually elect from among those qualified to be councillors, two auditors to audit *the accounts of the borough*, who are by the 7th Will. IV. and 1st Vict. cap. 78, § 15, disqualified to be of the council.

In Scotland there is an auditor attached to the Court of Session, who officially examines accounts when costs are given, whose certificate or taxation is essential to the enforcement of payment. (R. M—M.)

AUDITORIUM, in the ancient churches, was the nave, or that part of the church where the auditors stood to hear and be instructed.

AUDÆUS, or AUDIUS, a reformer of the fourth century, by birth a Mesopotamian. He suffered much persecution from the Syrian clergy for his fearless censure of their irregular lives; and was eventually banished into Scythia, where, after propagating his sect with good success, he died at an advanced age, about A.D. 370. The Audæans celebrated the feast of Easter on the same day with the Jewish passover, and they were also charged with Anthropomorphism, or attributing to the Deity a human shape. They founded this opinion on Genesis i. 26. Mosheim's *Instit. of Eccles. Hist.*

Audouin ‖ Audran.

AUDOUIN, JEAN VICTOR, a distinguished French entomologist, was born at Paris, April 27. 1797. He began the study of law, but was diverted from it by his strong predilection for natural history, which subsequently led him to enter the medical profession. In 1824, he was appointed assistant to Latreille in the entomological chair at the museum of natural history, and succeeded him in 1833. He established in 1828, in conjunction with Dumas and Adolphe Brongniart, the *Annales des Sciences Naturelles*, to which he made numerous valuable contributions, generally in co-operation with M. Milne Edwards. Besides these, the greater part of his papers are contained in the Transactions of the Entomological Society, of which he was one of the founders, and for many years president. He died in 1841, more from the effects of mental than of bodily exhaustion.

AUDRAN, CLAUDE, a French engraver, was the son of Louis Audran, an officer belonging to the wolf-hunters in the reign of Henry IV. of France. He was born at Paris in 1592, and died at Lyons in 1677. Though he never acquired much reputation by his own works, he was the father of three great artists, Germain, Claude, and Girard; the last of whom has immortalized the name of the family.

AUDRAN, *Carl*, brother to the preceding, was born at Paris in 1594. In his infancy he discovered a great taste for the arts; and to perfect himself in engraving, went to Rome, where he produced several prints which did him great honour. On his return he adopted that species of engraving which is performed with the graver only. He settled at Paris, where he died in 1674. In the early part of his life he marked his prints with C, or the name of Carl, till his brother Claude published some plates with the initial only of his baptismal name, when, for distinction's sake, he used the letter K.

AUDRAN, *Germain*, the eldest son of Claude, was born in 1631, at Lyons. Not content with the instructions of his father, he went to Paris and perfected himself under his uncle Carl; and on his return to Lyons, published several prints which contributed much to his reputation. He was made a member of the academy established in that town, and chosen a professor. He died at Lyons in 1710, and left behind him four sons, all artists, namely, Claude, Benoit, Jean, and Louis.

AUDRAN, *Claude*, the second of this name, and second son to Claude above mentioned, was born at Lyons in 1639, and went to Rome to study painting. On his return he was employed by Le Brun to assist him in various works. He was made an academician in 1675, and died at Paris in 1684.

AUDRAN, *Girard*, or *Gérard*, the most celebrated artist of the whole family, was the third son of the Claude Audran first mentioned, and was born at Lyons in 1640. He was taught the first principles of design and engraving by his father; and, following the example of his brother, went to Paris, and afterwards to Rome, to perfect himself in his art. At Rome, where he resided three years, he engraved several fine plates. That great patron of the arts, M. Colbert, was so struck with the beauty of Audran's works, that he persuaded Louis XIV. to recal him to Paris. On his return he applied himself assiduously to engraving, and was appointed engraver to the king, from whom he received great encouragement. In the year 1681 he was admitted to the council of the Royal Academy. He died at Paris in 1703. His greatest works are his engravings of Le Brun's *Battles of Alexander*.

"He was," says the Abbé Fontenai, "the most celebrated

Audran || Audubon.

engraver that ever existed in the historical line. We have several subjects which he engraved from his own designs, that manifested as much taste as character and facility. But in the *Battles of Alexander* he surpassed even the expectations of Le Brun himself."

AUDRAN, *Benoit*, the second son of Germain Audran, was born at Lyons in 1661. He studied, first under his father, and afterwards at Paris, under his uncle Girard. Though he never equalled his preceptor, yet he deservedly acquired a high reputation by the boldness and clearness of his style. He died at Louzouer in 1721.

AUDRAN, *Jean*, the third son of Germain Audran, was born at Lyons in 1667. After having received instructions from his father, he went to Paris to perfect himself in the art of engraving under his uncle Girard, next to whom he was the most distinguished member of his family. At the age of twenty his genius began to display itself in a surprising manner; and his subsequent success was such, that in 1707 he obtained the title of engraver to the king, and had a pension allowed him by His Majesty, with apartments in the Gobelins; and the following year he was made a member of the Royal Academy. He was eighty years of age before he quitted the graver, and nearly ninety when he died. The best prints of this artist are those which appear not so pleasing to the eye at first sight. In these the etching constitutes a great part; and he has finished them in a bold rough style. The *Rape of the Sabines*, after Poussin, is considered his masterpiece.

AUDRAN, *Louis*, the last son of Germain Audran, was born at Lyons in 1670, and thence went to Paris, after the example of his brothers, to complete his studies in the school of his uncle Girard. He died suddenly at Paris in 1712, before he had produced any great number of prints. His best work is *The Seven Acts of Mercy*.

AUDRAN, *Benoit, the younger*, was the son of Jean Audran, and nephew to the former Benoit. He engraved but few plates, and, in point of merit, is vastly inferior to his uncle.

AUDUBON, JEAN JACQUES, the well-known naturalist, was born in Louisiana in 1781, where his parents, who were French Protestants, took up their residence while it was still a Spanish colony. They afterwards settled in Pennsylvania. He informed the writer of this memoir, that from his early years he had a passion for observing the habits and appearances of birds, and attempting delineations of them from nature. At the age of fifteen he was sent to Paris, and remained there about two years, when among other studies he took some lessons in the drawing-school of David. On returning to America his father established him in a plantation in Pennsylvania, and he soon after married. But neither the management of his plantation, nor his domestic relations as a husband and a father, could damp his ardour for natural history. This favourite pursuit often led him to explore the depths of the primeval forests of America in long and sometimes hazardous expeditions, far from his family and his home. For the fifteen years that followed 1810, he annually continued these excursions, and in that school acquired the facility of making those spirited drawings of birds that give such value to his magnificent work, *The Birds of America*. At that period he had not dreamt of any publication of his labours; and has informed us "it was not the desire of fame that prompted to those long exiles; it was simply the enjoyment of nature."

He afterwards removed with his family to the village of Henderson on the banks of the Ohio, where he remained for several years, pursuing his ornithological propensities; and at length set out for Philadelphia with a portfolio containing 200 sheets filled with coloured delineations of about 1000 birds. Business obliged him to quit Philadelphia unexpectedly for some weeks, and he deposited his portfolio in the warehouse of a friend; but judge of his horror and mortification at finding on his return, that these precious fruits of his wanderings and his labours had been totally destroyed by rats! Audubon.

The shock threw him into a fever of several weeks' duration, that had well-nigh proved mortal. But his native energy returned with returning health; and he resumed his gun and his gamebag, his pencils, and his drawing-book, and replunged into the recesses of the backwoods. In eighteen months passed far from home, he had again filled his portfolio; and then rejoined his family, who had in the mean time gone to Louisiana.

After a short sojourn there, he bade them again adieu; and set out for the Old World, to exhibit to the ornithologists of Europe the riches of the New World in that department of natural history.

Audubon arrived in 1826 at Liverpool, where the merits of his spirited delineations of American birds were immediately recognized, and greatly admired by his present biographer and several other friends, who advised an exhibition of them to the public, in the galleries of the Royal Institution of that town. The exhibition was repeated at Manchester, and at Edinburgh, where they were no less admired. When he proposed to publish a work on the birds of America, several naturalists advised him to issue the work in large quarto, as the most useful size for the lovers of natural history, and the most likely to afford him a sufficient number of subscribers to remunerate his labours. At first he yielded to this advice, and acknowledged its soundness; but finally he decided that his work should eclipse every other ornithological publication. Every bird was to be delineated of the *size of life*, and to each species a whole page was to be devoted; consequently the largest *elephant folio* paper was to receive the impressions. In such enormous pages the white headed-eagle and the wild turkey certainly fill the space with good effect; but to occupy such pages with a humming-bird or a fly-catcher, seemed to his more sober friends rather extravagant. It is true that his beautiful drawings of plants and flowers, which he introduced with the smaller birds, were often very spirited and characteristic; but size necessarily increased the expense of the work so much as to put it beyond the reach of most scientific naturalists; which accounts for the small number of persons whom, for a considerable time, he could reckon among his supporters in this gigantic undertaking. The extreme beauty, however, of this splendid work, extorted the applause of the wealthy and the eminent in station; and a sufficient number of subscribers was obtained in Britain and America, during the ten or twelve years that the work was going through the press, to indemnify him for the vast cost of the publication; yet left him a very moderate compensation for his uncommon industry and skill. We are convinced that had a quarto size been adopted, with a scale of the size for each species, it would have been far more advantageous to the gifted and indefatigable author.

The first volume of this noble work was published in the end of the year 1830, the second in 1834, the third in 1837, and the fourth and last in 1839. The whole consists of 435 coloured plates, containing 1055 figures of birds the size of life. It is certainly the most magnificent work of the kind ever given to the world, and is well characterized by Cuvier, "C'est le plus magnifique monument que l'art ait encore élevé à la Nature."

During its preparation and publication, Audubon made several excursions from Great Britain. In the summer of 1828, he visited Paris, where he obtained the acquaintance and gained the high approbation of Cuvier, Humboldt, and many other celebrated naturalists. The following winter he passed in London. In April of 1830 he revisited the United States of America; and again explored the forests of the central and southern federal territories. In the following year he returned to London and Edinburgh; but the August of 1831 found him again in New York. The fol-

Auerstadt ‖ Augeas.

lowing winter and spring he spent in Florida and South Carolina; and in the summer of 1832, he set out for the Northern States, with an intention of studying the annual migrations of birds, particularly of the passenger pigeon, of which he has given a striking description; but his career was arrested at Boston by a severe attack of cholera, which detained him there till the middle of August. After that he explored the coasts, the lakes, rivers, and mountains of N. America, from Labrador and Canada to Florida, during a series of laborious journeys, that occupied him for three years. From Charleston, accompanied by his wife and family, he took his third departure for Britain.

Before, however, he had quitted these islands, he had begun to publish at Edinburgh his *American Ornithological Biography*, which at length filled five very large octavo volumes. The first appeared in 1831, and the last in 1839. This book is admirable for the vivid pictures it presents of the habits of the birds, and the adventures of the naturalist. The descriptions are characteristically accurate and interesting.

M. Audubon spoke English fluently, with a foreign accent; and he wrote it easily, but with an occasional foreign idiom. It is true, as he informed us, that in this publication the style was corrected by his friend the late Professor Macgillivray of Aberdeen; but from having examined Audubon's MS. notes, before he had ever met Mr Macgillivray, we can positively state, that any similarity to be discerned between their acknowledged writings on natural history, may be as justly attributed to an imitation of the spirited descriptions of Audubon by his friendly assistant, as to any obligation of Audubon to that author for the graphic style of his narrative. We may add, that Audubon always acknowledged the services of Mr Macgillivray in terms of enthusiastic friendship and regard.

In 1839 Audubon bade a final adieu to Europe; and returning to his native country, he published in a more popular form his *Birds of America*, in seven octavo volumes, the last of which appeared in 1844.

His ardent love of nature still prompted him to new enterprizes, and he set out on fresh excursions; but in these he was accompanied by his two sons, and one or two other individuals, instead of his former solitary rambles. The result of these excursions was the projection of a new work, *The Quadrupeds of America*, in atlas folio, and also a *Biography of American Quadrupeds;* both of which were commenced at Philadelphia in 1840. The latter was completed in 1850, and is, perhaps, even superior to his *Ornithological Biography*.

To great intelligence in observing, and accuracy in delineating nature, to a vigorous handsome frame, and pleasing expressive features, M. Audubon united very estimable mental qualities, and a deep sense of religion without a trace of bigotry. His conversation was animated and instructive; his manner unassuming; and he always spoke with gratitude to Heaven for the very happy life he had been permitted to enjoy.

He died, after a short illness, in his own residence on the banks of the Hudson, at New York, on the 27th of January 1851. (T. S. T.)

AUERSTADT, a small village in the Prussian province of Saxony, celebrated for the victory more commonly known by the name of the neighbouring city of Jena, which the French gained over the Prussians in October 1806.

AUGEAS (Αὐγέας or Αὐγείας), a fabulous king of Elis, famed for his stable, which contained 3000 oxen, and had not been cleansed for thirty years. Hercules was desired to clear away the filth from this stable in one day; and Augeas promised, if he performed it, to give him a tenth part of the cattle. This task Hercules is said to have executed by turning the course of the rivers Alpheus and Peneus through the stable; and when Augeas refused to keep his engagement, Hercules slew him, and gave his kingdom to his son Phyleus, who had shown an abhorrence of his father's insincerity.

Augereau ‖ Augsburg.

AUGEREAU, Pierre François Charles, Duke of Castiglione, was the son of obscure parents, and born in 1757. After enlisting in the armies of France, he afterwards entered into the Neapolitan service; but retired from it and joined the Republican army that watched the movements of Spain in 1792. He became an officer in the army of Italy, and distinguished himself in storming the Bridge of Lodi in 1796. Next year he took part with Barras and the Directory, and was the prime agent in the revolution of Fructidor; but his jealousy of his former comrade, Buonaparte, prevented their intimacy; and he had the honour of being one of the general officers not privy to the noted revolution of the 18th of Brumaire (Nov. 9.) 1799. Mutual jealousy kept them aloof until 1805, when Augereau was made a marshal of the French Empire, and appointed to the command of the expedition against the Voralberg, which he quickly subdued. He distinguished himself greatly in the battles of Jena and Eylau. In 1809–10 he commanded the French in Catalonia, and tarnished his laurels by unnecessary cruelty to the Spaniards; but he was again more honourably conspicuous in the campaign of 1813, especially in the terrible battle of Leipzig. In 1814 he submitted, and retained a command under the Bourbons; and in the following year he refused to join Napoleon on his escape from Elba. He had the painful task of being one of the commission that sat on the trial of Marshal Ney, whom he did not long survive, as he died of dropsy in 1816. (T. S. T.)

AUGRE, or Auger, an instrument used by carpenters and joiners to bore large round holes. It consists of a wooden handle and an iron shank, terminated at bottom with a steel bit. *Auger* is likewise the name of an instrument of a similar kind which is used for boring into the soil in order to ascertain the nature of the substrata, or the existence of water. It has connecting rods to adapt it to the different depths required.

AUGSBURG, a celebrated city of Germany, capital of the circle of the Upper Danube, in Bavaria. On the conquest of Rhætia by Drusus, Augustus established a Roman colony here, about B.C. 14, and gave it the name of *Augusta Vindelicorum*. In the fifth century it was sacked by the Huns, and afterwards came under the power of the Frankish kings. It was almost entirely destroyed in the war of Charlemagne against Thassilon, Duke of Bavaria; and after the dissolution and division of that empire, it fell into the hands of the Dukes of Suabia. After this it rose rapidly into importance as a manufacturing and commercial town, and about the middle of the thirteenth century it was raised to the rank of a free imperial city, which it retained till 1806, when it was annexed to the kingdom of Bavaria.

This city is pleasantly situated in an extensive and fertile plain, between the rivers Werlach and Lech, 36 miles W.N.W. of Munich, with which it is connected by railway. Lat. 48. 21. 46. Long. 10. 54. 42. E. Its fortifications were dismantled in 1703, and though still surrounded by walls and ditches, these would now form but a poor defence against an enemy. The town is generally ill-built; one street, however (Maximilian Street), is remarkable both for its breadth and architectural magnificence. The public buildings of Augsburg are worthy of notice. Among these is the town-hall, said to be the finest in Germany, built in the beginning of the seventeenth century. One of its rooms, called the "Golden Hall" from the profusion of its gilding, is 110 feet long, 58 broad, and 52 high. The palace of the bishops, where the memorable Confession of Faith was presented to Charles V., is now used for government offices. There are also a cathedral, various churches and chapels, a school of arts, a polytechnic institution, a picture gallery, gymnasium, deaf-mute institution, orphan asylum, public library, &c. The "Fuggerei," built in 1519 by the bro-

Augsburg Confession || Augustin.

thers Fugger, consists of 106 small houses let to indigent citizens at a mere nominal rent. The manufactures of Augsburg are various and important, consisting of woollen, linen, cotton, and silk goods, watches, jewellery, mathematical instruments, machinery, leather, paper, &c. The *Allgemeine Zeitung*, or Augsburg Gazette, is published here. It is the principal seat of the commerce of S. Germany, and of the commercial transactions between that and the S. of Europe. Pop. (1849), including the garrison, 37,986.

AUGSBURG CONFESSION. This celebrated confession of faith was drawn up by Luther and Melanchthon, on behalf of themselves and other reformers, and presented in 1530 to the Emperor Charles V. at the diet of Augusta or Augsburg, in the name of the evangelic body. It contains 28 chapters, of which the greater part is occupied with an impartial representation of the religious opinions of the Protestants, and the remainder in pointing out the errors and abuses that occasioned their separation from the Church of Rome.

AUGUR, an officer among the ancient Romans, originally appointed to foretell future events by the chattering, flight, and feeding of birds; though afterwards they divined also by prodigies, lightning, &c. There was a college or community of these functionaries, consisting originally of three members. Afterwards the number was increased to nine, four of whom were patricians and five plebeians. This number was augmented by Sulla to fifteen, and Julius Cæsar added another. They bore an augural staff or wand, as the ensign of their authority; and their dignity was so much respected that they were never deprived of office, even though convicted of the most enormous crimes.

AUGURY, in its proper sense, the art of foretelling future events by observations on birds; though it is used by some writers in a more general signification, as comprising all the different kinds of divination.

AUGUST, in *Chronology*, the eighth month of our year; so called in honour of Augustus Cæsar, who in this month was created consul, thrice triumphed in Rome, subdued Egypt, and made an end of the civil wars.

AUGUSTA, capital of the county of Kennebec, in the state of Maine, N. America, is situated on both sides of the river Kennebec, 43 miles from the ocean. The river is here crossed by a fine bridge, 520 feet in length; and the town is well laid out, containing a handsome state-house of white granite, an arsenal, lunatic asylum, &c. Population (1850) 8231.

AUGUSTA, a city in the state of Georgia, on the Savannah river, and capital of the county of Richmond; 96 miles from Milledgeville, with which it is connected by railway. It is situated in a district rich in cotton, large quantities of which are conveyed to Charleston and Savannah. The town is regularly laid out, and handsomely built, the streets crossing each other at right angles. Pop. 6403.

AUGUSTA, or AGOSTA, a well-built and fortified city in the intendancy of Catania, in Sicily. It stands on a tongue of land near Cape Croce, and has a good harbour, from which salt, honey, oil, and wine are exported. Pop. 15,000.

AUGUSTALES, in *Roman Antiquity*, an epithet given to the flamens or priests appointed to sacrifice to Augustus after his deification. The *ludi*, or games, celebrated in honour of the same prince on the 4th day before the ides of October, were also called *Augustales*, or *Augustalia*.

AUGUSTALIS PRÆFECTUS, a title peculiar to the Roman magistrate who governed Egypt, with a power much like that of a proconsul in other provinces.

AUGUSTAN AGE, a term used to designate the most brilliant period of Roman literature, or the age of Augustus, when Virgil, Horace, Cicero, Ovid, Catullus, Tibullus, and other great geniuses flourished.

AUGUSTAN CONFESSION. See AUGSBURG CONFESSION.

AUGUSTIN, or AUSTIN, ST, the first archbishop of Canterbury, was originally a monk in the convent of St Andrew at Rome, and educated under St Gregory, afterwards Pope Gregory I., by whom he was sent into Britain with forty other monks of the same order, about the year 596, to convert the English Saxons to Christianity. The missionaries landed in the isle of Thanet; and having sent some French interpreters to King Ethelbert with an account of their errand, the king gave them leave to convert as many of his subjects as they could, and assigned as their place of residence Durovernum, now *Canterbury*, to which they were confined till the conversion of the king himself, whose example had a powerful influence in promoting the conversion of his subjects; but though he was extremely pleased at their becoming Christians, he never attempted to compel them. Augustin despatched a priest and a monk to Rome, to acquaint the pope with the success of his mission, and to desire his solution of certain questions. These men brought back with them a pall, and several books, vestments, utensils, and ornaments for the churches. His holiness, by the same messengers, gave Augustin directions concerning the settling of episcopal sees in Britain; and ordered him not to pull down the idol temples, but to convert them into Christian churches, only destroying the idols, and sprinkling the place with holy water, that the natives, by frequenting the temples they had been always accustomed to, might be the less shocked at their entrance into Christianity. Augustin resided principally at Canterbury, which thus became the metropolitan church of England; and having established bishops in several of the cities, he died May 26, 607.

Augustine.

AUGUSTINE, (*Aurelius Augustinus*), or AUSTIN, ST, the most illustrious of the fathers of the church, was born at Tagaste (Tajelt), a city in Numidia, on the 13th November, A.D. 354. His father, *Patricius*, was a burgess of Tagaste, and at that time an unconverted pagan; but his mother, *Monica* or *Monnica*, a woman of great piety, instructed their son in the principles of Christianity. In his early youth he fell dangerously ill, and earnestly desired to be baptized; but the danger being past, the rite was deferred. He studied, by his father's desire, at Tagaste, Madaura, and afterwards at Carthage. In his nineteenth year, the perusal of Cicero's *Hortensius* (a work now lost) made a deep impression on his mind, and he began to entertain a love for wisdom. Accordingly he applied himself with diligence to the study of the Sacred Scriptures; but he soon suffered himself to be seduced by the Manicheans, to whose pernicious doctrines he adhered for nine years. After teaching grammar for some time at Tagaste, he returned to Carthage and became a teacher of rhetoric; but being disgusted with his companions and the manners of the scholars, he formed the resolution of going to Rome, much against the inclination of his mother. In that city he soon attracted many scholars; but finding them no less depraved than his former pupils, he quitted Rome and settled at Milan, where he was elected professor of rhetoric. Here he had the opportunity of hearing the discourses of St Ambrose, whose arguments, together with the study of St Paul's epistles, and the conversion of two of his friends, determined him to retract his errors and quit the sect of the Manicheans. He spent the vacation of the year 386 at the country seat of his friend Verecundus, and applied himself in earnest to the study of the Scriptures, preparatory to his baptism, which took place, together with that of his natural son Adeodatus, and his friend Alypius, at Easter in the following year. Shortly after this event, his mother came to Milan, and invited him to return with her to Carthage; but at Ostia, whither they had gone to embark for Africa, Monica was seized with sickness and died. Augustine arrived in Africa towards the close of 388; and having obtained a small villa beyond the walls of the city of Hippo, he associated himself with eleven other persons of eminent piety, and they dwelt together in a monastic state for the space of three years. Renouncing

Augustins || Augustus.

all individual property, they possessed their goods in common, distinguished themselves by wearing leather girdles, and exercised themselves continually in prayer, fasting, study, and meditation. Hence arose the Austin or Augustine friars, or eremites of St Augustine, who were the first order of mendicants; those of St Jerome, the Carmelites, and others, being only branches of that of St Augustine.

It was about this period that Augustine acceded to the urgent solicitations of Valerius, bishop of Hippo, to be ordained a priest; but he still continued to reside with his brethren in their little monastery. In the year 393 he was appointed, though still only a presbyter, to expound the creed before the council of Hippo. Two years after, Valerius, who was very desirous to retain the services of so eminent a person, appointed Augustine his coadjutor or colleague, and succeeded in obtaining his appointment to the bishopric of Hippo, by Megalus, bishop of Calame, who was at that time primate of Numidia. The life of Augustine closed amidst scenes of violence and blood. The Vandals under the fierce Genseric laid siege to Hippo; and during this period of aggravated distress and misery, Augustine breathed his last on the 28th August 430, at the age of 76. The best account of his life is to be found in his own celebrated *Confessions*, in which he has recorded with manly candour the excesses of his early years, and the progress of his conversion to Christianity. His writings are greatly esteemed, and there are many editions of his separate works. The best complete edition is that of the Benedictines in 11 vols. folio, published at Paris, 1679–1700, and reprinted at Paris in 1836–38, in 22 half volumes. Tillemont, in his *Ecclesiastical History*, has devoted a quarto volume of 1075 pages to the life and writings of St Augustine.

AUGUSTINS, or Augustinians, one of the four mendicant orders in the Church of Rome, so called from St Augustine, whose rule they observe. The Augustins, popularly also called Austin friars, were originally hermits, whom Pope Alexander IV. first congregated into one body, under their general Lanfranc, in 1256. Soon after their institution this order was brought into England, where they had about thirty-two houses at the time of their suppression. The Augustins dress in black.

AUGUSTOO, or Augustow, a city in Poland, capital of the woiwodship of the same name, situated on the river Netta, near a lake. It contains about 4000 inhabitants, and has a considerable trade in horses and cattle. It was founded in 1557 by Sigismund II. (Augustus). The woiwodship is the northernmost part of Poland, extending from the Bug to the Niemen, between N. Lat. 52. 40. and 55. 5. E. Long. 21. 20. and 23. 9. Its extent is 6870 square miles, inclosing the greater portion of the lakes of Poland, and many districts of extensive woods, but with some patches of good arable land. It is divided into five obwods or circles, one of which bears the same name.

AUGUSTULUS, Romulus, the last Roman emperor of the West. See Roman History.

AUGUSTUS, Fort, a small fortress seated on a plain at the head of Loch Ness, in Scotland, between the rivers Tarf and Oich.

Augustus, the appellation conferred upon Cæsar Octavianus, the first Roman emperor. Its etymology is not quite certain, but the Greeks always translate it by Σεβαστός, "the Venerable." He was the son of C. Octavius by Atia, a daughter of Julia, the sister of C. Julius Cæsar. An account of his life is given under the article Roman History. The obscure name *Octavius*, as Gibbon observes, he derived from a mean family in the little town of Aricia. It was stained with the blood of the proscription; and he was desirous, had it been possible, to erase all memory of his former life. The illustrious surname of Cæsar he assumed as the adopted son of the dictator, for which reason his name Octavius also was changed into Octavianus; but he had too much good sense either to hope to be confounded, or to wish to be compared, with that extraordinary man. It was proposed in the senate to dignify their minister with a new appellation; and, after a very serious discussion, that of Augustus was chosen from among several others, as being the most expressive of the character of peace and sanctity which he uniformly affected. Augustus was therefore a personal, Cæsar a family distinction. The title of Augustus, which should naturally have expired with the prince on whom it was bestowed, continued to be reserved for the monarch; while the name of Cæsar was more freely conferred on his relations, and, from the reign of Hadrian at least, became appropriated to the second person in the state, who was considered the presumptive heir of the empire. Nero was the last prince who could allege any hereditary claim to the honours of the Julian line. But at his death the practice of a century had inseparably connected the appellation with the imperial dignity, and it has been preserved by a long succession of emperors, Romans, Greeks, Franks, and Germans, to the present time.

Aula || Aungervyle.

AULA is used by Spelman for a court-baron, as by Tacitus and Suetonius for courtiers generally. In some old ecclesiastical writers it signifies the nave of a church, and sometimes a courtyard.

Aula Regia, or *Regis*, a court established by William the Conqueror in his own hall, composed of the king's great officers of state, who resided in his palace, and were usually attendant on his person. This court was regulated by the article which forms the eleventh chapter of Magna Charta, and was established in Westminster Hall, where it has ever since continued.

AULCESTER, or Alcester, a market-town of Warwickshire, at the junction of the Alne and Arrow. It was once a place of some importance, and the residence of several of our monarchs in remote periods. It has a fine old Gothic church. Market-day Tuesday. Pop. in 1851, 2027.

AULERCI, a powerful Gallic people who dwelt between the Seine and the Loire. They were divided into three tribes, viz., the *Eburovices*, the *Cenomāni*, and the *Branovices*. According to Ptolemy, the *Diablintes* were a branch of the same.

AULIC, an epithet given to certain officers of the German empire, who compose a court which decides, without appeal, in all processes entered in or submitted to it.

Aulic, in the Sorbonne and foreign universities, is the ceremony observed in conferring the degree of doctor of divinity. It begins by a harangue of the chancellor, addressed to the young doctor, after which he receives the cap, and presides at the aulic or disputation.

AULIS, the port in the Greek island of Eubœa from which the Grecian fleet sailed to the siege of Troy.

AULUS Gellius. See Gellius.

AUMALE, formerly Albemarle, from the Latin *Alba Marla*, a town of France, capital of a canton in the department of Seine Infer., on the banks of the Bresle, 35 miles N.E. of Rouen. Pop. 2000. The French dukedom of Aumale, originally a county, has belonged since 1675 to princes of the blood. In the English peerage the earldom of Albemarle is at present in the family of Keppel.

AUMONE, Tenure in, in *Law*, a tenure where lands are given in alms to some church or religious house.

AUNCEL Weight, an ancient balance, prohibited by several statutes, on account of the deceits practised by it. It consisted of scales hanging on hooks, fastened at each end of a beam, which were lifted up by the hand. In many parts of England auncel weight signifies meat sold by the hand, without scales.

AUNE, a French measure for cloths, &c.: at Rouen = 1 English ell, at Calais = 1·52, at Lyons = 1·061, and at Paris = 0·95; all now superseded by the *mètre*.

AUNGERVYLE, Richard, commonly known by the

Aunis || Auriflamma.

name of *Richard de Bury*, was born in 1281, at St Edmund's Bury, in Suffolk, and educated at the University of Oxford; after which he entered into the order of Benedictine monks, and became tutor to the Prince of Wales. On the accession of his pupil to the throne as Edward III., he was promoted to various offices of dignity, and was finally made bishop of Durham, as well as lord high chancellor and treasurer of England. He corresponded with some of the greatest men of the age, particularly with the poet Petrach. He was of a most humane and benevolent temper. Every week he caused eight quarters of wheat to be made into bread, and given to the poor; besides distributing large sums whenever he travelled. He founded a library at Oxford for the use of the students, which he furnished with the best collection of books then in England; and appointed five keepers, to whom he granted yearly salaries. He died at his manor of Aukland, 24th April 1345, and was buried in the cathedral church of Durham. He wrote, 1. *Philobiblion*, containing directions for the management of his library at Oxford, and a great deal in praise of learning, but in very bad Latin. 2. *Epistolæ Familiarium;* some of which are addressed to Petrarch. 3. *Orationes ad Principes;* mentioned by Bale and Pitts.

AUNIS, an ancient province of France, now included in the departments of the Lower Charente and Deux Sevres.

AURAY, a small seaport town of France, situated on a river of the same name in the department of Morbihan, 10 miles W. of Vannes. It consists of one handsome street, and is chiefly known for its trade. Pop. in 1846, 3755.

AURELIA (from *aureus*, golden). See CHRYSALIS.

AURELIANUS, LUCIUS DOMITIUS, emperor of Rome, See ROMAN HISTORY.

AURELIANUS, *Cœlius*, a very celebrated physician, born in Numidia, probably towards the end of the third century. He wrote on acute and chronic diseases. Edited by Amman, Amstel. 1709, 4to.

AURELIUS VICTOR. See VICTOR.

AURELIUS. See ANTONINUS, *Marcus Aurelius*.

AUREOLA, in its original signification, signifies a jewel, which is proposed as a reward of victory in some public dispute. Hence the Roman schoolmen applied it to denote the reward bestowed on martyrs, virgins, and doctors, on account of their works of supererogation; and painters use it to signify the crown of glory with which they adorn the heads of saints, confessors, and martyrs.

AUREUS, the standard gold coin of Rome, first struck A.U.C. 546; current value = 25 denarii, or 100 sestertii, equivalent to 17s. 8½d. Forty aurei were made from a pound of gold; but their value was gradually diminished till, under Nero, 45 were made from a pound, and under Constantine, 72.—Hussey, *On Ancient Weights and Money*.

AURICH, a province (Landrosteibezirk) of Hanover, situated on the North Sea, between Oldenburg and Holland. It comprizes the old province of East Friesland. Its area is 870 geographical square miles, and it is divided into 12 amts. Pop. in 1848, 174,355, of whom 118,394 were Lutherans, 50,007 Reformers, 3249 Roman Catholics, and 2254 Jews. See HANOVER. Aurich, its capital, is 12 miles N.E. of Emden, with which it is connected by the canal of Trecktief. The town is well built and has an ancient princely castle, in which the provincial courts now sit; several handsome churches, cavalry barracks, gymnasium, and public library. It is noted for its horse and corn markets, and has a considerable general trade. Pop. 4500.

AURICULAR CONFESSION, in the *Roman Catholic Church*, is a declaration of sins made in private to a priest, for the purpose of obtaining absolution. The scriptural authority for this practice is supposed to be found in Matthew xviii. 18; Acts xix. 18; James v. 16; 1 John i. 9.

AURIFLAMMA, or ORIFLAMME, a standard belonging to the Abbey of St Denis, suspended over the tomb of that saint, which the religious, on occasion of any war, took down with great ceremony and gave to their protector or advocate, to be borne at the head of their forces. Oriflamme is sometimes used to denote the chief standard in any army.

Auriga || Aurora Borealis.

AURIGA, the WAGGONER, a constellation of the northern hemisphere. It contains, in Bode's catalogue, 261 stars.

AURILLAC, a town of France, capital of the dep. of Cantal and of an arrond. of the same name. It is pleasantly situated on the right bank of the Jourdanne, which is here crossed by a handsome bridge. It has tribunals of primary instance and commerce, a communal college, a society of agriculture, arts, and commerce, and a public library of 7000 volumes. Here are to be seen remains of the ancient castle of St Etienne, the church of St Geraud, a Benedictine Abbey, &c. The inhabitants manufacture tapestry, lace, cutlery, paper, leather, &c.; and are great breeders of horses. Pop. of arrondissement in 1851, 96,433; of town, 9886.

AURORA, the Ἠώς of the Greeks, the goddess of the dawn, was the daughter of Hyperion and Theia according to Hesiod, or of Pallas according to Ovid. It was under this name that the ancients deified the light which foreruns the rising of the sun above our hemisphere. Aurora is represented by the poets as ascending from her ocean bed in a flame-coloured chariot, and opening with her rosy fingers the gates of the east, pouring dew upon the earth, and causing the flowers to spring. Nox and Somnus fly before her, and the constellations of heaven disappear at her approach. Her amours with Orion, Cephalus, and Tithonus, are celebrated by the poets; and by Astræus she became the mother of the stars, winds, &c. In the tragic writers, Eos is identified with the day.

AURORA BOREALIS, *Polar Light, Northern Lights*, or *Streamers*, is a beautifully luminous meteor, appearing in the form of beams or rays, and sometimes in that of arches or crowns. The rays are seldom stationary, generally flitting with greater or less velocity throughout the heavens; the arches are sometimes single; sometimes several concentric ones are seen. These lights, or meteoric coruscations, are most brilliant in the arctic regions, appearing mostly in the winter season and in frosty weather. In the Shetland Islands, the *merry dancers*, as they are there and elsewhere called, are the general attendants of clear evenings, and serve to diminish materially the gloom of the long winter nights. They commonly appear at twilight near the horizon, and sometimes continue in that state for several hours without any sensible motion; after which they send forth streams of stronger light, which rise from the horizon in a pyramidal undulating form, shooting with great velocity up to the zenith, assuming columnar and other shapes, and varying in colour from a reddish yellow to the darkest russet. At other times they cover the whole hemisphere with their flickering and fantastical coruscations. On these occasions their motions are amazingly quick, and they astonish the spectator with rapid changes of form. They break out in places where none were seen before, skimming briskly along the heavens; then they are suddenly extinguished, leaving behind a uniform dusky track, which, again, is brilliantly illuminated in the same manner, and as suddenly left a dull blank. Some nights they assume the appearance of vast columns; exhibiting on one side tints of the deepest yellow, and on the other melting away till they become undistinguishable from the surrounding sky. They have generally a strong tremulous motion from end to end, which continues till the whole vanishes. According to the state of the atmosphere, their colours vary. They sometimes assume the hue of blood, on which occasion their appearance is considered portentous. Then the rustic sages become prophetic, and terrify the gazing spectators with the dread of war, pestilence, and famine. This superstition is not peculiar to the northern islands; nor are these appearances of recent date. The

Aurora Borealis. Formerly rare.

ancients called them *chasmata*, and *trabes*, and *bolides*, according to their forms or colours.

In early times, it is said, these meteoric lights were extremely rare, and on that account were the more taken notice of. From the days of Plutarch to those of our sage historian Sir Richard Baker, they were supposed to portend great events, and lively imaginations shaped them into aerial conflicts:

> Fierce fiery warriors fight upon the clouds,
> In ranks, and squadrons, and right form of war.

Dr Halley tells us, that when he observed a great aurora borealis in 1716, he had begun to despair of ever seeing one at all; none having appeared, at least of any considerable extent, from the time he was born until then. But notwithstanding this long interval, it seems that, in some periods, the aurora borealis had been seen much more frequently; and perhaps this, as well as many other natural phenomena, may be subject to periodical changes and variations.

History.

The only thing resembling a distinct history of this phenomenon is that which has been given by the learned Dr Halley, in the *Philosophical Transactions*, No. 347. The first account he gives is of the appearance of what is called by him *burning spears*, which were seen at London on the 30th January 1560. This account is taken from a book entitled *A Description of Meteors*, by *W. F.* D.D., reprinted at London in 1654. The next appearance, according to the testimony of Stow, was on the 7th October 1564. In 1574 also, according to Camden, and Stow above-mentioned, an aurora borealis was observed two nights successively, viz. on the 14th and 15th of November, having much the same appearances as that described by Dr Halley in 1716, and which we now so frequently observe. Again, an aurora was twice seen in Brabant, in the year 1575, viz. on the 13th of February and 28th of September. Its appearances at both these times were described by Cornelius Gemm, professor of medicine in the university of Louvain, who compares them to spears, fortified cities, and armies fighting in the air. After this, Michael Mæstlin, tutor to the great Kepler, assures us, that at Baknang in the county of Wurtemberg in Germany, these phenomena, which he styles *chasmata*, were seen by himself no less than seven times in 1580. In 1581 they again appeared, in an extraordinary manner in April and September, and in a less degree at some other periods of the same year. In September 1621, a similar phenomenon was observed all over France, and described by Gassendus, who gave it the name of *aurora borealis*; yet neither this, nor any similar appearance posterior to 1574, is described by English writers till the year 1707, which, as Dr Halley observes, shows the prodigious neglect of curious matters that then prevailed. From 1621 to 1707, indeed, there is no mention made of an aurora borealis having been seen by any body; and, considering the number of astronomers who during that period were in a manner continually poring over the heavens, we may very reasonably conclude that nothing of the kind really made its appearance until after an interval of eighty-six years. A small one was seen in November 1707; and during that and the following year, the same appearances were repeated five times. The next on record is that mentioned by Dr Halley in March 1716, which from its brilliancy attracted universal attention, and was considered by the vulgar as marking the introduction of a foreign race of princes. Since that time these meteors have been much more frequent. Many of those observed in this island have been described. The following account of a splendid aurora borealis, as seen from the Gosport Observatory on the 7th January 1831, will give an idea of the brilliancy of this meteor, and of its colours, lustres, arches, and beams.

Aurora Boreal. Aurora borealis of Gosport.

"In the afternoon of this day there was a peculiar brightness in the atmosphere near the horizon, for several degrees on each side of the true north point, which indicated the approach of an aurora; indeed we have reason to suspect that it was a faint appearance of one; while the sun shone in all his splendour, without the interposition of cloud or vapour. Shortly after sunset an aurora borealis gradually rose above the northern horizon, and at a quarter past five o'clock it had assumed the form of an arch of refulgent light, ten degrees in height, and seventy degrees in width. From this time till half-past five it continued to increase in the intensity of its light, expanding to the western point of the horizon, and fifty-five degrees to the eastward of north, which made the chord of the aurora a hundred and fifty-five degrees. Now, a bright *flame-coloured* rainbow-like arch, between three and four degrees broad, and pretty well defined at its upper edge, emanated from the curved edge of the aurora to an altitude of thirty-five degrees; and while it remained apparently stationary, a beautiful rainbow-like arch, still more brilliant, formed about ten degrees south of the zenith, by streamers suddenly springing up from the N. E. by E. and W. by S. points of the horizon, and meeting in the zenith, so that these two bows presented themselves at the same time. At thirty-five minutes past five, the latter bow, in some parts four and in others six degrees in width, divided a little to the eastward of its vertex; and the long streamers which formed it passed off gently to the southward in very bright patches, two in the south-east and one in the south-west quarters, like luminous clouds, and continued in sight nearly a quarter of an hour. One of these bright patches nearly covered Orion several minutes. At forty minutes past five another rainbow-like arch, equally wide and bright, was formed by long streamers from about the same points of the horizon, whose point of convergence was the same, and its course through the feet of Gemini, near the Pleiades, through Aries, the square of Pegasus, the head of Equuleus, and the bow of Antinous. It passed off gradually towards the south; and at a quarter before six the planet Mars, then near the meridian, and about forty-five degrees in altitude, rested, as it were, conspicuously on it. At six it had gone far towards the southern horizon, and could scarcely be perceived, leaving the sky unusually clear and bright. By this time the bow over the aurora had much increased in altitude, and was nearly effaced.

"At a few minutes past six, after a great many coloured columns of light had risen from the north-east and north-west quarters, and passed the zenith, the aurora sunk considerably towards the horizon; but its upper edge remained bright and very well defined. Some of the streamers or columns were long, others short, and the widest generally remained long enough to pass through a gradation of prismatic colours. At half-past six the aurora again increased in altitude, and vivid coruscations radiated from every part of its arch, and, on intermixing with each other, formed wide columns, which were so grand with crimson tints as to astonish every spectator. Between seven and eight the aurora had spread at least two thirds over the heavens, and as far as the shoulders of Orion on the eastern side of the meridian, when large perpendicular columns, and short pointed luminous coruscations, rising from the aurora, glittering like spears and conical points in nearly parallel rows, now mixing and then dividing, all passed through red, orange, lake, crimson, green, and purple tints; so that the appearance altogether over so great an extent of the heavens was exceedingly grand, particularly when contrasted with the cerulean sky, and its spangled constellations, in the southern portion of the hemisphere.

Aurora Borealis.

"At ten minutes before eight the aurora was in its greatest splendour. At five minutes before eight another luminous rainbow-like arch stretched across the heavens from the eastern point of the horizon, and displayed several prismatic colours while passing southward. Soon after eight a large dark space, in and near the horizon, presented itself several degrees on each side of the magnetic north, and the aurora, still far over the heavens, gradually diminished. At nine it again ascended, and wide columns rose from every part of its arch, and passed through the same colours as before-mentioned. Between nine and ten the magnetic needle, which in the early part of the evening stood at twenty-four degrees west of the true north, was disturbed, and receded upwards of half a degree northward, either by the influence of the aurora, or by a change of wind from north-east to south-west, and of course a change in its electrical state. At a quarter before eleven there was a grand display of about twelve or fourteen glowing columns from the aurora, several of which passed beyond the zenith, when a perfect red rainbow-like arch, ten degrees above the aurora, was visible. At eleven another bow three degrees and a half wide rose from the aurora, and passed through Aries, Cassiopeia, Ursa Minor, and the square of Ursa Major, until, reaching the zenith, it gradually disappeared. At half-past eleven the aurora again began to sink slowly, and did not rise afterwards. At five minutes before twelve, a large brilliant meteor, the only one observed through the night, passed under Ursa Major. At one o'clock A. M. the highest part of the aurora, about the magnetic north, had sunk to within six or seven degrees of the horizon; yet bright coruscations occasionally emanated from it till two, when the observations were discontinued, as no more interesting meteoric appearances were likely to occur."

Aurora Cumberland House.

The auroras observed, one at Cumberland House and another at Fort Enterprize, in North America, are described by Lieutenant Hood, in Captain Franklin's *Narrative*. The account of the former is as follows:—

"For the sake of perspicuity," says Mr Hood, "I shall describe the several parts of the aurora observed at Cumberland House, which I term *beams*, *flashes*, and *arches*. The *beams* are little conical pencils of light, ranged in parallel lines, with their pointed extremities towards the earth, generally in the direction of the dipping needle. The *flashes* seem to be scattered beams, approaching nearer to the earth, because they are similarly shaped, and infinitely larger. I have called them flashes, because their appearance is sudden, and seldom continues long. When the aurora first becomes visible, it is formed like a rainbow, the light of which is faint, and the motion of the beams undistinguishable. It is then in the horizon. As it approaches the zenith, it resolves itself at intervals into beams, which, by a quick undulating motion, project themselves into wreaths, afterwards fading away, and again brightening, without any visible expansion or concentration of matter. Numerous flashes are seen in different parts of the sky. That this mass, from its short distance above the earth, would appear like an *arch* to a person situated at the horizon, may be demonstrated by the rules of perspective, supposing its parts to be nearly equidistant from the earth. An undeniable proof of it, however, is afforded by the observations of the 6th and 7th of April, when the aurora, which filled the sky at Cumberland House, from the northern horizon to the zenith, with wreaths and flashes, assumed the shape of arches at some distance to the southward.

"But the aurora does not always make its first appearance as an arch. It sometimes rises from a confused mass of light in the east or west, and crosses the sky towards the opposite point, exhibiting wreaths of beams, or coronæ boreales, in its way. An arch, also, which is pale and uniform at the horizon, passes the zenith without displaying any irregularity or additional brilliancy; and we have seen three arches together very near the northern horizon, one of which exhibited beams, and even colours; but the other two were faint and uniform. On the 7th of April an *arch* was visible to the southward, exactly similar to that in the north, and it disappeared in fifteen minutes. It had probably passed the zenith before sunset. The motion of the whole body of aurora is from the northward to the southward, at angles not more than twenty degrees from the magnetic meridian. The centres of the arches were as often in the magnetic as in the true meridian.

Aurora Borealis.

"The *colours* do not seem to depend on the presence of any luminary, but to be generated by the motion of the beams, and then only when that motion is rapid, and the light brilliant. The lower extremities quiver with a *fiery red colour*, and the upper with *orange*. We once saw *violet* in the former. The number of auroræ visible in September was two, in October three, in November three, in December five, in January five, in February seven, in March sixteen, in April fifteen, and in May eleven. Calm and clear weather was the most favourable for observation; but it is discernible in cloudy weather, and through mists. We could not perceive that it affected the weather. The magnetic needle, in the open air, was disturbed by the aurora, whenever it approached the zenith. Its motion was not vibratory, as observed by Mr Dalton; and this was, perhaps, owing to the weight of the card attached to it. It moved slowly to the east or west of the magnetic meridian, and seldom recovered its original direction in less than eight or nine hours. The greatest extent of its aberration was 45′. A delicate electrometer, suspended at the height of fifty feet from the ground, was never perceptibly affected by the aurora; nor could we distinguish its rustling noise, of which, however, such strong testimony has been given to us, that no doubt can remain of the fact."

Aurora of Fort Enterprise.

The account of the aurora observed at Fort Enterprize is also interesting and instructive with reference to the theory of the phenomenon.

"The shapes of the aurora observed at Fort Enterprize, at its entry into the horizon, and progress through the sky, may be reduced under two general descriptions. In the first I shall class those which are formed like rainbows or arches in the earliest stage of their appearance. They rise with their centres sometimes in the magnetic meridian, and sometimes several degrees to the eastward or westward of it. The number visible at the same time seldom exceeds five, and is seldom limited to one. The altitude of the lowest, when first seen, is never less than four degrees. As they advance towards the zenith, their centres (or the parts most elevated) preserve a course nearly in the magnetic meridian, or parallel to it. But the eastern and western extremities vary their respective distances, and the arches become irregularly broad streams in the zenith, each dividing the sky into two unequal parts, but never crossing one another till they separate into parts. Those arches which were bright at the horizon increase their brilliancy in the zenith, and discover the beams of which they are composed when the interior motion is rapid. This interior motion is a sudden glow, not proceeding from any visible concentration of matter, but bursting out in several parts of the arch, as if an ignition of combustible matter had taken place, and spreading itself rapidly towards each extremity. In this motion the beams are formed, such as are described in the preceding observations upon the subject. They have two motions; one at right angles to their length or sideways; and the other a tremulous

Aurora Borealis.

and short vibration, in which they do not exactly preserve their parallelism to each other. By the first they project themselves into wreaths, serpentine forms, or irregular broken curves. The wreaths, when in the zenith, present the appearance of coronæ boreales. The second motion is always accompanied with colours; for it must be observed, that beams are often formed without any exhibition of colours; and I have not, in that case, perceived the vibratory motion. The beams, in different auroræ, and sometimes in the same, are of different magnitudes, arising, probably, from their various distances. These evolutions, often repeated, destroy the shape and coherence of the several arches, though they doubtless retain the arched appearance to the eye of a spectator at the southern horizon; for it would be absurd to suppose that these changes occur only in the zenith of one particular place. The observations at different places in 1820 afford satisfactory proof to the contrary; and the number of arches often increased or diminished in their advance to the zenith, by a dismemberment of which, from their distance, we could not distinguish the particulars. However, their several parts passed gradually to the southward, where they assumed the form of an arch. They are also sometimes distributed into flashes, and other detached portions, which pass to the south-eastward. The revolution of an arch from north to south occupies a space of time varying from twenty minutes to two hours. At Cumberland House, the arches were in many instances almost stationary for several hours, a proof that if their motion was not slower, their distance from the earth was greater, than at Fort Enterprize. The arches, which are faint at the horizon, very frequently pass the zenith without any increase of brilliancy or apparent internal motion.

"The second general class of auroræ are those which propagate themselves from different points of the compass, between north and west towards the opposite points; sometimes also originating in the south-east quarter, and extending themselves towards the north-west. They may be subdivided, like the former, into the distant arches which pass to the southward without much visible change in their appearance, and those which discover beams, and separate at intervals into wreaths, flashes, and irregular segments, exhibiting all the phenomena described above. In explaining the mode by which the two general classes of auroræ are conducted into the horizon, I shall call the motion of the arches, which is in a plane seldom deviating more than two points from the magnetic meridian, the direct motion; and that by which the auroræ propagate themselves nearly at right angles to the magnetic meridian, the lateral motion. Let us suppose a mass of auroræ to be modelled at its birth in a longitudinal form, crossing the meridians at various angles, the whole to be impelled with a direct motion towards the magnetic south, but the parts having different velocities, and each extremity continually removing itself by a lateral motion from the centre, so as to increase the length of the mass. If the centre enter the northern horizon, it will appear like an arch, the real extremities being invisible; and its direct motion will carry it to the southward in that form. But if one extremity first enter the horizon, it will extend itself by its lateral motion to the opposite point, passing, at the same time, by its direct motion to the southward. Of the unequal velocities of the parts, we had many instances, in the direct motion of the arches, by which the centres were often carried from the zenith sixty or seventy degrees to the southward, while the extremities did not materially alter their positions. Nor can this be accounted for by any application of the rules of perspective, because arches exactly similar sometimes changed the bearings of their extremities in proportion to the advance of their centres; and at Cumberland House, on two occasions, the extremities of arches arrived at the east and west points of the compass, while their centres remained only ten degrees above the northern horizon."

Aurora Borealis.

It was for a long time matter of doubt whether this meteor made its appearance only in the northern hemisphere, or whether it was also to be observed near the south pole. But the occurrence of the aurora in the antarctic regions was clearly ascertained by Mr Forster, who, in his voyage round the world with Captain Cook, observed it in the high southern latitudes, though with phenomena somewhat different from those which are seen here. On the 17th February 1773, when the navigators were in latitude 58° south, "a beautiful phenomenon was observed," says Mr Forster, "during the preceding night, which appeared again this and several following nights. It consisted of long columns of a clear white light, shooting up from the horizon to the eastward, almost to the zenith, and gradually spreading on the whole southern part of the sky. These columns were sometimes bent sidewise at their upper extremities; and though in most respects similar to the northern lights (*aurora borealis*) of our hemisphere, yet differed from them in being always of a whitish colour, whereas ours assume various tints, especially those of a fiery and purple hue. The sky was generally clear when they appeared, and the air sharp and cold, the thermometer standing at the freezing point." The accounts of subsequent navigators, particularly Weddell, though given more in detail, differ in no material respect from that just quoted, and therefore need not be cited at length. They prove that this splendid meteor is not confined to the northern, but occurs also in the southern regions of the globe, though with considerable diversity in the accompanying phenomena.

Aurora Australis.

Colour.—The colours of the polar lights are of various tints. The *rays* or *beams* are steel gray, yellowish gray, pea-green, celandine green, gold yellow, violet blue, purple, sometimes rose red, crimson red, blood red, greenish red, orange red, and lake red. Some of the beams appear as if tinged with black, and resemble dense columns of smoke. The *arches* are sometimes nearly black, passing into violet blue, gray, gold yellow, or white bounded by an edge of yellow. The colours are also sometimes vivid and prismatic. Maupertuis describes a very remarkable red-coloured polar light which he saw at Oswer Zornea on the 18th December 1786. An extensive region of the heavens towards the south appeared tinged of so lively a red, that the whole constellation Orion seemed as if dyed in blood. The light was for some time fixed, but soon became movable; and after having successively assumed all the tints of violet and blue, it formed a dome, of which the summit approached the zenith in the south-west. Its splendour was so great as to be in no degree affected by the bright light of the moon. Maupertuis adds, that he observed only two of these northern lights in Lapland, which are of very rare occurrence in that country, although the aurora there assumes a great variety of tints; hence they are considered by the natives as of portentous omen, and as the forerunner of some great calamity. These red-coloured polar lights have of late years been observed in the Shetland Islands; in many parts of Scotland, as in the neighbourhood of Edinburgh; and in England, from its northern to its southern extremity.

Lustre of the Polar Lights.—The lustre varies in kind as well as intensity. Sometimes it is pearly, sometimes imperfectly vitreous, sometimes also metallic. Its degree of intensity varies from a very faint radiance to a light nearly equalling that of the moon.

Progressive Motions.—The reverend James Farquharson states that "the aurora borealis follows a determinate order

Aurora Borealis.

in its appearance and progress; that the streamers or beams generally appear first in the north, forming an arch from east to west, having its vertex at the line of the magnetic meridian; that when this arch is yet only of low elevation, it is of considerable breadth from north to south, having the streamers of which it is composed placed crossways in relation to its own line, and all directed towards a point a little south of the zenith; that the arch *moves forward towards the south,* contracting its lateral dimensions as it approaches the zenith, and increasing in intensity of light by the shortening of the streamers near the magnetic meridian and the gradual shifting of the angles which the streamers near the east and west extremities of the arch make with its own line, till at length these streamers become parallel to that line, and then the arch is seen as a narrow belt, 3° or 4° only in breadth, extending across the zenith at right angles to the magnetic meridian; that it still makes progress southwards; and, after it has reached several degrees south of the zenith, again enlarges in breadth, by exhibiting an order of appearances the reverse of that which had attended its progress towards the zenith from the north; and that the only conditions which can explain these appearances are, that the streamers of the aurora are vertical, or nearly so, and form a deep fringe or arch, which stretches a great way from east to west at right angles to the magnetic meridian, but which is of no great thickness from north to south; and that the arch moves southward, preserving its direction at right angles to the magnetic meridian." The same gentleman elsewhere remarks, that "the whole lights in the north part of the sky made a rapid progress southward; and the manner of this progress was repeatedly finely exhibited in the fringes and fragments that had reached or passed the zenith, by the extinction of streamers at their northern faces, and the formation of new ones at their southern faces. The advanced southern fringe expired when it had reached about 25° south of the zenith; and all did so, either when they attained a similar angle south, or before they had gone so far. The confused mass of streamers in the north, as they came forward in succession to the zenith, and passed that point, unfolded themselves into narrow zones of light at right angles to the magnetic meridian, or very nearly so; for there was occasionally a small deviation from parallelism among themselves. The zones were more numerous than usual, and were separated from each other by less intervals, sometimes not exceeding 3° or 4°, sometimes, however, 15° or 20°." (*Edinb. Phil. Mag.*)

Height of the Polar Lights.—Opinions differ as to the elevation of the aurora borealis above the surface of the earth, which is a point that can be determined only by a series of accurate observations. Dr Halley observed that the aurora described by him rose to a prodigious height, it being seen from the west of Ireland to the confines of Russia and Poland on the east, nor did he know how much farther it might have been visible; so that it extended at least 30 degrees in longitude, and from latitude 50 degrees N. it was seen over all the northern part of Europe; and, what was very surprising, in all those places where it was visible, the same general appearances were exhibited which Dr Halley noticed at London. But he observes, with seeming regret, that he could by no means determine its height for want of observations made at different places; otherwise he might easily have calculated the height of the aurora, as he did that of the luminous ball of 1719. Father Boscovich, says he, determined the height of an aurora borealis, observed on the 16th of December 1737 by the Marquis of Poleni, to have been 825 miles; Bergmann, from a mean of thirty computations, makes the average height of the aurora borealis to be 70 Swedish or upwards of 460 English miles; Euler supposes it to be several thousands of miles in height; and Mairan also assigns it a very elevated region. In the 74th volume of the *Philosophical Transactions* Dr Blagden, speaking of the height of some fiery meteors, remarks that the "aurora borealis appears to occupy as high if not a higher region above the surface of the earth, as may be judged from the very distant countries to which it has been visible at the same time." On the 22d October 1804 it is said that the same polar light was seen at the same time in Saxony and in Liefland. Mr Dalton of Manchester, in a paper read to the Royal Society of London on the 17th April 1828, describes a polar light which he observed on the 29th March 1826, assuming the form of a regular arch at right angles to the magnetic meridian, and continuing for above an hour in the same position; thus affording a favourable opportunity for obtaining the data requisite for determining its height. He took great pains to collect as many authentic accounts as possible of the apparent position of this luminous arch with reference to the stars, when seen from various places where it had been observed in England and in Scotland. And according to Mr Dalton's view of the distribution of the meteor, it appears to have been seen in places 170 miles distant from one another in a north and south direction, and 45 miles distant from east to west, thus comprising an area of 7000 or 8000 square miles; but it must have been visible over a much greater extent. Accounts were received of its having been seen as far north as Edinburgh, and as far south as Manchester and Doncaster, and at most of the intermediate towns. From the exact correspondence of the descriptions at all these places, it was inferred that they referred to the same individual luminous appearance. In proceeding from north to south, the apparent altitude of the arch continually increased, still keeping the south of the zenith to the distance of Kendal, at which place it very nearly crossed the zenith. At Warrington, which is farther south, the culminating point of the arch was north of the zenith; and, wherever seen, the arch always seemed to terminate nearly in the magnetic east and west, at two opposite points of the horizon. The observations in which the author placed the greatest confidence for determining the height of the aurora were those made at Whitehaven and at Warrington, places which are distant 83 miles from each other, and situated nearly on the same magnetic meridian. Calculating from the data they afford, he found the height of the arch very nearly 100 miles above the surface of the earth, and immediately over the towns of Kendal and Kirkby-Stephen. This conclusion is countenanced by observations made at Jedburgh; yet if the former be compared with those at Edinburgh, the height will come out to be 150 or 160 miles, and the position vertical above Carlisle; but he thinks the former result more entitled to confidence. Assuming the height to be 100 miles, it follows that the breadth of the arch would be eight or nine miles; and its visible length, in an easterly and westerly direction from any one place, would be about 550 miles.

But we are disposed to reject these calculations of Dalton, because from the particular details in his memoirs, and the known distribution of the auroræ, it is highly probable that the auroræ said by him to have been seen at the same time at great distances were different auroræ, and then not much elevated above the clouds. Indeed Mr Farquharson, in the *Philosophical Transactions*, part i. 1829, when discussing the value of Mr Dalton's observations, thinks that the observations made from Edinburgh to Warrington might be explained on the supposition that there were several nearly vertical arches of the aurora, almost contemporaneously hanging over many lines from Edin-

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burgh to Warrington, at a few thousand feet above the surface. The observations of Dr Richardson, Captain Franklin, Lieutenant Hood, and others, render it highly probable that many polar lights occur at heights not higher than the region of clouds. Dr Richardson's observations seem to show that the aurora is occasionally seated in a region of the atmosphere, below a kind of cloud which is known to possess no great altitude, namely, that modification of cirro-stratus which, descending low in the atmosphere, produces a hazy sheet of cloud over-head, or a fog-bank in the horizon. Indeed Dr Richardson is inclined to infer that the aurora borealis is constantly accompanied by, or immediately precedes, the formation of one or other of the forms of cirro-stratus. On the 13th of November and 18th December 1826, at Fort Enterprize, its connection with a cloud intermediate between cirrus and cirro-stratus is mentioned; but the most vivid coruscations of the aurora were observed when there were only a few thin attenuated shoots of cirro-stratus floating in the air, or when that cloud was so rare that its existence was only known by the production of a halo round the moon. The natives of the arctic regions of North America pretend to foretell wind by the rapidity of the motions of the aurora; and they say, that when it spreads over the sky in a uniform sheet of light, it is followed by fine weather, and that the changes thus indicated are more or less speedy, according as the appearance of the meteor is early or late in the evening; an opinion not improbable, when it is recollected that certain kinds of cirro-stratus are also regarded by meteorologists as sure indications of rain and wind. Dr Richardson frequently observed the lower surface of nebulous masses illuminated by polar lights; a fact illustrative of the comparatively low situation of these auroræ. Biot, also, in the island of Unst, observed many auroræ that could not be higher than the region of clouds. Captain Franklin in like manner observed low auroræ. "The important fact," says he, "of the existence of the aurora at a less elevation than that of dense clouds was evinced on two or three occasions this night (13th February 1821, at Fort Enterprize), and particularly at 11 hours 50 min., when a brilliant mass of light, variegated with the prismatic colours, passed between an uniform steady dense cloud and the earth, and in its progress completely concealed that portion of the cloud which the stream of light covered, until the coruscation had passed over it, when the cloud appeared as before." Captain Parry, as stated in his third voyage, observed auroræ near to the earth's surface. It is said that while Lieutenants Scherer and Ross and Captain Parry were admiring the extreme beauty of a polar light, they all simultaneously uttered an exclamation of surprise at seeing a bright ray of the aurora shoot suddenly downward from the general mass of light, and between them and the land, which was only three thousand yards distant. The ray or beam of the polar light thus passed within a distance of three thousand yards, or less than two miles, of them. Further, Mr Farquharson observed in Aberdeenshire an aurora borealis not more than four thousand feet above the level of the sea; and he agrees with Richardson, Franklin, &c., in believing that the auroræ occur in a region immediately above that of the clouds, and of course vary in height with the different states of the atmosphere. But although this region was very low on the 20th December 1829, in the polar light seen from Alford, we know that at times it is several miles high, agreeing with the observations of these intelligent travellers. We have frequently seen the aurora when the height of the clouds could not be estimated at less than two or three miles, and at other times not higher than a thousand or fifteen hundred feet.

Position of the Polar Lights.—The arches of the polar lights generally cross the magnetic meridian at right angles; when two or more appear at once tney are concentric, and tend to the magnetic east and west. The beams or streamers in the direction of their length coincide with the plane of the dip of the needle, or nearly so; and each individual streamer is, in fact, parallel to the dipping needle. Dr Richardson thinks he has observed a polarity in the masses of cloud belonging to a certain kind of cirro-stratus approaching to cirrus, by which their long diameters, having all the same direction, were made to cross the magnetic meridian nearly at right angles. But the apparent convergence of such masses of cloud towards the opposite points of the horizon, which have been so frequently noticed by meteorologists, is an optical deception, produced when they are situated in a plane parallel to that on which the observer stands. These circumstances, says Dr Richardson, are here noticed, because, if it shall hereafter be proved that the aurora depends upon the existence of certain clouds, its apparent polarity may perhaps, with more propriety, be ascribed to the clouds themselves which emit the light; or, in other words, the clouds may assume their peculiar arrangement through the operation of one cause (magnetism, for example), while the emission of light may be produced by another, namely, a change in their internal constitution, perhaps connected with a motion of the electrical fluid.

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Magnetic Property of the Polar Lights.—Many years ago philosophers remarked that the magnetic needle was agitated during polar lights; and hence it was inferred that these lights were somehow connected with magnetism. Other observers, again, maintained that these observations must be erroneous, as they could not in any instance perceive the compass affected by the presence of this meteor. But the late observations, of Biot, Hansteen, Gay-Lussac, Kupfer, and particularly of Richardson, Franklin, and Farquharson, have demonstrated that the magnetic needle is affected by the polar lights. As the fact is one of the most curious in meteorology, we shall now state some particulars illustrative of its nature. In Captain Franklin's observations, the horizontal compass was placed in a firm sheltered stand, fixed to the back wall of the house at Fort Enterprize, three feet above the ground, on a northern exposure; and the dipping needle was similarly fixed to the end of the storehouse, at the distance of forty feet. There was no iron near either of them. The house stood on a sand-hill, and there were no large stones in its immediate neighbourhood. The horizontal compass belonged to a small variation transit made by Dollond; and its graduated scale, of one and a half inch radius, was divided into degrees, the degrees counting from north towards west to 360. Each degree was subdivided into 20, and, by the assistance of a magnifying glass, he could read it off accurately to within three minutes. The horizontal position was preserved by means of a spirit-level attached to the instrument.

Action of the polar lights on the compass.

The manner in which the needle is affected by the aurora will require some description. "The motion communicated to it," says Captain Franklin, "was neither sudden nor vibratory. Sometimes it was simultaneous with the formation of arches, prolongation of beams, or certain other changes of form or action of the aurora. But generally the effect of these phenomena upon the needle was not visible immediately, but in about half an hour or an hour the needle had attained its maximum of deviation. From this its return to its former position was very gradual, seldom regaining it before the following morning, and frequently not until the afternoon, unless it was expedited by another arch of the aurora operating in a direction different from the former one.

"The *arches* of the aurora," he adds, "most commonly traverse the sky nearly at right angles to the magnetic

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meridian, but the deviations from this direction, as has been already stated, were not rare; and I am inclined to consider that these different positions of the aurora have considerable influence upon the direction of the needle. When an arch was nearly at right angles to the magnetic meridian, the motion of the needle was towards the west; this westward motion was still greater when one extremity of an arch bore 301°, or about 59° to the west of the magnetic north, that is, when the extremity of the arch approached from the west towards the magnetic north. A westerly motion also took place when the extremity of an arch was in the true north, or about 36° to the west of the magnetic north, but not in so great a degree as when its bearing was about 301°. A contrary effect was produced when the same end of an arch originated to the southward of the magnetic west, viz. when it bore from about 245° to 234°, and, of course, when its opposite extremity approached nearer to the magnetic north. In these cases the motion of the needle was towards the east. In one instance only a complete arch was formed in the magnetic meridian; in another, the beam shot up from the magnetic north to the zenith; and in both these cases the needle moved towards the west.

"The needle was most disturbed on February 13, P. M., at a time when the aurora was most distinctly seen passing between a stratum of clouds and the earth, or at least illuminating the face of the clouds opposed to the observer. This and several other appearances induced me to infer that the distance of the aurora from the earth varied on different nights, and produced a proportionate effect on the needle. When the light shone through a dense hazy atmosphere, when there was a halo round the moon, or when a small snow was falling, the disturbance was generally considerable; and on certain hazy cloudy nights the needle frequently deviated in a considerable degree, although the aurora was not visible at the time. Our observations do not enable us to decide whether this ought to be attributed to an aurora concealed by a cloud or haze, or entirely to the state of the atmosphere. Similar deviations have been observed in the day-time, both in a clear and cloudy state of the sky, but more frequently in the latter case. Upon one occasion the aurora was seen immediately after sunset, whilst bright day-light was remaining. A circumstance to which I attach some importance must not be omitted. Clouds have been sometimes observed during the day to assume the forms of the aurora, and I am inclined to connect with the appearance of these clouds the deviation of the needle, which was occasionally remarked at such times. An aurora sometimes approached the zenith without producing any change in the position of the needle, as was more generally the case; whilst at other times a considerable alteration took place although the beams or arches did not come near the zenith. The aurora was frequently seen without producing any perceptible effect on the needle. At such times its appearance was that of an arch, or an horizontal stream of dense yellowish light, with little or no internal motion. The disturbance in the needle was not always proportionate to the agitation of the aurora, but it was always greater when the quick motion and vivid light were observed to take place in a hazy atmosphere. In a few instances, the motion of the needle was observed to commence at the instant a beam darted upwards from the horizon; and its former position was more quickly or slowly regained according to circumstances. If an arch was formed immediately afterwards, having its extremities placed on opposite sides of the magnetic north and south to the former one, the return of the needle was more speedy, and it generally went beyond the point from whence it first started."

A series of interesting observations on this subject were also made in December 1829, by the reverend James Farquharson, F. R. S., of Aberdeenshire, with an apparatus transmitted to him by the Royal Society of London. This apparatus consisted of a horizontal brass circle, about one foot in diameter, graduated to divisions of ten minutes, and capable of adjustment to a perfect level by means of spirit levels and screwed feet. Concentrically within this divided circle moved a circular horizontal brass plate, its edge touching the divisions, and having at opposite points two verniers, which, by means of attached microscopes, indicated the movements which it made to 60th parts of ten minutes, or 10″. The movement of the plate within the circle was effected by means of a screw. A circular brass needle-box was attached to the surface of the inner plate, and a vertical pointed steel wire for supporting the needle formed the centre. At opposite points in the needle-box were fixed two micrometers, with cross wires in the foci, for adjusting the needle to a level, and observing any change in its direction. The top of the needle-box was a circular plate of ground glass in a brass ring, made to slip easily off and on, and having screwed into its centre a vertical brass tube about eight inches long, for the purpose of suspending the needle with fibres of silk, for measuring the time of its oscillations. A horizontal brass pin, with a minute perforation for the silk near its middle, passed through the vertical tube near its top, and being contrived with several motions, served to adjust the suspended needle, and bring it correctly over the steel point, where its levelling could be completely ascertained. The magnetic needle itself was a rectangular plate about five inches long, half an inch broad, and $\frac{1}{40}$th of an inch thick. An agate cup set in brass admitted of being screwed in either at the narrow or flat side of the needle; and a little fixed ring of brass, with a minute perforation in its top, rising over the cup, admitted of the ready attachment of the silk; so that the needle could be placed on the steel point, or suspended with the silk, with its flat face either vertical or horizontal. This apparatus measured, with great accuracy, very minute changes in the declination of the needle, one so small as 10″ being quite sensible by it.

The observations made with this apparatus, and published in the *Transactions of the Royal Society of London* for 1830, also show, in a most satisfactory manner, that the magnetic needle is actually affected by the presence of the polar lights. They equally prove that the needle is not in every instance agitated by the polar lights, even when they are very brilliant; the oscillations taking place only when the beams or fringes of the meteor are in the same plane with the dip of the needle. But as the needle is affected in those planes only where the fringes or arches are in the plane just mentioned, it is evident that observers in different latitudes may obtain very discordant results in the same evening. The observations collected by Dalton, of the appearance of the aurora of the 29th March 1826, prove that many fringes or arches may be parallel to each other at remote distances; and the observations of the President of the Royal Society, on a luminous arch in Cornwall, 29th September 1828, which appeared simultaneously with a remarkable aurora of many arches extending over the whole of Aberdeenshire, show that the meteor is sometimes active over a space nearly coincident with the extent of the kingdom; and there is reason for believing that it often extends much farther. There might, therefore, be an extensive succession of observations of disturbance and non-disturbance of the needle at the same instant from north to south over many degrees of latitude.

Noises from the Aurora Borealis.—Having, many years ago, both in this country and in the Shetland Islands, heard very distinctly noises proceeding from the polar lights, we

have always given full credit to the statements of those observers who have published accounts of this fact. It is true that late observers, as Scoresby,[1] Richardson,[2] Franklin, Parry, and Hood, never heard such noises, although they do not deny that they may have been heard. Thus Richardson says, "I have never heard any sound that could be unequivocally considered as originating in the aurora; but the uniform testimony of the natives, both Crees and Copper Indians, and Esquimaux, and of all the older residents in the country, induces me to believe that its motions are sometimes audible." Captain Franklin says, "I have not heard the noise ascribed to the aurora, but the uniform testimony of the natives and of the residents in this country induces me to believe that it is occasionally audible." Parry frequently listened for sounds from the polar lights, but never heard any. Lieutenant Hood says (Franklin's *Narrative*, p. 535), "We repeatedly heard a hissing noise, like that of a musket bullet passing through the air, which seemed to proceed from the aurora; but Mr Wentzel assured us that this noise was occasioned by severe cold succeeding mild weather, and acting upon the surface of the snow previously melted in the sun's rays. The temperature of the air was then — 35°, and on the two preceding days it had been above zero. The next morning it was — 42°, and we frequently heard a similar noise. Mr Hearn's description of the noise of the aurora agrees exactly with Mr Wentzel's, and with that of every other person who heard it. It would be an absurd scepticism to doubt the fact any longer, for our observations have rather increased than diminished the probability of it." Muschenbroeck says that the Greenland fishers in his time assured him that they had frequently heard noises proceeding from the aurora borealis. Mr Nairne is confident that he has heard a hissing and whizzing noise when the polar lights were very bright; and Mr Cavallo affirms that he more than once heard a crackling noise from polar lights. Giesecké, who resided so long in West or Old Greenland, says, "the polar lights sometimes appear very low, and then they are much agitated, and a crashing and crackling sound is heard, like that of an electric spark, or the falling of hail." Professor Parrot of Dorpat describes a magnificent polar light he witnessed on the 22d October 1804, from which a crackling and rustling noise proceeded. "We learn from the inhabitants," says Captain Brooke, in his interesting travels through Norway, "with respect to the polar or northern lights, that they had frequently heard the noise that sometimes attends them, which they describe like that of a rushing wind. At Hammerfest they said they were violent, and descended so low that it would appear almost possible to touch them." In a letter from Mr Ramm of Tonset in Norway, addressed to Professor Hansteen, and published in the *Magazin fur Naturwidenskaberne*, Christiana, 1825, we are told that he several times heard a quick whispering noise simultaneously with the motion of the beams of the polar lights. In the same journal, Professor Hansteen says, "The polar regions being in reality the native country of the polar light, we ought to be particularly interested in obtaining any additional information on the natural history of this remarkable phenomenon; and we have so many certain accounts of the noise attending it, that the negative experience of southern nations cannot be brought in opposition to our positive knowledge. Unfortunately, we live, since the beginning of this century, in one of the great pauses of this phenomenon; so that the present generation knows but little of it from personal observation. It would therefore be very agreeable to receive, from older people, observations of this kind, made in their youth, when the aurora borealis showed itself in full splendour. It can be proved mathematically that the rays of the northern lights ascend from the surface of the earth, in a direction inclining towards the south (an inclination which, with us, forms an angle of about 73°). If, then, this light occupies the whole northern sky, rising more than 17° above the zenith, the rays must proceed from under the feet of the observer, although they do not receive their reflecting power till they have reached a considerable elevation, perhaps beyond our atmosphere. It is therefore conceivable why we should frequently hear a noise attending the northern lights, when the inhabitants of southern countries, who see the phenomenon at a distance of many hundred miles, hear no report whatever. Wargentin, in the fifteenth volume of the *Transactions of the Swedish Academy*, says, that Dr Gisler and Mr Hellant, who had resided for some time in the north of Sweden, made, at the request of the academy, a report of their observations on the aurora borealis." To these observations Professor Hansteen adds, that Captain Abrahamson, in the *Transactions of the Scandinavian Literary Society*, has given an account of several observations of noises that were heard proceeding from the northern lights. The professor concludes with stating that he himself knows several persons who have distinctly heard the same sounds; he expresses his surprise that a fact so well established should be called in question; and he relates, with some sharpness, a conversation he once had on this subject with an Englishman, who remarked that the Norwegian tales of noises proceeding from polar lights were akin to the ghost stories of this country.

Theory of the Aurora Borealis.—The theory of this phenomenon is involved in the copious details which have been given under the different foregoing heads; and, indeed, from all that is known, it appears reasonable to infer that it is intimately connected with electricity and magnetism. "The aurora borealis," says Dr Young, "is certainly in some measure a magnetical phenomenon; and if iron were the only substance capable of exhibiting magnetic effects, it would follow that some ferruginous particles must exist in the upper regions of the atmosphere. The *light* usually attending this magnetical meteor may possibly be derived from electricity, which may be the immediate cause of a change in the distribution of the magnetic fluid contained in the ferruginous vapours which are imagined to float in the air." (*Lectures*, vol. i. p. 687.) This assumption of ferruginous particles or vapours, however, seems purely gratuitous and imaginary; and as iron is not the only substance or matter capable of exhibiting magnetic effects, light itself being susceptible of polarization, the above hypothesis is therefore untenable even on the ground on which it has been rested by its author. But it is nevertheless certain that the cause of this luminous meteor is intimately connected with magnetism and electricity; or rather, as the magnetic is variously modified and affected by the electric power, with the phenomena of electro-magnetism. "It is doubtful," says Dr Young in another place, "whether the light of the aurora borealis may not be of an electric nature; the phenomenon is certainly connected with the general cause of magnetism:" and he refers in support of this opinion to the ascertained fact that the primitive beams or rays of light are constantly observed in a direction parallel to that of the dipping needle; adding, that "although the substance be magnetical, the illumination which renders it visible may still be derived from the passage of electricity,

[1] *Arctic Regions, and Journal of a Voyage to the Northern Whale Fishery.*
[2] Remarks on the Aurora Borealis, in Franklin and Richardson's *Journey to the Shores of the Polar Sea.*

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at too great a distance to be discovered by any other test." (*Lectures*, vol. i. p. 716.) The fact is, that in magnetism, the agency of electricity is now clearly made out, and they are shown to stand to each other in the relation of effect and cause, at least in as far as that all the phenomena of magnetism are producible by electricity; but no electric phenomena have ever been hitherto produced by magnetism. (Herschel's *Preliminary Discourse*, p. 93.) Hence the aurora "is certainly connected with the general cause of magnetism," in as far as it is a joint result or effect of the cause by which it is now known that all the phenomena of magnetism are producible; but this connection is one of relation or coincidence merely; and hence it is to the agency of electricity that the phenomena of the aurora are primarily to be ascribed. "This wonderful agent," says Mr Herschel, "which we see in intense activity in lightning, and in a feebler and more diffused form traversing the upper regions of the atmosphere in the northern lights, is present, probably in immense abundance, in every form of matter which surrounds us, but becomes sensible only when disturbed by excitements of peculiar kinds." (*Prelim. Discourse*, p. 329, 330.) Mr Canton, likewise, conceives that the aurora is occasioned by the rapid transition or passage of electrical matter from positive towards negative clouds, throughout the upper region of the atmosphere, where the resistance is the least; but he supposes that the aurora which appears at the time when the magnetic needle is disturbed is not the cause of this disturbance, which he attributes to the heat of the earth, and that it is merely the electricity of the heated air above, disengaged chiefly in the northern regions, where the alteration in the temperature of the air is greatest. Be this as it may, however, the experiment contrived by Mr Canton shows clearly that the phenomena of the aurora are intimately connected with, or rather consequent on, a particular constitution of the atmosphere in regard to density and electricity. If, for example, a glass tube about three feet in length be partially exhausted of air, hermetically sealed, and then applied longitudinally to the prime conductor of an electrical machine, the whole tube will be illuminated from end to end, and this illumination will continue for a considerable time after it has been removed from the conductor. If, again, the tube be drawn through the hand either way, the light will become remarkably intense throughout its whole length; and although a great part of the electricity will be discharged by this operation, the tube will nevertheless emit flashes at intervals, if held by one extremity and kept quite steady; while, if grasped by the other hand at a different place, vivid flashes of light will dart from one end to the other, and continue to be emitted for a considerable time without any fresh excitation. It is to be observed, however, that if the density of the air included in the tube be either increased or diminished beyond a certain limit, none of these luminous appearances will be exhibited; and it is this circumstance which shows that the phenomena of the aurora depend on a certain constitution of the atmosphere in point of density and electricity, and that the meteoric appearances or coruscations can never attain the elevation ascribed to them by some philosophers, but must in every case be confined within the limits of our atmosphere, conformably to the observations of Biot and others already detailed. Beccaria, indeed, conjectures that there is a constant and regular circulation of the electric fluid from north to south; and he gives it as his opinion that the aurora borealis is this electric matter performing its transit southwards, in a state of the atmosphere which renders it visible, or approaching nearer than usual to the earth. But such a transition or circulation as that here suggested could only be produced by the diurnal revolution of the earth round its axis; and as the meteor is observed in the southern with nearly the same appearances as in the northern hemisphere, there must consequently be a circulation from south to north as well as from north to south; in other words, if there be any such tendency as that which Beccaria supposes, it must proceed equally or nearly so from both poles towards the equator. The following is a list of the most important papers, treatises, and works on this subject: *Berlin Mem.* 1710, i. 131; Halley, *Phil. Trans.* 1716, 1719, xxix. 406, xxx. 584; Hearne, *Phil. Trans.* xxx. 1107; Langworth, Huxham, Hallet, and Callendrini, *Phil. Trans.* xxxiv. 132, 150; Maier, *C. Petr.* iv. 121; Mairan, *Traité de l'Aurore Boréale*, 1733, 1754; Weidler, *de Aurora Boreali*, 4; Wargentin, *Phil. Trans.* 1751, p. 126, and *History*, 1752, p. 169, 1753, p. 85; Bergmann, *Schw. Abh.* 200, 251; Wiedeburg, *über die Nordlichter*, 8, Jena, 1771; Hüpsch, *Untersuchung des Nordlichts*, 8, Cologne, 1778; Van Swinden, *Recueil de Mémoires*, Hague, 1784; Cavallo, *Phil. Trans.* 1781, p. 329; *E. M. Physique*, art. Aurore Boréale; Wilke *von den Neuesten Erhlärungen des Nordlichts*, Schwedisches Mus. 8, Wismar, 1783; Hey, Wollaston, Hutchinson, Franklin, Pigott, and Cavendish, *Phil. Trans.* 1790, pp. 32, 47, 101; Dalton's *Meteorological Observations*, 1793, p. 54, 153; Chiminello *on a Luminous Arch*, Soc. Ital. vii. 153; Ritter *on the Lunar Periods of the Aurora*, Gilb xv. 206. (R. J.)

Aurum Coronarium ‖ Ausenses.

AURUM CORONARIUM, in *Roman Antiquity*, a present of money collected in the provinces for a victorious general, which was originally expended for a golden crown (Cic. *Leg. Agr.* ii. 22). The number of crowns sent to a general was sometimes very great. (Liv. xxxix. 7.)

AURUM MUSIVUM, or MOSAICUM, the old name for the bisulphuret of tin. See CHEMISTRY.

AURUNGABAD, a city of Hindostan, in the native state of Hyderabad, or dominions of the Nizam. It was founded about the year 1620 under the name of Gurka, by Mallik Amber, an Abyssinian who had risen from the condition of a slave, to great influence and command. Subsequently it became the capital of the Mogul conquests in the S. of India; and in the time of Aurungzebe, who made it the seat of government during his viceroyalty of the Deccan, it received the name of Aurungabad, and became the principal place of an extensive province of the same name, stretching westward to the sea, and comprehending nearly the whole of the territory now comprised within the British districts, constituting the northern division of the Presidency of Bombay. Aurungabad continued to be the capital of the succession of potentates bearing the modern title of Nizam, after those chiefs became independent of Delhi, until they quitted it for Hyderabad. The city has greatly fallen from its ancient grandeur. The interior is but half peopled, and in ruins, presenting melancholy appearances of desertion and decay. The population is, however, still considerable, and in the bazaar, which is very extensive, are exposed for sale various kinds of commodities, European and Indian, particularly silks and shawls. The walls are similar in their construction to those of all the other cities in this quarter in India, being rather low, with round towers. Distance from Poona 138 miles, from Bombay by Poona 207, from Hyderabad 270. Long. 75. 21. E. Lat. 19. 51. N. (E. T.)

AURUNGZEBE, the last of the eminent Mogul sovereigns of India. See INDIA.

AUSCULTATION (*auscultare*, to listen), among physicians, is a method of distinguishing internal diseases by observing the sounds in the different organs by means of a tube applied to the surface. See STETHOSCOPE.

AUSENSES (Αὐσεῖς), an ancient and very savage people of Libya. Herodotus tells us that they had all their women in common. The children were brought up by their mothers till they were able to walk; after which they were intro

Ausonia ‖ Australasia.

duced to an assembly of the men, who met every three months, and the man to whom any child first spoke acknowledged himself its father. They celebrated annually a feast in honour of Minerva, in which the girls, dividing into two companies, fought with sticks and stones, and those who died of their wounds were concluded not to have been virgins.

AUSONIA, an ancient name of Italy, so called from the Ausŏnes, who were likewise designated Aurunci.

AUSONIUS, Decimus Magnus, a Roman poet of the fourth century, was the son of an eminent physician, and born at Burdigăla (*Bordeaux*) about A.D. 300. His education was conducted with unusual care, either because his genius was very promising, or because the scheme of his nativity, which had been cast by his maternal grandfather, was found to promise great fame and advancement. He made extraordinary progress in classical learning; and after completing his studies at Toulouse, he practised for a time at the bar in his native place. At the age of 30 he became a teacher of grammar, and soon afterwards was promoted to be professor of rhetoric. In this office he acquired so great a reputation that he was appointed preceptor to Gratian, the Emperor Valentinian's son. The rewards and honours conferred on him for the faithful discharge of his duties, prove the truth of Juvenal's maxim,—that when fortune pleases she can raise a man from the humble rank of rhetorician to the dignity of consul. He was appointed consul by the Emperor Gratian in the year 379, after having filled other important offices; for besides the dignity of quæstor, to which he had been nominated by Valentinian, he was made præfect of Latium, of Libya, and of Gaul, after that prince's death. His speech returning thanks to Gratian on his promotion to the consulship, is highly commended. The time of his death is uncertain, but he was certainly alive in 388, and is said to have attained a great age. It has been supposed that he was a convert to Christianity. There is great inequality in his works. His manner and style are often harsh, and he is decidedly inferior to Claudian in Latinity and versification. The best edition of Ausonius' poems is the *Variorum* of Tollius, published in 8vo at Amsterdam in 1671.

AUSPEX, a name signifying "the observer of birds" for the purpose of ascertaining the will of the gods, and is synonymous with *augur*. The word is formed from *avis*, bird, and *inspicere*, to inspect. *Plin. Quæst. Rom.* c. 72.

Ausserhoden ‖ Australasia.

AUSSERHODEN, or Outer Rhodes, one of the districts of the canton of Appenzell, in Switzerland. See Appenzell.

AUSTEN, William, an eminent English artist of the fifteenth century, whose works in bronze are pronounced by Flaxman to equal in style the first Italian *Cinquecentists*. His best-known work, the magnificent tomb of Richard Earl of Warwick, who died in 1439, is in the Beauchamp chapel in that city. It is of gilt bronze, ornamented with many figures in a vigorous style, and displaying great knowledge of the human figure. It is inscribed as the work of "Willm. Austen, citizen and founder of London." See *Dugdale's Warwickshire*.

Austen, *Jane*, an elegant novelist of the present century, born in 1775 at Steventon in Hampshire, of which parish her father was the rector. Miss Austen was a lady of great personal attractions, and a most amiable disposition. Her six novels are pure and spirited delineations of domestic life, with that delicate discrimination of female character which few but of the gentler sex can adequately pourtray. "*Sense and Sensibility*," "*Pride and Prejudice*," "*Mansfield Park*," and "*Emma*," were published before her death; but "*Northanger Abbey*," and "*Persuasion*," were posthumous works. Miss Austen died at Winchester on the 24th of July 1817.

AUSTER, the south wind, or south-west wind, called *Notus*, Nóros, by the Greeks.

AUSTERLITZ, a small town of Moravia, 12 miles E.S.E. of Brunn. It has a magnificent palace belonging to the prince of Kaunitz-Rietberg, and contains 3300 inhabitants. It has been rendered memorable by the great victory obtained in its vicinity, on the 2d December 1805, by the French under Napoleon, over the united forces of Austria and Russia under their respective emperors.

AUSTLE, or Austell, St, a market-town in the hundred of Powder, county of Cornwall. It stands in a district rich in tin and copper mines, and abounding in clay used in the porcelain-clay works in the neighbourhood, as well as in the potteries of Staffordshire. There are also some manufactures of woollen cloths. The church is an ancient structure with a very fine tower and many curious sculptures. Market-day Friday. It is 243 miles from London, and 13 from Truro. Population of town in 1851, 3565.

AUSTRALASIA,

Introductory observations.

In modern geography, the *fifth* great division of the earth's surface.

The learned and intelligent President de Brosses was the first writer who suggested that all the lands and islands in the Austral world should be divided into three portions, corresponding with the three great oceans, the Indian or Ethiopic, the Atlantic, and the Pacific; those in the Indian Ocean and to the south of Asia to be named *Australasia;* those in the two Pacifics, from the multitude of islands, *Polynesia* (a name first used, we believe, by De Barros); and those in the Atlantic to the south of Cape Horn, and the Cape of Good Hope, *Magellanica*. The last, however, became unnecessary, as soon as it was ascertained that the *Terra Australis incognita* had no existence.

The two divisions of Australasia and Polynesia will be found to comprehend, with sufficient convenience, all those islands that cannot with propriety be referred to any of the four continents of the globe. Nor is there any difficulty in drawing a line of separation between these two divisions; though it is not quite so easy to mark the distinct boundary between the Australasian and the Asiatic islands, where they melt into each other, about the equator, at the N.W. extremity of Papua or New Guinea. In a geographical view, the small islands of Waygiou, Salwatty, Batanta, Mysol, and Timorlaut, ought strictly to belong to Australasia; but peopled as they are by Asiatics of the Malay tribe, and under the influence of the Dutch settlements, it may perhaps be more proper, in a moral and political point of view, to consider them as belonging to the Asiatic Islands; more particularly as we shall then have all the Australasian population with very few exceptions, marked with more or less of the African or Negro character. But, in fact, all geographical divisions are and must be to a certain degree arbitrary.

Boundaries.

If, then, we take the equator as the northern boundary from the 132° to the 175° of east longitude; continue a line on the latter meridian to the 55th parallel (bending a little to take in New Zealand) for the eastern; another line along the same parallel to the 65th degree of east longitude for the southern; and a slanting line to the point on the equator from which we set out, so as to include Kerguelen's Land, and pass on the eastern sides of Timorlaut, Ceram, Mysol, and Salwatty, for the western boundary; those lines

Plate C.

Australasia. will circumscribe the whole of the Australasian islands. We have included the uninhabited islands of Kerguelen and St Paul and Amsterdam, because they cannot properly be considered as African islands, though arranged, we believe, under that division by Pinkerton; they are of less importance to geography than to geology.

Australasia, then, may be subdivided into the following groups and islands:—

1. Australia, or New Holland.
2. Van Diemen's Land, or Tasmania.
3. New Guinea, and the Louisiade Archipelago.
4. New Britain, New Ireland, and neighbouring islands.
5. Solomon's Islands.
6. New Hebrides.
7. New Caledonia.
8. New Zealand, and isles to the southward.
9. Kerguelen's Islands, or Islands of Desolation.
10. St Paul and Amsterdam.
11. Numerous reefs and islets of coral scattered over the Australasian Sea.

Australia, or New Holland. I. The first attempt to explore this island, which, from its size, may be considered as the fifth continent of the earth, is unquestionably due to the Dutch; for although some part of the northern coast may have been seen by the early navigators of Spain and Portugal, there is no direct testimony in favour of such a discovery. There are two charts in the British Museum which belonged to the *Harleian Collection;* one French, without date, which was probably the original; and the other English, apparently a copy: the latter is dedicated to the king of England, and bears date 1542. In both of these charts is marked down an extensive tract of country to the southward of the Moluccas, under the name of *Great Java*, agreeing more nearly with the position and extent of New Holland than any other land. The form given to the N.W. part of the coast in these charts approaches nearest to the truth; a part, indeed, which may have been seen by those early navigators who visited the Moluccas long before the date of the English chart. It is a singular coincidence in geographical nomenclature, that, on the east coast of the French chart, something like a *Botany Bay* should be designated under the name of *Coste des Herbaiges.* The Abbé Prévost, in the *Histoire Générale des Voyages*, and the President de Brosses, in his *Histoire des Navigations aux Terres Australes*, are not very happy in advancing a claim in favour of Paulovier de Gonneville, a French captain, to the discovery of this *Terra Australis* in 1504. It was the coast of Madagascar upon which Gonneville was driven, as is evident by their own accounts.

Progress of discovery.

The best and most authentic abstract of the Dutch discoveries on the coasts of New Holland is contained in the instructions given by the governor-general of Batavia to Commodore Abel Jansen Tasman, and published by Mr Dalrymple in his *Collection concerning Papua.* From this document it appears that the Dutch government of Bantam in 1605 despatched the Duyfhen yacht to explore the islands of New Guinea. Returning to the southward along the islands on the northern side of Torres Strait, she came to that part of the *Great South Land* which is now called Cape York; but all these lands were then thought to be connected, and to form the southern coast of New Guinea. "Thus," says Captain Flinders, "without being conscious of it, the commander of the Duyfhen made the first authenticated discovery of any part of the *Great South Land*, about the month of March 1606." About the same place, and in the same year, Torres, a Spanish navigator, being second in command to Fernandez de Quiros, saw the *Terra Australis*, but had as little knowledge of the nature of his discovery as the commander of the Duyfhen. He passed the strait, however, which divides this *Terra Australis* from New Guinea, whose existence was not generally known till 1770, when it was rediscovered and passed by our great circumnavigator Captain Cook. Of this, and his other discoveries, Torres addressed an account to the king of Spain, and, as it afterwards appeared, had taken the precaution to lodge a copy of it in the archives of Manilla; for, when that city was surrendered to the British forces in 1762, Mr Dalrymple snatched from oblivion this interesting document of early discovery, and, as a just tribute to the enterprising Spanish navigator, he gave to this passage the name of *Torres Strait*, by which it is now universally known. Australasia.

In 1617 the Dutch sent a second expedition, but "with little success;" the journals of which were lost. In 1623, the yachts Pera and Arnheim were despatched from Amboyna, under the command of Jan Carstens, who, with eight of the Arnheim's crew, was treacherously murdered by the natives of New Guinea; but the vessels prosecuted the voyage, and discovered the great islands Arnheim and the Spult. The Arnheim returned to Amboyna; the Pera persisted, and ran along the west coast of New Guinea, as they thought, but in reality New Holland, to Cape Keer-weer or Turn-again, and from thence explored the coast farther southward, as far as 17°, to Staten River. "In this discovery were found everywhere shallow water and barren coasts, islands altogether thinly peopled by divers cruel, poor, and brutal nations; and of very little use to the (Dutch East India) Company."

The next expedition sent by the Dutch was from Banda in 1636, when Gerrit Tomaz Pool proceeded with the yachts Klein Amsterdam and Wesel, and nearly at the same place, on the coast of New Guinea, met the same fate which had befallen Carstens; but the supercargo, Pieterson, continued the voyage, and discovered the coast of Arnheim, or Van Diemen's Land, in 11° S., and sailed along the shore 120 miles, but without seeing any inhabitants.

Abel Jansen Tasman sailed on a second voyage of discovery from Batavia in 1644; but no account of this voyage was ever made public, nor is it known to exist. No chart bearing his name is now known, but there is little doubt that the N.W. coast of New Holland was first explored by him; and it is singular enough that Dampier should say he had Tasman's chart of it. Tasman is also supposed to have sailed round the Gulf of Carpentaria; an opinion which Captain Flinders considers to be strengthened, from the names of Tasman, of the governor-general, and of two of the council, who signed his instructions, being applied to places at the head of the gulf, as well as that of Maria, the governor's daughter, to whom Tasman is said to have been attached. Tasman had sailed, on a former voyage, from Batavia in 1642, for the Mauritius; whence steering south and eastward upon discovery, he fell in with land, to which he gave the name of *Anthony Van Diemen's Land*, in honour of the governor-general, "our master," he adds, "who sent us out to make discoveries."

The last voyage undertaken by the Dutch for the discovery of *Terra Australis* was in 1705, when three Dutch vessels were sent from Timor, "with orders to explore the north coast of New Holland better than it had been done before." The account, however, given by the President de Brosses is so vague and imperfect that very little satisfactory information is to be obtained from it. It is on the west coast that the Dutch appear to have been most successful. In Tasman's instructions it is stated, that "in the years 1616, 1618, 1619, and 1622, the west coast of this great *unknown* south land, from 35° to 22° south latitude, was discovered by outward-bound ships, and among them, by the ship *Endragt.*" Dirk Hartog commanded this ship, and seems to have made the coast in latitude about 26° 30′ S., and to have sailed northward along it to about 23°, giving the name of *Landt van Endragt* to the coast so discovered; and that of Dirk Hartog's Road (called afterwards *Shark's Bay* by Dampier) to an inlet on the coast a little to the southward of 25°. A plate of tin was found in 1697, and again seen by

Australasia. Baudin in 1801, on one of the islands which forms the roadstead, bearing an inscription that the ship Endragt of Amsterdam arrived there on the 25th October 1616. After this several outward-bound ships fell in by accident with different parts of this coast.

The Dutch made little progress in any other part of the extensive coasts of New Holland. The instructions to Tasman say, "In the year 1627 the south coast of the Great South Land was accidentally discovered by the ship the Guldee Zeepard, outward bound from Fatherland for the space of 1000 miles." From the circumstance of this ship having on board Pieter Nuyts, who was sent from Batavia as ambassador to Japan, and afterwards appointed governor of Formosa, the name of *Nuyts' Land* was given to this long range of coast.

The first English navigator who appears to have seen any part of New Holland is the celebrated William Dampier, who, in his buccaneering voyage round the world, in January 1686, touched at the N.W. coast, for the purposes of careening his vessel and procuring refreshments. He made the land in latitude 16° 15′, and ran along the shore to the N.E. till he came to a bay or opening fit for the purpose. In 1699 Dampier a second time visited the north-western coast of this *Terra Australis*, being now legitimately employed in making discovery in His Majesty's ship the Roebuck. Of this part of the coast little more is yet known than what has been described by Dampier, and that little is due to the exploration of Captain King.

It was left for our celebrated navigator Captain Cook to complete the grand outline of the fifth continent of the world. The reign of George III. will ever be distinguished for the liberal principles on which voyages of discovery were undertaken, and their results communicated to the world. The Endeavour was fitted out to observe, at Tahiti, the transit of Venus over the sun's disk; on her return, in 1770, Captain, then Lieutenant Cook, explored the whole E. coast of the *Terra Australis Incognita*, from Cape Howe to Cape York, not minutely entering into the details of every part, which would have been impossible, but laying down a correct general outline. "He reaped," says Captain Flinders, "the harvest of discovery; but the gleanings of the field remained to be gathered." In his passage through Endeavour Strait, between Cape York and the Prince of Wales' Islands, he not only cleared up the doubt which till then existed, of the actual separation of *Terra Australis* from *New Guinea*, but, by his accurate observations, enabled geographers to assign something like a true place to the former discoveries of the Dutch in these parts.

In 1777 Captain Cook, in the Resolution and Discovery, visited Van Diemen's Land; but as Captain Furneaux, in His Majesty's ship Adventure, had preceded him four years, and Tasman and Marion had examined the coast, little was here supposed to remain for discovery, except in detail. It was long subsequent to Furneaux's visit that Van Diemen's Land was ascertained to be an island; a discovery which may have been retarded by that officer having given an opinion "that there is no strait between New Holland and Van Diemen's Land, but a very deep bay." The existence of such a strait was, however, suspected; but the various attempts to ascertain it, without success, by different navigators from both sides of the coast, seemed to have decided the question in the negative, when Mr Bass, surgeon of the Reliance, having observed, as he ran down the E. coast in an open whale boat, that a heavy swell rolled in from the westward, was satisfied in his own mind that such a swell could proceed only from the great Southern Ocean. To ascertain whether this was the fact, was a point of great importance to the new colony on the eastern coast; and for this purpose Mr Flinders, together with Mr Bass, was sent on this service in a small decked boat. At the end of three months they returned to Port Jackson, with an interesting account of the survey of the coasts of Van Diemen's Land, which they had completely circumnavigated, and thus confirmed the conjecture of Mr Bass, whose name the strait deservedly bears. Australasia.

The French are entitled to the honour of some partial discoveries on *Terra Australis*. Captain Marion, in the year 1772, was despatched from the Isle of France with two ships, the Mascarin and Marquis de Castries, on a voyage of discovery, one of the objects of which was that of the supposed southern continent. He touched at Van Diemen's Land, quarrelled with the natives, and finding no fresh water, and the weather being stormy, he set sail for New Zealand, having added very little to the prior discoveries of Tasman.

In the year 1792, Rear-Admiral D'Entrecasteaux, having been sent out with two ships, La Recherche and L'Esperance, in search of the unfortunate La Pérouse, made the S. coast of New Holland, which he explored as far as the Termination Island of Vancouver; the deficiencies of whose chart he was able to supply, by the state of the weather permitting him to keep the coast closer on board than the English navigator had been able to do. Termination Island was found to be the first of a large group laid down by Nuyts, whose accuracy is praised by the Admiral, he having found "the latitude of Point Leeuwin and of the coast of Nuyts' Land laid down with an exactness surprising for the remote period in which they had been discovered." This liberal acknowledgment did not, however, prevent him from giving to the group of islands, which he only saw, but did not survey, the name of *Archipel de la Recherche*. But the most important discovery of D'Entrecasteaux was an inlet on the S. coast of Van Diemen's Land, which was found to be the entrance into a fine navigable channel, running more than thirty miles to the northward, and there communicating with Storm Bay; containing a series of excellent harbours, or rather one continued harbour the whole way, from beginning to end. "The charts," says Captain Flinders, "of the bays, ports, and arms of the sea, at the S.E. end of Van Diemen's Land, constructed in this expedition by Messieurs Beautemps, Beaupré, and assistants, appear to combine scientific accuracy and minuteness of detail with an uncommon degree of neatness in the execution. They contain some of the finest specimens of marine surveying, perhaps, ever made in a new country."

In 1800 Captain Baudin was sent out with two armed vessels, Le Géographe and Le Naturaliste, on a voyage of discovery nominally *round the world*, but actually, as appears from his instructions, to examine every part of the coasts of New Holland and Van Diemen's Land. The first volume of the account of this voyage was published by M. Péron, one of the naturalists, in 1807; the second never appeared. All the old names of the capes, bays, inlets, and islands, were unblushingly changed to those of Napoleon, his family, his marshals, and members of the Institute; and to 900 leagues of the southern coast, comprehending all the discoveries of Nuyts, Vancouver, D'Entrecasteaux, Flinders, Bass, and Grant, was given the general name of *Terre Napoleon*, while not 50 leagues of real discovery were effected which had not been anticipated by Captain Flinders, who, after losing his ship, and proceeding homewards, was scandalously detained as a prisoner in the Isle of France, "to give time for the previous publication of the voyage of M. Baudin, to prepossess the world that it was to the French nation only the complete discovery and examination of the south coast of Australia was due."

Flinders, however, ultimately triumphed. After an unjust and cruel captivity of seven years, he arrived in England in 1810, and in 1814 published his discoveries in two volumes, accompanied with an atlas of charts, which may be regarded as models in maritime surveying. At this time not a single chart of coast, bay, or island, of Captain Baudin's discoveries had appeared, though shortly afterwards an atlas was published by Freycinet, the first lieutenant, differing in their form

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and structure very little from those of Captain Flinders, but bearing the names recorded in M. Péron's first volume. The frontispiece to this atlas affords an instance of that almost impious adulation which Buonaparte was in the habit of receiving from his creatures. An *eye*, having an N within it, darts its rays through a dark cloud overshadowing a globe with the southern pole uppermost, on which is drawn the outline of New Holland, with this inscription, "*Fulget et ipso.*"

To Captain Flinders we owe the completion in detail of the survey of the coasts of New Holland, with the exception of the W. and N.W. coasts, which he was prevented from accomplishing by the loss of his ship. To him also, we are indebted for the very appropriate name of "Australia," which is now universally adopted to designate the entire island-continent, instead of the old Dutch name of New Holland. Dampier had said, in anchoring near the south end of De Witt's Land, behind Rosemary Island, which was one of an extensive cluster, "by the tides I met with a while afterwards, I had a strong suspicion that there might be a kind of archipelago of islands, and a passage possibly to the S. of New Holland and New Guinea, into the Great South Sea eastward;" but whether it might be a channel or strait, or the mouth of a large river, he seems not to have made up his mind. Vlaming saw an opening 12 miles wide near the same place, and could find no anchorage. It has now been ascertained that there is no outlet into the Great Ocean eastward, nor into the Gulf of Carpentaria, nor into Bass Strait; but the geographical problem yet remains to be solved, whether the opening in the coast behind Rosemary Island be not the mouth of a large river. Le Géographe and Le Naturaliste, under Baudin, stood along this coast, examined in a very slovenly manner some particular points, but assisted geography less than they perplexed it, by unwarrantably changing every old name for that of some of the upstarts created by the French revolution.

In 1829, when the settlement at Swan River was effected under the governorship of Captain Stirling, R.N., it was expected that our knowledge of the harbours and rivers on the W. coast of Australia would be considerably enlarged. In this expectation, however, geographers were much disappointed, no naval discoveries of any importance having been accomplished under the auspices of the government. It was not until 1837 that the anchorages and harbours in the immediate vicinity of the settlement were correctly laid down; in which year detailed charts of the coast from King George's Sound to Melville Harbour were furnished to the colonial government by J. C. Wickham, commander of H.M.S. Beagle. That excellent officer was intrusted with the duty of conducting a minute survey of all the Australian coast which Flinders had left unsurveyed. He was succeeded in 1839 by Mr Stokes, who continued zealously employed in this important duty until 1843; assisted by a staff of meritorious and scientific officers. The result of their investigations was not only a considerable addition to natural history, but a complete topography of the bays and harbours on the N.W. and northern coasts; besides the important discovery of four rivers of considerable magnitude. The largest of these, the Victoria, flows into Cambridge Gulf in Lat. 16°, which Stokes explored towards its source for a distance of 140 miles. He also discovered in Torres Strait a safe channel through the inner passage, at the extreme N. of this vast territory; while at the extreme S. he rendered the charts of Bass's Strait as safe for the mariner to navigate by, as those of the English Channel. Having circumnavigated the island, he and his predecessor left no harbour or estuary unsurveyed, which previous navigators had passed over; and doubtful positions of capes and other headlands they finally assigned to their correct latitudes and meridians upon the map. The detailed outline of the Australian coasts may now therefore be considered as complete, so far as maritime discovery is concerned. It is from the interior that we must look for further explorations of the many streams which are known to flow into the bays on its extensive shores.

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For 25 years after the settlement was effected at Sydney, the Blue Mountains, which are visible from the heights around Port Jackson, formed the barrier to the government surveyors in their explorations to the westward. And it is a fact which serves to illustrate the difficulties which beset the progress of the Australian explorer, even at the present day, that during this period all the country beyond the inlets and their ramifications on the coast, and the course of the Hawkesbury River in the interior,—a semicircular section of land about 50 miles across, and comprised within the present county of Cumberland,—was a complete *terra incognita* to the settlers. This range of mountains, which forms a section of the great Australian Cordillera, was at last surmounted by Mr Evans, a government surveyor, and a path found through the forest in 1813. This discovery led to the occupation of the pastoral lands to the westward; since known to all the world as the Bathurst gold-fields. Three enterprising colonists named Wentworth, Lawson, and Blaxland, were the first to occupy that region with their flocks and herds. They ascertained that it was not only better watered, and had more permanent running streams than the country on the eastern flank of the main range, but possessed a cooler climate, with richer alluvial soils, and was altogether better adapted for agricultural operations than the poor lands and warm climate nearer the coast. Forty years have since then elapsed; and not only has that western country become densely peopled on every side, and a road carried over the mountains, but even in the trackless wilds of the interior, intrepid men, braving all hardship and peril, have explored the recesses of this vast continent.

Explorations in the interior.

Of these explorations it will be necessary to give a brief abstract. In 1813 Mr Evans prosecuted two successful journeys across the Blue Mountains, to the distance of about 300 miles W. from Sydney. As he ascended the range towards the sources of the eastern streams, he came upon the Fish River, to which he gave its name in consequence of the great number of fish his party caught in it; and descending on the western shed of waters he traced the course of the Macquarie River through the Bathurst plains. He was surprised also to find fish of a large size resembling trout in this river, some weighing as much as fifteen pounds. On the plains, unusually large herds of kangaroos were met with, besides numbers of emus. Some aboriginal women and children whom he encountered, were so terrified at the appearance of the white men, that they fell down with fright. Governor Macquarie, who subsequently visited the plains, considered them an eligible site for a township and the centre of a district. He accordingly planned out the present town of Bathurst, by the banks of the river.

Evans, 1813.

In May 1815 Mr Evans was despatched a second time across the Blue Mountains to follow the course of the Macquarie River still further into the interior. On this occasion he traced it for about 115 miles from its source, and then returned; reporting as his opinion that the river crossed the entire breadth of the island to its north-western extremity, a distance of 2200 miles in a straight line. This is an instance of the erroneous speculations of surveyors as to the course of unexplored streams, of which another example was lately given by Sir T. L. Mitchell, with regard to the Victoria. Had Mr Evans pursued his survey about as far again as he had gone, he would have found that his supposed Australian Mississippi lost itself entirely in a marshy plain.

Evans, 1815.

In 1816 Mr Oxley the surveyor-general of the colony, in penetrating into the interior across the Bathurst plains in a S.W. direction, came upon a fine flowing stream which he named the Lachlan; and which has since been found to be one of the great tributaries of the Murray. He followed its course down to 34° S. Lat., and 145. 20. E. Long., and

Oxley, 1816.

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traversed the undulating prairie lands to the southward; besides exploring the western flank of the Peel range, or Coccopara Mountains. On his return in January 1817, he recrossed the river in Long. 147. 15. E., and encamped in Wellington valley, through which the Macquarie runs. From thence he traced that river down its course for about 190 miles, where he found it disappear in what is now termed the marshes of the Macquarie; although scarcely 20 miles before it terminates it is a clear flowing river 50 yards wide, and from 7 to 16 feet deep. Retracing his steps, Oxley struck right across the country in an easterly direction from Mount Harris, Lat. 31° S., until he reached the sea-coast. In this journey he encountered many obstacles; and at one time his progress was arrested by the dense vegetation, when he entered the impenetrable country on the western side of the great dividing range. He succeeded, however, in crossing to the eastern waters, when he came upon the Hastings River, which he traced to its outlet at Port Macquarie, about 200 miles N. from Port Jackson.

Explorations in the interior.

That part of the Bathurst country traversed by Evans and Oxley was but thinly peopled. The natives were the same as those of Sydney, but more docile; they wore their kangaroo and opposum-skin rugs with the fur inside, indicating a colder region at that altitude, which averages about 1800 feet above the level of the sea. They exhibited the usual terror of savages at seeing a man on horseback for the first time, imagining Mr Evans and his horse to be one animal. Beyond Bathurst plains, the country was even superior to that first explored. The grassy undulating downs showed a fertile soil; while the kangaroos and emus flocked in hundreds over the sward. A saccharine exudation from the trees, resembling manna, attracted Mr Evans's attention. He also passed mountains composed entirely of blue limestone, and picked up topazes, rock-crystals, and agates, on the very same streams and hills where the gold-fields are now worked.

Oxley, 1823.

In 1823 Mr Oxley was despatched to make a survey of Moreton Bay, 500 miles N. from Sydney. He found several considerable streams flowing into the bay; the largest he named the Brisbane, after the governor then in office. This river is navigable for 60 miles, and presents one of the finest deep-flowing streams on the eastern coast. Proceeding further N. he entered Hervey Bay, and explored Port Curtis, where he found a considerable stream, which he named the Boyne.

Hovell and Hume, 1824–5.

In 1824-5 explorations were actively pursued to a like distance southward. Messrs Hovell and Hume, two enterprizing settlers, who had driven their live stock over the ranges to fresh pastures on the Yass Plains—through which the present road from Sydney to Melbourne passes—animated by the spirit of discovery, pushed on, single-handed, to explore the southern regions. During their journey they passed over a most extensive range of country from the junction of the Murrumbidgee and Yass Rivers to the western shore of Port Phillip. They were the first travellers who crossed the main branch of the greatest known Australian river, which was deservedly named by the colonists after Mr Hume. On its further exploration, however, by Captain Sturt in 1830, when he descended to its termination in a boat, that gallant officer named it the Murray, in compliment to Sir George Murray, who presided over the colonial office at that time.

Cunningham, 1825.

In 1825 the indefatigable but unfortunate botanist, Allan Cunningham, prosecuted a successful exploration up the valley of the Hunter, and through a gap in the Liverpool ranges, which he called Pandora Pass; where he discovered a fine country, through which a western stream flowed in a northerly direction. In 1827 he crossed the same range of mountains at the source of the N. branch of the Hunter River, and travelled in a northerly direction over the beautiful table-land known as the Liverpool Plains. Continuing his course a little more to the eastward of that region. he traversed a fine grazing country at the elevation of 1500 feet above the level of the sea, which he called New England. Farther N. still, he discovered the verdant prairie-lands of Darling Downs, proceeding onwards until he reached the Lat. of 28. 10. S., having discovered a greater extent of grazing land in New South Wales than any explorer before or since. Making a detour to the eastward, he ascertained the direction of the great dividing range, and retraced his steps. During the following year, and in 1829, he proceeded to Moreton Bay, and prosecuted a successful journey to the source of the River Brisbane. He likewise discovered a pass on the E. side of the range which divides Darling Downs from Moreton Bay district.

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Sturt, 1828–9.

In 1828-9 Captain Sturt travelled from Wellington Valley, along the banks of the Macquarie River, and skirted the marshes which absorb that stream—the same which Oxley had deemed interminable—until he found an open and verdant country to the N.W., with several small streams flowing in that direction. Continuing his course westward, he ascended "New Year's Range," and descried some high table-land and grassy plains to the N.W. His further researches were rewarded by the discovery of the Darling, the greatest tributary of the Murray; its source being within tropical Australia. Having ascertained the course of this important river, which he followed down as far as 30. 20. S. Lat. and 145. 40. E. Long., he returned, impressed with the idea that it, as well as all the western streams, flowed into an inland sea; a favourite hypothesis of geographers at the time.

With a view to determine this point, and the course of the Murrumbidgee River, or the outlet of its waters, this enterprising officer started a second time in January 1831; and the result has been, that instead of the Darling and the Lachlan, and other streams that run to the westward, falling into a great inland sea or extensive marsh, as was conjectured, their united waters constitute a large river, which, under the name of Murray, was found to turn to the southward, and empty itself into an extensive estuary, 60 miles in length, by 30 or 40 in width. The river, near the point where it fell into this lake or estuary, was about 400 yards wide and 20 feet deep. The whole country on both banks was composed of undulating and picturesque hills, at the bases of which extended plains and valleys, within sight of many thousand acres of the richest soils.

The mouth through which the waters of the estuary communicated with the sea was in Encounter Bay, in Long. 139. 40. E. and Lat. 35. 25. 15. S., a little to the eastward of the Gulf of St Vincent, and round the point named Cape Jervis. The river was well stocked with fish, and its banks more populous than any other part of the country that had been traversed. Some accounts state the total number of aborigines seen to have amounted to at least 4000. They could scarcely be brought to believe that the discovering party were of the same genus as themselves; they placed their hands against those of the strangers, in order to ascertain if the number of fingers on each corresponded. Nothing surprised them more than the act of taking off the hat, believing, it would seem, that the superstructure of *felt* formed a part of the strange animal that had come into their country.

Banister, 1831.

In 1831, while these explorations were opening up a knowledge of Eastern Australia, the government of the new colony of Swan River in Western Australia, despatched Captain Banister to explore the country between that settlement and King George's Sound. This journey he accomplished at the risk of death by starvation to himself and his party. He has represented the country he passed through as of the most inviting description for settlers, both for grazing and agriculture. Several other expeditions were subsequently prosecuted to the N.W. of that territory by

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Captain Grey and others, which added much information concerning the coasts and bays up to that time visited only by Tasman, Dampier, Baudin, and King.

Explorations in the interior. Mitchell. 1832.

In 1832 Major (now Sir Thomas L.) Mitchell, surveyor-general of the colony, was instructed by the government to proceed on a journey of discovery to the N.W. of Liverpool Plains, in search of a great stream reported by a captured bushranger to exist in that direction. No such river could be discovered. The party, however, explored a large tract of indifferent country on the upper branch of the Darling River, which, no doubt, was the great stream of the bushranger, called by him the Karaula. The ability and energy displayed by Major Mitchell in this expedition, induced the government to fit out an exploring party under his command upon an extensive scale, having for its object the thorough survey of the Darling and its tributaries. The expedition

1835. started from Bathurst in 1835, more fully equipped for the journey than any which had started previously in the colony. Major Mitchell was ably seconded in his scientific arrangements by the assistance of the botanist Allan Cunningham. Within a few weeks, however, of their departure, that estimable man fell a sacrifice to his scientific enthusiasm. While the leader and his men were surveying the Bogan River in about Lat. 32. S., he was lost from the main body of the party in his ramblings for plants through the interminable wilderness; and from subsequent facts which came to light, there is every reason to believe that he was murdered by the natives. In memory of his sad fate and invaluable services to the colony, the government have erected an obelisk in the Botanic Garden at Sydney. Major Mitchell reluctantly left the spot where his companion had been missed, and traced the Bogan River down to its confluence with the Darling. Below this junction he erected a stockade which he called Fort Bourke, and from thence surveyed the Darling as far as Lat. 32. 34. S. The fort he found useful as a resting-place on his return homewards.

1836. In 1836 Major Mitchell accomplished a still greater journey into the interior from Bathurst; he followed the course of the Lachlan along its northern bank. After surveying its junction with the Murrumbidgee, and tracing the latter stream to its confluence with the Murray, as previously explored by Sturt, he followed that river in its N.W. course till he found its clear waters mingling with the turbid stream of the Darling, in Lat. 34. 10. From this point he traced the Murray River upwards, crossing the stream to its southern bank a short distance below its junction with the Murrumbidgee; after which he continued surveying upwards to Lat. 36. S. From this point he left the Murray and its tributaries, and journeyed in a S.W. direction across several small streams which he found flowing to the N. In Lat. 37. 10. he came upon a considerable stream flowing to the S. This river he navigated in a canvas boat down nearly to its outlet in the sea; and named it the Glenelg River (in honour of the colonial secretary, Lord Glenelg), which will be found on the map to be situated in Victoria, crossing the boundary between that colony and South Australia, and disemboguing itself into the sea a few miles farther to the west. After surveying this outlet he proceeded eastward towards Portland Bay; and was surprised on his journey thither to encounter two gentlemen driving "tandem" through the beautiful forest lands as leisurely as if they had been in Hyde Park, where he expected to meet with no inhabitants but hostile aborigines. These travellers belonged to a whaling station at Portland Bay, which had been established in 1834 by the enterprising Brothers Henty, merchants and bankers of Launceston, Van Diemen's Land. Since that period it has risen into a flourishing government town. Mitchell's further discoveries to the eastward were likewise forestalled by information he received, that a number of settlers from Van Diemen's Land had colonized the shores of Port Phillip during the previous year. On his journey back to Sydney, however, he explored that magnificent territory—the garden of Australia, which he denominated Australia Felix, from its agreeable aspect and fertility. All this extensive country southward from the River Murray to the coast is well watered; and the Snowy Mountains not only temper the climate, but they afford a supply of moisture throughout the summer to the large rivers to which they give birth; while the Great Southern Ocean on three sides throws up clouds of moisture, which descend in abundant rains. Extensive downs occur, which are covered with the best kind of grass, or are gracefully wooded. From Mount Macedon Major Mitchell says he reconnoitred Port Phillip at the distance of 60 miles. "In this region," he adds; "the party crossed ranges of granite, others of trap-rock; the woods forming open forests, which only partially covered the country. This, even in its present state, seems nearly all available for the purposes of agriculture and grazing; and being almost without any aboriginal inhabitants, it is consequently in the best state for the reception of British emigrants."[1] The region described so graphically in this extract is the recently discovered gold region of Victoria; Mount Alexander being the Mount Byng of Mitchell.

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In 1840 Count Strzlecki, an adventurous traveller of great reputation in other lands, and devoted to geological pursuits, made a successful though harassing journey on foot from the Murrumbidgee River southwards through the Australian Alps, and across the Gipps' Land district to Alberton in Corner Inlet; from whence he penetrated through the densest and widest "scrub" or brushwood in Australia, which had hitherto baffled all the settlers and surveyors. His *Physical Description of New South Wales* is at once the most scientific work on Australian geology and mineralogy, and the most practical treatise on Australian agriculture which has hitherto been published.

Strzlecki, 1840.

In 1840 the government of the new colony of South Australia despatched Edward John Eyre from Adelaide, overland to King George's Sound, through the territory denominated Nuyts' Land on the map. He and his party accomplished the journey, after encountering great privations and disasters, some of his party having sunk through sheer fatigue, and their aboriginal guide having been lost. In 1841 he likewise conducted an expedition of discovery towards the interior from Spencer's Gulf. From that point he found a shallow marshy lake, about 20 miles in breadth, extending, in a serpentine form, 400 miles into the interior. This substitute for "the great inland sea," so confidently expected by geographers, he named Lake Torrens. After reaching 29. S. Lat., he returned without crossing the Tropic of Capricorn, the main object of his expedition.

Eyre, 1840-1.

In 1844–5–6 the great purpose of inland exploration, to ascertain the nature of the country in Central Australia, was determined by the "father of Australian discovery," Captain Sturt. From Adelaide he penetrated due north into the very centre of the island; and his account of the desolate stony region he found in the interior, proves beyond a doubt that the vast *terra incognita* of Central Australia is a desert, a second Sahara. He found it depressed in some places below the level of the sea, where, in the rainy season, extensive marshy lakes are formed, which, in the dry season, become parched up, and fringed with incrustations of salt; upon the surface of which vegetation is blasted and animal life is unknown. The sufferings which this undaunted old man encountered uncomplainingly, and the privations which he and his party endured from thirst and hunger under the rays of a sun which frequently raised

Sturt, 1844–5–6.

[1] See Account of Major Mitchell's Expedition into the Interior of Australasia. Journal of the Royal Geographical Society of London, vol. vii. 1837.

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the temperature to 157°, and the scorching winds of the Austral simoom, are unparalleled, except in the history of the African expeditions of Park and Lander.

Explorations in the interior. Leichhardt, 1843–4–5.

In 1843 an unobtrusive botanist of the name of Dr Ludwig Leichhardt arrived at Sydney from Moreton Bay—where he had been devoting himself to Australian botany and zoology—and solicited the public support to fit out an expedition for the purpose of crossing overland from Moreton Bay to Port Essington. A similar project had, a short time previously, been laid upon the table of the legislative council for the sanction of the governor, by Sir Thomas Mitchell. The legislative body approved of the undertaking, but Sir George Gipps, the governor, referred the matter to the home authorities before he would grant funds for such a purpose. Meanwhile Dr Leichhardt was successful in obtaining for his enterprize public subscriptions of sufficient amount to fit out himself, five Europeans, and an aboriginal native; which ultimately were increased by another volunteer, and a black man, making in all eight individuals; who with a most slender equipment started from the Darling Downs on the 30th September 1844, to prosecute this distant journey through an unknown country for 3000 miles. After hairbreadth escapes from perils "by flood and field," and no less dangerous savages, who killed one of the party, this gallant little band reached their destination on the 17th December 1845, after a journey of fifteen months. The briefest abstract of this indefatigable explorer's additions to Australian geography would extend the present article beyond its limits: they are to be found modestly recorded in his ably written and scientific journal.[1] The volume itself comprises the details of one of the most remarkable enterprizes ever planned by human sagacity and executed by courage and endurance.

In 1846, while the intrepid Leichhardt and his companions had been given up for lost by the people of New South Wales—who were not apprised of his success until his own return by sea on the 29th March of that year—the sanction of the home-government had been obtained to fit out the proposed expedition of Sir Thomas Mitchell, for the same purpose. Sir Thomas altered his plans upon learning the result of Leichhardt's expedition. Keeping to the westward of Leichhardt's route he came upon what appeared to be the source of a large river flowing in a north-westerly direction; which he felt convinced was the upper branch of the Victoria, discovered by Wickham and Stokes, flowing into Cambridge Gulf. After tracing this stream towards Central Australia for about 150 miles, our sanguine explorer left the further prosecution of this enterprize, on his return to Sydney, to his able and accomplished junior on the surveying staff, Edmund B. Kennedy. He shortly afterwards sailed for England, full of the conviction that he had discovered a great highway from Eastern Australia to India by an inland navigable river. Like his predecessor Evans, in his speculations on the course of the Macquarie, he was doomed to be disappointed; for soon after Mr Kennedy found that the supposed Victoria suddenly turned to the southward and became absorbed in the great Australian desert, in the same manner that Oxley found the Macquarie vanish among the marshes.

Kennedy, 1847–8.

In 1847, after Mr Kennedy had returned from his fruitless survey of the Victoria River, the government acquiesced in the suggestions of that gentleman, and other members of the survey department, to prosecute short exploratory journeys into the interior and the northern parts of Australia, as a better method of completing the survey of the country than by long and hazardous expeditions. Mr Kennedy's plan was to survey that part of tropical Australia situated between Cape York in Lat. 10. 43. S., and Rockingham Bay in Lat. 18. 10., a distance by ordinary travelling of not more than 500 miles. But this country, within the influence of the tropical rains, is apparently of such an impassable nature from swamps and prickly scrubs, and so thickly inhabited by hostile aborigines, that this expedition proved to be the most perilous and calamitous of any hitherto attempted in Australia of which we have any record. Out of thirteen persons who started from Rockingham Bay on 5th June 1848, one man alone—Mr Kennedy's aboriginal servant, Jackey Jackey—reached Port Albany, after a six months' journey. At this harbour, a small schooner, the Ariel, commanded by Captain Dobson, was lying at anchor with stores on board, waiting the arrival of the party, to succour them and take them back to Sydney. Here this faithful creature related, in his broken English, his doleful tale. It had taken them a month to extricate themselves from the swamps and thickets of Rockingham Bay. Their sheep and horses could scarcely find any grass to eat. They journeyed along the coast ranges for four months through a frightfully-broken country, almost destitute of game and provender, which reduced both men and horses to the verge of starvation; insomuch that they had to kill twenty-four of the latter to sustain their own lives. Notwithstanding these attempts to support their strength, Mr Kennedy found his men so faint from inanition that he resolved upon leaving eight of them at Weymouth Bay, within about 150 miles of Port Albany, from whence he promised to return for them by sea. Fresh disasters were in the way of this intrepid traveller; one of the men accidentally shot himself, and was disabled. It was agreed that this man and his two mates should remain behind, while Mr Kennedy and his servant were to proceed onwards. Undismayed, he pursued his journey, attended by his faithful servant, and was almost within view of the harbour where he expected succour, when he was inhumanly murdered by a tribe of barbarous savages who speared him to death. The incident of his death, as related in the simple language of Jackey Jackey, is truly affecting. "He then said, 'Jackey, give me paper and I will write;' I gave him paper and pencil and he tried to write, and he then fell back and died. And I caught him as he fell back, and held him, and I then turned round myself and cried; I was crying a good while until I got well; that was about an hour, and then I buried him; I digged up the ground with a tomahawk, and covered him over with logs, grass, and my shirt and trousers; that night I left him near dark."[2] Without delay the vessel was brought round to Weymouth Bay, after a fruitless attempt to find the wounded man and his two companions; who there is little reason to doubt met with the same untimely fate as their leader. Here, alas! two *living skeletons* were all that remained alive of the eight men left at the bay; the other six "withered away, and died from sheer inanition and prostration of the physical energies," as described by one of the survivors, Mr Carron, the botanist to the expedition. His simple and unaffected narrative of their sufferings is the only existing document from which any account of the expedition can be gathered. For although the local government subsequently despatched a party to collect what papers and instruments of Mr Kennedy's might be found in the possession of the natives, scarcely anything of importance was recovered.

Leichhardt, 1848.

The latest, and greatest in contemplation, of these exploring expeditions, the melancholy result of which can scarcely be now a matter of doubt, was that led on by the zealous and indomitable Leichhardt. We have already mentioned his return from his successful expedition to Port Essington in March 1846. Not having then accomplished his original design of penetrating into Central Australia, he rested but a brief space in the settled districts until he was again rally-

[1] *Journal of an Overland Expedition in Australia from Moreton Bay to Port Essington, during* 1844–5. By Dr Ludwig Leichhardt.

[2] Jackey Jackey's Statement to Dr Vallack.—*Sydney Morning Herald*, February 1849.

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ing a band of adventurers round his Standard of Discovery. "His project was to penetrate to the westward, if practicable, across the great desert, to the settlement of Swan River, a distance little short of 3000 miles in a direct line; hoping to find by the way a succession of oases, like those in the African or Arabian deserts, which would enable him to recruit his party on the journey."[1] After making a false start in 1847, when some of his volunteers, whose enthusiasm quailed before the privations in store for them, abandoned the expedition, he finally left the Darling Downs in the early part of 1848. Since that year no tidings have reached us from the gallant band of explorers, excepting some false rumours of their massacre brought in by the aborigines; which induced the government to despatch a party in July 1852, to make inquiry into the truth or falsehood of the report, but without any satisfactory result. Since the date of his last letter in April 1848, at the furthest white man's home in the interior, from Moreton Bay, five Australian springs have strewed their flowers on the far western shore, but no Leichhardt has revisited these objects of his ardent study: and the probability is, that if he and his companions have not been massacred by savages, their bodies are buried under the sands of the great desert.

It is a remarkable fact, that the most recent of these exploratory expeditions have been the most calamitous, notwithstanding the advantages of former experience, and of modern scientific invention. It is worthy of remark, also, that those unfortunate leaders whose untimely fates have been recorded, were all young men, while the veteran explorers have survived to witness the beneficial results of their discoveries. A new expedition under Captain Stokes has been decided on by the British government. Its chief object will be the exploration of N.W. Australia, for which purpose the expedition is to start from the Victoria River, and to reach the southern extremity of the Gulf of Carpentaria. Captain Stokes hoped to leave England in May 1855.

General view of Australia.

As the structure of the country is brought to light by those discoveries, we observe the broken fragments of its geography gradually pieced together, and at last united into one great whole. Before us on the map we have the grand outline of this island-continent completed, and its limits correctly ascertained; showing a superficies on the earth's surface equal to about three-fourths of the continent of Europe. And although four-fifths of that area is a blank in geography, yet we have sufficient data to determine its principal geographical features. From Wilson Promontory, in 39. 11., the extreme south point, to Cape York in 10. 43. S. Lat., its extreme north, we know that there is a continuous chain of mountains, which, for want of a better name, Sir Roderick Murchison has called the Australian Cordillera,—the backbone of Australia, stretching in one sinuous serrated ridge from S. to N. for 1708 geographical miles, in a straight line, at an average altitude of 1500 feet above the level of the sea; dividing the eastern and western waters of Eastern Australia: and that the water-shed is rapid on its eastern flank, where the sources of the streams are upon an average not more than eighty miles in a direct line from the coast where they disembogue into the South Pacific Ocean; while the western waters have a gradual descent to the great Murray River, flowing through the interior, for an average distance of 500 miles. On the western coast from Cape Leeuwin to N.W. Cape, similar features present themselves in the geographical direction of the rivers and mountain ranges, only on a smaller scale; while between these two mountain parallels exists the Great Australian Desert, a second Sahara; which Sturt has defined on its southern limit, and Mitchell and Kennedy to the eastward. It now remains for future explorers to approach it from the north and from the west to define its general area. At the same time, nothing new of much importance can be contributed to the great geographical problem of what the *terra incognita Australis* is; for we have now sufficient data to solve the question. And it is not unphilosophical to conclude from all that is known of its geography, that the entire island, at some distant geological epoch, formed a vast archipelago, with those two mountain chains forming distinct groups of islands trending north and south, while the desolate region between was the bed of a shallow sea, studded with smaller islands.

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General view of Australia.

Of the individuals belonging to the organic kingdoms of nature which inhabit this varied territory, we may observe in this place generally, that they are remarkable for their difference in structure from those of any other part of the world; still the inorganic substances which compose the rocks and minerals are much the same as those found upon other localities of the earth's crust. And although the recent discoveries of her mineral treasures have taken the world by surprise, it is evident that the convulsions of nature which produced these phenomena obeyed the same laws which upheaved the lands of the northern hemisphere. And we shall find, when treating of the gold-discovery, that the light of science in the hands of an eminent geologist guided him to foretell its existence. (For a more detailed view of its surface, geographical divisions, mountains, rivers, lakes, and coasts, see the article AUSTRALIA.)

Aborigines.

The aborigines, wherever they have been met with, are of the very lowest description of human beings. In the journal of the Duyfhen, the N. coast is described as thinly "inhabited by wild, cruel, black savages, by whom some of the crew were murdered;" and the ship Vianen, touching on the western coast about 21° S., observed "a foul and barren shore, green fields, and very wild, black, barbarous inhabitants." In 24° S., Polsert, who commanded the Batavia, saw four natives, whom he describes as "wild, black, and altogether naked, not covering even those parts which almost all savages conceal." Tasman "found in *Hollandia Nova*, in Lat. 17. 12. S., a naked black people, with curly hair, malicious and cruel, using for arms bows and arrows, hazagaeys, and kalawaeys." The S. coast is so barren, and the naked hillocks of sand so continuous, that there appears to be nothing for human inhabitants to subsist upon. "It is not surprising," says D'Entrecasteaux, "that Nuyts has given no details of this barren coast; for its aspect is so uniform, that the most fruitful imagination could find nothing to say of it." None of our navigators, however, saw more than the coast line, which is either of rock or hillocks of sand. But where the country begins to improve towards the eastward, in the neighbourhood of Kangaroo Island, Captain Flinders found not the least vestige of inhabitants; and, from the stupidity of the kangaroos on that island, "which," he observes, "not unfrequently appeared to consider us as seals," he concludes there either were no natives, or that they were ignorant of every kind of embarkation. Towards the northern part of the eastern coast, the same navigator thinks they are somewhat superior to those near Sydney, having belts round the waist, and fillets about the head and upper part of the arm, associating in greater numbers, and dwelling in huts of a superior construction. They also catch fish with nets, which he thinks is alone a feature of distinction from those who only spear the fish, as a net requires more than one person to manage it, consumes much time in making, cannot easily be dragged about, and, in short, must occasion a sense of the advantage to be derived from mutual assistance, and suggest the necessity of a permanent residence.

Notwithstanding these evidences of social progression from the lowest depths of the savage state, and which may be accounted for amongst the tribes inhabiting the great York Peninsula, from their contiguity to the superior races of mankind peopling New Guinea and the Polynesian Islands, the ethnologist can discover clear and distinctive characteristics in the Australian aboriginal people, to warrant him in classifying them as the *furthest removed* type of humanity from any other race with whom we are acquainted. Their general description may be given thus, according to European notions on the standard of humanity, as exemplified in the northern varieties of mankind. They are hideously ugly, with flat noses, having wide nostrils; eyes deeply sunk in the head, large and wide apart, over-shadowed by bushy black eyebrows; the hair black and straight, clotted but not woolly, the males having long curly beards; the mouth is extravagantly wide, with thick prominent lips; and the colour of the skin varies from dark bronze

[1] Mossman and Banister's *Australia Visited and Revisited.*

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to jet black. The skull and jaws, when stripped of the hair, integuments, and muscles, present still more distinct characteristics. The cranium is thick and spongy, the inner and outer plates being wide apart, the coronal region flattened. By external admeasurement the capacity of a male skull now in our possession—which was that of a native doctor who died about forty years of age, and furnishes us with a type of these Australian crania *above the average*—is 117 cubic inches; which, when compared with the average size of Anglo-Saxon crania—according to Mr Straton's tables—scarcely equals the admeasurement of a boy ten years of age, laid down by him at 120 cubic inches. The facial angle, according to Count Strzelecki, is between 80° and 85°. The zygomatic process is widely arched; and the lower jaw, although unusually expanded at the base, is short, and forms a remarkably small chin. The molar teeth are flattened more than ordinarily, and sometimes are so smoothly ground by friction in chewing that they frequently resemble the teeth of ruminating animals. Their stature is below the average of the most diminutive European race; and they are wretchedly thin and ill-made, with long lean arms and legs, and short wide feet, the great toe largely developed—which is strengthened to a wonderful degree by use from their youth, in placing that member in the notches they cut with a tomahawk on the trees, when in search of animals for food.

To add to their natural deformity, they thrust a bone through the cartilage of the nose, and stick with gum to their hair, matted with moss, the teeth of men, sharks, or kangaroos, the tails of dogs, jaw-bones of fish, &c., and daub their faces and bodies with red and white clay, and scarify the skin in every part with sharp shells.

On the sea-coast they live principally upon fish, turtle, and shell-fish; the former are caught by nets, hooks, and speared by double and treble pronged spears. In the interior they hunt the kangaroo, wallaby, and emu, with their boomerangs, spears, and waddies; besides which they procure an uncertain supply of opossums, flying squirrels, sloths, storks, cranes, ducks, parrots, cockatoos, eels, lizards, snakes, grubs, ants and their eggs, tuberous roots, wild berries, and honey; in fine, any description of creature or plant from the animal or vegetable world which can supply any nutriment, does not come amiss to the appetites of these attenuated savages. Nay more, although man be described specifically as a "cooking animal," the Australian, in his natural state, scarcely troubles himself with this process, beyond that of throwing a bird or beast on the burning embers of a fire, without skinning it or drawing the entrails; and when it is partially roasted, brushing the singed hair or feathers off, tearing a mouthful or two with his teeth, and throwing it into the fire again to cook another portion of it; when this process of mastication is repeated until the bones are picked.

They have no fixed habitations, the climate generally allowing of their sleeping in the open air, in the crevices of rocks, or under the shelter of the bushes. Their temporary hovels consist of the bark of a tree, or a few bushes interwoven in a semicircular form, tapering at the top, and raised upon a prop-stick, open in front, and forming merely a breakweather, occasionally large enough to shelter six persons from the rain, but most frequently for the accommodation of two. They seem to have no idea of the benefits arising from social life; their largest clans extend not beyond the family circle, of each of which the eldest is called by a name synonymous with that of *father*. They are totally without religion, paying neither the least respect nor adoration to any object or being, real or imaginary. Hence they have nothing to prompt them to a good action, nothing to deter them from a bad one; hence murder is not considered as any heinous crime, and women think nothing of destroying, by compression, the infant in the womb, to avoid the trouble, if brought alive into the world, of carrying it about and finding it subsistence. Should a woman die with an infant at the breast, the living child is inhumanly thrown into the same hole with the mother, and covered with stones, of which the brutal father throws the first. They are savage even in love, the very first act of courtship, on the part of the husband, being that of knocking down his intended bride with a club, and dragging her away from her friends bleeding and senseless, to the woods. The consequence is, that scarcely a female of the age of maturity is to be seen without her head full of scars, the unequivocal marks of her husband's affection.

To these details, generally acknowledged by all travellers, such as Collins, Flinders, Sturt, Mitchell, and others, we shall add some further observations based upon experience and scientific data which have escaped their notice, as illustrative of the ethnographic characteristics of this barbarous people. So various are the languages spoken by the entire radius of tribes located outside the great desert—which, we presume, is untenanted by human beings—that a subdivision of the east and west coasts into lingual districts fifty miles in diameter for 300 miles inland, would give in each district not merely a distinct dialect, but in the majority of cases a different *language* from that of the adjacent tribes. One universal affinity, however, which, we have observed, these languages bear towards each other is, that the letter S is never found in the construction of their words. No evidences of tilling the ground, planting, sowing seed, and reaping the harvest, have been seen by travellers amongst them; which distinguishes them essentially from the Maori race in New Zealand, the races inhabiting the Polynesian Islands to the N.E., and the Malays to the N.W., excepting the tribes located on the extreme north coast. They do not trade or barter with each other or with strangers. Though each family or tribe has a generally recognized boundary within which they hunt and consider their "sit-down" or territory, and beyond which they seldom stray, still they neither exchange, buy, nor sell land among each other; and when their territory was taken possession of by the British, they demanded no equivalent as the New Zealanders have done—they cannot conceive a right of claim to that which is fixed and immovable. Not having any movable property beyond their spears, boomerangs, clubs, shields, opossum-skin rugs, and baskets, their *wealth* is less than that of the industrious bee, and their idea of property inferior to that of the beaver. These rudely-constructed articles of clothing, and weapons of offence and defence, they appear to divide promiscuously among each other, holding possession very much on the old lawless principle that "he may take who hath the will, and he may keep who can." Lunatics or idiots are rarely or never to be found amongst them. Slavery, as understood in the negro sense of the term, does not exist; the married females, however, are to all intents and purposes the slaves of their husbands: virtue and modesty are terms to them, in their purely savage state, utterly unintelligible. Polygamy is recognized and adopted; but from their savage custom of murdering infant female children, the proportion of the sexes is kept nearly equal, and seldom permits of more than one of each cohabiting together. Cannibalism exists among them. The writer has had proofs of several instances; this horrible practice, however, was confined to the bodies of their enemies killed in fight, and of half-caste children of the female sex. They show very little affection for their offspring, especially the males; and we have frequently taxed their philoprogenitive feelings by offering a few pieces of tobacco or a blanket for a child, when we should have easily succeeded in bartering with the fathers, and with no great difficulty overcome the affection of the mothers. Their treatment of the aged is even worse than their neglect of their offspring. These wretched specimens of humanity look at the age of 50 or 60 like octogenarians. Instead of being respected as elders of the tribe, as is the case among other savage races, they are considered as useless members who can no longer fight, hunt, or dig up roots. Hence the garbage of the game captured by the strong son or daughter is thrown with contempt to the father or mother; and they are even prohibited, like the children, from eating the best kinds of food, which the sturdy warriors of the tribe claim as theirs by the law of might. Rheumatism and diseases of the skin are their most prevalent complaints; the result of continual exposure to the weather, and their filthy habits. In every group or tribe of families, there is a doctor-man who uses charms, decoctions of herbs, and personal manipulation to cure the afflicted. In all such services rendered for the general welfare of the whole, or even in any other matter of assistance given to each other, we have never known of any sort of remuneration being tendered, or any special expression of gratitude coming from the patient. That they are capable of being civilized in a measure is shown by the organized troops of black mounted police throughout the south-eastern colonies, and the general employment of them by the colonists as shepherds and mounted herdsmen; nay, so far as intellectual advancement is concerned, in a few instances they have been taught to read and write. But at the best they are uncertain retainers, and cannot be kept to constant labour, while they have a very faint conception of the relations between master and servant. We are confident, also, that the Australian aboriginal would pine and die under any attempts to enslave him by means of the lash and the fetters, which the passive African submits to. Like most other savages, however, they exhibit the extremes of indolence when their appetite is satiated, and of activity when hunger prompts them to hunt for food. Treachery and cunning among them are considered virtues; and it is no disparagement to designate them, morally speaking, a generation of liars. The truth is not in them; in their relations with the Europeans no faith can be placed in what they say, and the local governments take exception to their evidence in a court of justice, or at the utmost value it but slightly.

This unfavourable delineation of the general characteristics of the Australian race, before they have mingled with the European settlers, is one, however, of the faithfulness of which we can confidently challenge disproof. They have, on the other hand, their redeeming qualities. Expert in the capture of game and fish, they will cheerfully share their meals with an unsuccessful neighbour, and will seldom refuse the white man a share—from whom, however, they expect an equivalent. Like children, they are easily pleased, and when

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their appetites are satisfied they become a jocular and merry race, full of mimicry and laughter. The sounds of hilarity are often heard ringing joyously through the echoing forests around their camping grounds; and the delight with which they enjoy the pleasures of the dance at their *corrobborees*, is not exceeded by the most enthusiastic frequenters at Almacks. Their conceptions of harmony and melody are very low, and they have no instrument, however rude, to produce musical intonations. Their wild yells of glee, and monotonous *crooning* songs, are reduced to a barbarous kind of measure by striking two pieces of wood together at long and short intervals. As exceptional cases of a better nature (our previous remarks having strictly reference to the Australian aboriginal in his purely savage condition), we can speak of many instances where feelings of great tenderness have been shewn, by the females more especially, and European life and property have been voluntarily rescued from fire and shipwreck. We can likewise testify to the fact of finding faithful and honest followers among them during our travels in the interior. We treated them as *children*, and they were obedient; had we resented supposed injuries they tried to inflict upon us, as if they were responsible *men*, as some have done, we should have exposed ourselves to their deadly enmity. In our transactions with them we dealt on the principle which they themselves considered just. The fidelity and devotion of Jackey Jackey towards the unfortunate explorer Kennedy, are sufficient in themselves to prove that the rudiments of a better nature than they ordinarily display are implanted in their minds.

The history of this race is comprised within a small compass. Records they have none, and their traditions are as evanescent as their dwellings; and like the summer fires, which sweep every vestige of these rude structures from the face of the earth, so their history is buried in oblivion with each succeeding generation. To estimate their present population is likewise a matter of uncertainty. Some years ago the governments instituted a calculation which gave for New South Wales, including Port Phillip, 13,700, and for South Australia, 4500; taking this as a criterion of the other portions of Australia at an approximate census, there would in 1853 be some 210,000 aborigines on the entire island. In this estimate we have allowed for their rapid decrease before the colonizing races of Europe; which may, ere long, render them an extinct people. This subject is fraught with intense interest to the ethnologist. Some morbid philanthropists who have formed associations for the preservation of these races, attribute their extinction to the aggressions by fire and sword upon them by the settlers, and the deadly diseases they introduce. Although to some extent this may be the case, still there is a more powerful influence at work, which ultimately will cause the inferior race to be swallowed up by the superior. Count Strzlecki, states his views in these terms:—"The aboriginal woman, after connection with a European male, loses the power of conception on a renewal of intercourse with the male of her own race, retaining that of only procreating with the white man." From our own investigations, and the testimony of others whom we have consulted, we cannot adduce evidence sufficient to corroborate this statement.[1] The facts are before us that the aboriginal inhabitants of Van Diemen's Land have dwindled down, from between 4000 and 5000, to 8 males and 10 females, who are calculated to die out within 20 years, notwithstanding the efforts of the government to preserve them; whereas, in that time, the same number of our prolific countrymen in the neighbouring isle, would in all likelihood increase tenfold. The tribe also that inhabited the country around Port Jackson and Botany Bay, which Governor Phillip on his arrival found to number about 1500 individuals, is now extinct. The last of its members died in 1849, little more than 60 years after the occupation of their lands by the Anglo-Saxon. These facts are startling, and demand further investigation.

If the rocks and mountains, and the earths, resemble nearly the inorganic substances that are met with in other parts of the world, there is at least a very extraordinary and a distinct characteristic difference in both the animal and vegetable part of the creation, which makes a considerable class of subjects in both these kingdoms peculiar to Australia. The fauna and flora of this arid region are so unique, so far removed in their nature and habits from the generality of species which exist in other parts of the world, so low in the scale of classified animals and plants, and bearing so close an affinity in their structure to the extinct tribes and genera whose fossil remains are found imbedded in European rocks of the eocene geological period, that some ethnologists are tempted to advance the hypothesis that Australia exhibits the most ancient surface-geology for our investigations, of any portion of the terraqueous globe. In other words, that this great south land has existed upheaved from the ocean, contemporary with the bygone epochs of the palæozoic formation, which at a recent geological era was submerged below the sea; and that its groups of living creatures, and its vegetation, have been perpetuated throughout subsequent epochs which have extinguished whole genera of animals and plants in the northern hemisphere. The recent investigations of naturalists in Australia and the surrounding seas, have shown that certain forms of star-fishes and bivalve shells found petrified in the chalk formations of Europe, have existing types in the tropical seas of Australia, and that the Port Jackson shark is the only living example of the ancient group of *Cestrationte* fishes. And while the superficial observer perceives, in the apparently anomalous examples of plants in the grasses and gum-trees,—and animals, in the kangaroo and duck-billed platypus, a mere assemblage of *lusus naturæ*, when compared with the productions of other regions, the attentive student of natural history finds at every step some useful harmony between the individuals of the organic kingdoms, and the peculiar physical geography of this great southern land. Here he finds the grasses containing an unusual pith in their stems, from which they derive nourishment during the dry seasons which occur in this arid climate, when the hollow-stemmed grasses of Europe would perish. And when he examines the structure of that curious animal the duck-billed platypus (*Ornithorhynchus paradoxus*), he discovers that its organism is peculiar to the manner in which it secures food from the water insects, where, in its burrowings in the earth, scarcely any worms are to be found. These and other anomalous forms of the organic world in Australia, are doubtless reconcileable to the universally harmonious system of nature, and require only further investigation to be made manifest.

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The animals hitherto discovered, with very few exceptions, are of the numerous species of kangaroo or the various opossum type; the former having their hinder legs long out of all proportion when compared with the length of the fore-legs, and both families being *Marsupial*, that is, having a sack under the belly of the female for the reception of the young; of which families, though divided into different genera, there are at least a hundred distinct species. To these marsupial genera may be added another of a singular kind, classed by naturalists under the genus *Ai*, represented by the *wombat* of the natives, or the native bear of the colonists, a herbivorous animal of the sloth kind. Of carnivorous animals, there are very few. The dingo or native dog has some resemblance to the English fox in its appearance and predatory habits, and is the dread of the sheep-farmer. It is supposed, however, not to be indigenous; and with the buffalo, which is found on the northern coast, has no doubt been brought by the Malays, who cross over to fish for trepang, from Java, Timor, and other islands in the Indian Archipelago, as it exhibits very little specific difference from the jackal of these countries. The feline tribe is represented by several species of yellow-spotted cats; and these pretty nearly complete the catalogue of Australian quadrupeds. One animal, however, deserves some specific notice, from the discussions that have arisen regarding the nature and uses of the unusual organic structure of its head: we allude to the duck-billed water-mole of the colonists (*Ornithorhynchus paradoxus*, or *Platypus anatinus*); "a quadruped," says the late Dr White of the British Museum, "with the beak of a bird, which is contrary to known facts and received opinions." The investigations, however, of modern scientific men, have discovered that even this apparent paradox of nature, "setting the bill of a bird upon the head of a quadruped," is in harmony with her laws. This organ, although it has the same function as the bill of a duck, is not, like that appendage, affixed to the skeleton, but merely attached to the skin. It was by Cuvier, along with a somewhat similar Australian animal, the *Echidna*, ranked among the *Edentata*; but now they are both more usually arranged as a distinct class of mammals termed *Monotremata*. They approach the marsupials in possessing the abdominal bones of that order, though they have not the pouch; and they approximate mammals to birds, in possessing a common *cloaca*. The echidna has also a bill-formed mouth, and spines like those of a hedgehog on its body. Australia at the present period is the great metropolis of the order. The flying phalangers (*Phalangista*) are likewise an interesting and

[1] It may be remarked that the assertions of Strzlecki on this subject are more than doubtful, and are at variance with all analogy respecting sexual intercourse between other races of mankind. The same notion once prevailed regarding the negro and white varieties of the human species; but is not founded on fact. The barrenness of the aboriginal females, under such circumstances, will excite little surprise when we consider the well-known effect of promiscuous sexual intercourse in checking fecundity: while the rapid decrease of the Australian native population is further explicable by the frequent practice of infanticide, especially of female children, the excessive labour exacted from their women, the introduction of epidemic disorders by Europeans, and immoderate indulgence in intoxicating liquors.—Ed.

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beautiful group of marsupials. Crocodiles, turtles, and yangan, or dugong, one of the cetaceæ, inhabit the rivers and harbours of tropical Australia; and in the southern, eastern, and western streams, large fish of the perch tribe abound. The seas swarm with scaled fish and crustacea; many of them edible, others poisonous, and some of the most brilliant colours. Reptiles are frequently met with, but not abundant. There are several species of snakes; some are venomous, but the majority are harmless. Lizards are more plentiful, and all of them harmless; while a large species of iguana affords the natives a delicate kind of food.

The birds are equally singular with the beasts, there being black swans and white eagles; the former everywhere in such multitudes as to spoil a proverb that had held good for two thousand years; and their song as described by Mr Bass, "exactly resembles the creaking of a rusty sign on a windy day." The *Mœnura superba*, with its scalloped tail feathers, is perhaps the most singular and beautiful of that graceful species known by the name of *birds of paradise;* ducks, pigeons, cockatoos, parrots, and parakeets, are innumerable, and of great variety and beauty. The mountain eagle is a magnificent creature, and the emu is, next to the ostrich, the tallest bird that exists, many of them standing full six feet high; and the insect creation presents strange and brilliant forms.

Plants.

The plants are no less singular than the animals. Of these the distinguished botanist Mr Brown has given a very curious and instructive account in his Geographical and Systematical Remarks, in the Appendix to Flinders's *Voyage*. He collected nearly 3900 species of Australasian plants, which, with those brought to England by Sir Joseph Banks and others, supplied him with the materials for a *Flora terræ Australis*, consisting of 4200 species, referable to 120 natural orders; but he remarks that more than half the number of species belong to *eleven* only of those orders. Of the *Eucalyptus* or gum-tree, the largest yet discovered, there are not fewer than 100 different species. "The *Eucalyptus globulus* of Labillardière," says Mr Brown, "and another species, peculiar to the S. of Van Diemen's Land, not unfrequently attain the height of 150 feet, with a girth near the base of from 25 to 40 feet." Of this magnificent genus there are 50 different species within the limits of the colony around Sydney. Of the beautiful and elegant *Melaleuca*, Mr Brown collected upwards of 30 species, all of which, with the exception of the two species *Leucodendron* and *Cajaputi*, appear to be confined to Terra Australis. The tribe of *Stackhouseæ* is entirely peculiar to that country. Of the natural order of *Proteaceæ*, consisting of about 400 known species, more than 200 are natives of New Holland, of which they form one of its characteristic botanical features; the *Banksia*, in particular, being one of the most striking peculiarities of the vegetable kingdom. The *Casuarina*, of which 13 species have been discovered, is another characteristic feature of the woods and thickets of Australia. The most extensive genus, however, is the apetalous *Acacia*, of which there are more than 100 species; and this, with the *Eucalyptus*, "if taken together," says Mr Brown, "and considered with respect to the mass of vegetable matter they contain, calculated from the size as well as from the number of individuals, are perhaps nearly equal to all the other plants of that country." The *Casuarina* and the *Eucalyptus* are represented as furnishing excellent timber for ship-building, and for all the purposes of domestic furniture and agricultural implements; the gum of the *Eucalyptus* is medicinal; and that of one species might be employed as pitch. Freycinet says they procured a resinous substance from the *Xanthorrhea*, which served them to caulk their vessels. The bark of a tree (*Acacia dealbata*) is known to be more efficacious in tanning leather than the oak-bark; and a shrub (*Leptospermum scoparium*) was used by Captain Cook as a substitute for tea. Nutmegs were found by Flinders on the northern coast, but they were small, and had so little of an aromatic flavour, that Mr Brown gave the plant the specific name of *insipida*. Among the curious productions of the vegetable world is the *Nepenthes distillatoria*, or pitcher plant, of which a very correct and detailed drawing is given in the Atlas to Flinders's *Voyage*. The pines of the genus *Auracaria* have the double-dotted vascular tissue of the carboniferous *Coniferæ*. The *Eucalypti* or gum-trees shed their bark annually instead of their leaves; while the latter hang vertically from the branches, instead of horizontally, as in most English forest-trees; and the *Casuarinæ* or she-oak trees have the jointed articulations of *Hippuris* instead of leaves. Altogether, the anomalous characters of Australian botany, though presenting organic phenomena distinct from those of the northern hemisphere, are in harmony with the branches of the animal kingdom already alluded to. Since Brown's *Prodromus* was published in 1810, very little has been added to that profound work. And it is a remarkable fact, that few genera, if any, have been discovered since that eminent botanist and his patron Sir Joseph Banks first collected the plants of Botany Bay. Although Cunningham, Labillardière, and others, have added materially to the list of species, there is still a vast region open to botanic enterprize, especially in the unexplored mountain ranges of the great Australian Cordillera.

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General view of Van Diemen's Land.

II. Having marked the progressive discovery of this fair and fertile island, until it was ascertained to be such by Tasman, Marion, Furneaux, Cook, D'Entrecasteaux, Bass, and Flinders, we shall not think it necessary to notice the minor discoveries of Bligh, Hunter, Cox, &c., but proceed to give a general account of its dimensions, surface, and natural productions. It is situated between the parallels of 41. 0. and 43. 32. S. Lat., and 144. 32. and 148. 25. E. Long.; its medial length from N. to S. being about 160, and breadth from E. to W. 145 geographical miles. Its surface possesses every variety of mountain, hill, and dale,—of forests and open meadows,—of inland lakes, rivers, and inlets of the sea, forming safe and commodious harbours,—that can render a country valuable or agreeable; and it enjoys a temperate climate, which is perhaps not very different from that of England, though less subject to violent changes. In May, corresponding to our November, Labillardière observed the mountains in the interior covered with snow. The western and southern coasts are bold, steep, and rocky; the latter terminating so abruptly as to appear as if it had been broken off, and the group of islands named De Witt's Isles, to the southward, twelve in number, formed out of the fragments. Cook found the cliffs on the eastern side composed of sandstone; but the vast buttresses that look towards the southern seas of ice are stated by Flinders to be composed of basaltic columns, appearing like so many stacks of chimneys. Labillardière found, near this southern extremity, a stratum of coal $3\frac{1}{2}$ feet thick and 200 fathoms long, resting on sandstone.

The soil, in general, is represented as more productive than that of the E. side of Australia; and the island has the advantage of being intersected by two fine rivers, rising near the centre; the one named the Tamar, falling into Bass's Strait on the N., and forming Port Dalrymple; the other, the Derwent, which discharges itself into the sea on the S.E. extremity, spreading its waters, in the first instance, over the Great Storm Bay, which communicates with North Bay, Norfolk Bay, and Double Bay, on the E., and with D'Entrecasteaux's Channel on the W. The Tamar in its course receives three streams—the North Esk, the South Esk, and the Lake River; and the tide flows about 30 miles up the river, to the point where it is joined by the two Esks. At this spot is situated the flourishing town of Launceston; having a population of about 6500. At the head of the western arm of Port Dalrymple is situated George Town, on the skirt of a beautiful, rich, and well-wooded country. There is also a town named Hobart Town, which is now the capital, on the right bank of the Derwent, about five miles inland, with a population, in 1851, of 14,000 inhabitants. The country between these two towns is everywhere rich and beautiful, abounding in grassy plains, marshes, and lakes, bounded on each side by hills, well clothed with wood, rising into high and rocky mountains. A turnpike road now bisects the island between Launceston and Hobart Town,—a distance of 130 miles, which is accomplished by stage-coaches within 12 hours.

The description given by D'Entrecasteaux of the channel that bears his name, and the surrounding shores, corresponds generally with the following animated account of it from M. Péron, ten years afterwards. "Crowded on the surface of the soil are seen on every side those beautiful *Mimosas*, those superb *Metrosideros*, those *Correas*, unknown till of late to our country, but now become the pride of our shrubberies. From the shores of the ocean to the summits of the highest mountains may be observed the mighty *Eucalyptus*, those giant trees of Australasian forests, many of which measure from 162 to 180 feet in height, and from 25 to 30 and even 36 feet in circumference. *Banksia* of different species, the *Protea*, the *Embothria*, the *Leptosperma*, form an enchanting belt round the skirts of the forests. Here the *Casuarina* exhibits its beautiful form; there the elegant *Exocarpus* throws into a hundred different places its negligent branches. Everywhere spring up the most delightful

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thickets of *Melaleuca, Thesium, Conchyum, Evodia,* all equally interesting, either from their graceful shape, the lovely verdure of their foliage, the singularity of their corollas, or the form of their seed-vessels."—*Voy. aux Terres Australes.*

All the navigators who have visited the southern part of Van Diemen's Land describe the natives as a mild, affable, good-humoured, and inoffensive people; with the exception of Marion, the effect of whose fire-arms, Labillardière thinks, had made them afraid of Europeans. Subsequently the settlers found them a hostile and treacherous race, probably from the same cause. Flinders and Bass conceived that the natives of this island were sunk still lower in the scale of human existence than those in the neighbourhood of Port Jackson, though they saw but one man, and he is described as having "a countenance more expressive of benignity and intelligence than of that ferocity or stupidity which generally characterized the other natives." They are obviously the same people as those of Australia. The women refused from Cook's people all presents, and rejected all their addresses, not so much from a sense of virtue, it was supposed, as from the fear of the men, of whom they stood in great awe. With the convicts and free settlers they had free intercourse. In some places were found miserable huts of twigs, and rude baskets made of a juncus or rush; but these were all the signs that appeared of civilization. Cook, D'Entrecasteaux, and Baudin, all observed many of the largest trees with trunks hollowed out, apparently by means of fire; and as the hollow side invariably faced the E. and S.E., the lee-side to the prevailing winds, it was concluded they were intended as habitations. In D'Entrecasteaux's Channel only were indications of huts made of the bark of the *Eucalyptus*, consisting of three rolls stitched together. Of the numerous tribes who peopled this island when it was first colonized by the British, only 18 men and women now remain. At the early settlement it was a penal colony, and the natives were considerably thinned by a war of extermination carried on by the convicts and settlers against them, which ended in their being conveyed to Flinders' Island in Bass's Strait, from whence the miserable remnant now at Brown's River, near Hobart Town, were brought to end their days in peace.—D'Entrecasteaux, Labillardière, Flinders, &c.

New Guinea or Papua.

III. New Guinea, or Papua, is, after Australia, not only the first in point of magnitude, but claims a priority in discovery over that and every other island in the Australasian Sea. In the year 1526, when the Portuguese and the Spaniards were disputing their respective claims to the Spice Islands, Don Torge de Meneses, of the former nation, had, in his passage from Malacca to the Moluccas, by extraordinary and accidental circumstances, discovered the N. coast of Papua, so called, according to some, because the word signifies *black*, which was the colour of the natives, or *curled hair*, according to others. Meneses remained at a port called Versija till the change of the monsoon, and then returned to the Moluccas. The next navigator who touched at Papua was Alvarez de Saavedra, on his homeward voyage from the Moluccas in 1528, for New Spain; and from an idea that the country abounded in gold, he gave it the name of *Isla del Oro*. He staid a month, and obtained provisions; but some Portuguese deserted with the only boat the ship had, and were left behind. They found their way, however, to Gilolo, and reported that Saavedra had been wrecked; but on his subsequent arrival they were tried, condemned, and executed. He is supposed to have added about 50 leagues of discovery to that of Meneses. In 1529 Saavedra sailed a second time from New Spain, and, according to Galvaom (or Galvano), followed the coast of Papua eastwards above 500 leagues.

In 1537 Gonzalvo and Alvarado were despatched on discovery by the viceroy of Peru; but the former being killed in a mutiny, the crew chose another commander; and the first land they made was Papua. The ship was in so crazy a state that she was abandoned; the crew, only seven in number (the rest having died of hunger and fatigue), were made captives, and carried to an island called *Crespos* (curly-haired men), whence they were sent to the Moluccas and ransomed.

In 1545 Ynigo Ortiz de Retz, in his voyage from Tidore to New Spain, came to an archipelago of islands near the land of Papua; sailed 230 leagues along the N. coast; and not knowing it had been before visited by Europeans, he called it *Nueva Guinea*, from the resemblance of the natives to those of the coast of Guinea.

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In 1606 Torres made the E. coast of New Guinea, in his way to the Moluccas, sailed westward 300 leagues, doubled the S.E. point, sailed along the southern coast, saw the northern coast of New Holland, and passed the strait which now bears his name. He describes the coast of New Guinea as inhabited by a dark people, naked, except a covering round the middle, of painted cloth made of the bark of a tree. They had arms of clubs and darts ornamented with feathers. He fell in with many large islands, ports, and rivers. Towards the northern extremity he met with Mahometans, who had swords and fire-arms.

In 1616 Schouten came in sight of a burning mountain on the coast of New Guinea, which he named Vulcan, and immediately after of the coast itself. The island was well inhabited, and abounded with cocoa-nuts; but no anchoring ground could be found. The natives were black, with short hair; but others appeared of a more tawny colour, with canoes of a different shape. Among the islands in sight to the northward, four small ones continually smoked. On approaching the main land, the natives, whom he calls real Papoos, came off, "a wild, strange, and ridiculous people, active as monkeys, having black curled hair, rings in their ears and noses, and necklaces of hogs' tusks." They had all some personal defect; one was blind, another had a great leg, a third a swelled arm; from which Schouten concluded that this part of the country was unhealthy, an inference which was confirmed by observing their houses built upon stakes eight or nine feet from the ground. At the two little islands of Moa and Insou, on the N.E. coast, the friendly natives supplied them with abundance of cocoa-nuts. At 28 leagues from Moa, Schouten fell in with a group of 14 small islands covered with wood, and apparently uninhabited; but sailing to the northward, they were followed by six large canoes, the people in which were armed with javelins. Those in some canoes from another island were of a tawny complexion, had long curly hair, and appeared by their persons and language to be a different race from the natives of Papua: they had rings of coloured glass, yellow beads, and vessels of porcelain, which were regarded as "evidences of their having communication with the East Indies." Schouten's Island is the largest of this group. Tasman visited all these islands and the coast of New Guinea in 1643, but made no discoveries in this part of his voyage.

Our countryman Dampier saw the coast in 1699, but did not land: the natives came off to his ship, and he speaks in admiration of their large and picturesque *proas*. He discovered, however, a strait unknown before, which divides New Guinea from New Britain, and is now called after his name. Bougainville was less fortunate, when, in 1768, he touched on the coast of what he considered a separate island, and to which he gave the name of Louisiade. D'Entrecasteaux, in 1792, passed along the northern coast of Louisiade, and through Dampier's Strait, but left the point of its identity with or separation from New Guinea undecided.

Sonnerat published *A Voyage to New Guinea*, though he evidently never was there, but describes the natives and productions from what he saw and from what he could collect at the island of Gibby, to the eastward of Gilolo.

Forrest, in 1775, anchored in the Bay of Dory, on the northern extremity of New Guinea, and collected some information respecting the inhabitants from a Mahometan Hadji, who accompanied him. Captain Cook, also, in his first voyage in 1770, made the coast in about 6. 30. S. Lat., a little to the northward of Cape Valscher, but did not bring his ship to anchor, on account of the hostility of the natives. A party landed near a grove of cocoa-nut trees, and not far from it found plantain and the bread-fruit tree. The breeze from the trees and shrubs is said to have been charged with a fragrance not unlike that of gum *benjamin*.

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Three Indians rushed out of the wood with a hideous shout, and ran towards the party; the foremost throwing something out of his hand which burnt like gunpowder, the other two hurling their lances at the same time. Before they reached the pinnace, from 60 to 100 had collected, all stark naked; their appearance as to stature, colour, and crisped hair, resembling that of the New Hollanders. They let off fires by four or five at a time, but for what purpose could not be imagined. These fires appeared to be discharged from a piece of stick, probably a hollow cane; and the fire and smoke exactly resembled those of a musket, but without any report. Those who were on board ship, at a distance, concluded they had fire-arms; and even those in the boat might have supposed them firing volleys, had they not been so near as to ascertain that there was no report. Torres had observed something of the same kind in about 4. S. Lat. on the same coast, where, he says, the inhabitants were black, but better clothed than those southward; that among the weapons used by them were hollow bamboo sticks, which they filled with lime, and by throwing it out endeavoured to blind their enemies. This explanation, however, does not account for the *fire*. Forrest says that the Chinese from Tidore trade with Papua under Dutch colours; perhaps, therefore, gunpowder may be one of the articles carried by them in exchange for the slaves, ambergris, sea-slugs (*Sipunculus edulis*), tortoise-shell, lories, birds of paradise, &c., which they carry back to China.

The S.E. coast of New Guinea was visited in June 1793 by Mr Bampton, master of the Hormuzeer, and Mr Alt, master of the Chesterfield, two British merchant vessels, who, in their endeavours to find a passage to the N.W. while beating up the Great Bight of this island, added some valuable information to what was previously known of that part of the coast. Captain Bristow, also the discoverer of the Auckland Islands, visited in 1806 the northern shores of the smaller islands, which were described by D'Entrecasteaux in 1793. But the southern shores of the Louisiade remained unexplored from the period of Bougainville's voyage in 1768 until the year 1840, when a French navigator, Captain D'Urville, attempted a flying-survey of them in the Astrolabe during his voyage round the world. He was not sure, however, whether the land he observed belonged to New Guinea or the Louisiade, although he passed a multitude of islands with navigable channels between them.

In 1845 Captain Blackwood, in H.M.S. Fly, surveyed 140 miles of the S.E. coast of New Guinea within the Great Bight. Here he found a low muddy shore extending many miles inland of the same character, intersected by channels, which evidently are the estuaries of streams. One of these he ascended for a distance of 20 miles in the ship's boats, and saw numerous native villages built at intervals along the banks; but being confronted by the inhabitants, who appeared to be of warlike disposition, he considered it dangerous to attempt a landing. This partial survey was followed up in 1846 by Lieutenant Yule in H.M. schooner Bramble, who laid down the coast-line from where Blackwood's survey had terminated E. of Aird's River, along the S.E. shore of the bight. As he proceeded southerly, where the coast trends to the eastward, he found the country inland gradually improve in aspect from low mud banks to densely wooded hills; with a lofty range of mountains in the distance. At this point where he sighted a high peak of this mountain-chain—which now bears his name—he returned to Australia to await further orders.

On the 10th of June 1848, Captain Owen Stanley in H.M.S. Rattlesnake, accompanied by the Bramble, Lieutenant Yule, as tender, commenced a further survey of the doubtful S.E. peninsula of New Guinea, and Bougainville's Louisiade. During their combined indefatigable exertions for four months, they not only determined the fact that the latter island is separated from the mainland, but that it forms one of several groups of smaller islands, more or less surrounded by dangerous coral reefs, which extend for upwards of 200 miles E. by S. of the great Papuan Island, between 151. and 154. 30. E. Long., and the parallels of 11. and 12. S. Lat.: the entire assemblage of island and reefs, including the Calvados Group, being now denominated the Louisiade Archipelago.

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Much valuable information has been added to the natural history and ethnography of those coral-bound isles which Captain Stanley has now determined upon the charts of Australasia, by Mr John Macgillivray, the naturalist who accompanied the expedition; and who has furnished us with the journal of the voyage, which the death of the captain prevented himself from publishing. In his graphic descriptions of these new and interesting islands, he thus describes their appearance: "From the anchorage we enjoyed an extensive view of the south-eastern portion of the Louisiade Archipelago. On the extreme right is the large S.E. island, with its sharp undulating outline, and Mount Rattlesnake clearly visible, although distant 45 miles. Next, after a gap partially filled up by Pig Island, Joannet Island succeeds, 10½ miles in length, not so high as South-east Island, but resembling it in dimness of outline: its highest point, Mount Asp, is 1104 feet in height. Next come the Calvados, of various aspect and size, some with the undulating outline of the larger islands, others rising more or less abruptly to the height of from four to upwards of nine hundred feet. They constitute a numerous group—upwards of 40—some of which, however, are mere rocks: they are delineated upon the Rattlesnake's chart, and there are others to the northward. Behind them, in two of the intervals, the large and distant island of St Aignan (so named after one of D'Entrecasteaux's lieutenants) fills up the background, falling low at its eastern extreme, but the western half is high and mountainous, with an elevation of 3279 feet. Further to the westward, the last of the Calvados in this view was seen to form a remarkable peak, 518 feet in height, to which the name of Eddystone was applied; and still further to the left, Ile Real of D'Urville's chart shoots up to the height of 554 feet, as a solitary rocky island with a rugged outline and an abruptly peaked summit."[1]

Leaving these islands, Captain Stanley proceeded on his general survey along the S.E. coast of New Guinea, until he reached that point of land where Lieutenant Yule in the Bramble had left off. On making the S.E. cape of the island, the land appeared of a mountainous character inland; and this continued increasing in elevation for 250 miles, until he came to Yule's Peak. It is evident that this great mountain-chain divided the watershed on each side of the peninsula. On determining the altitude of this range of mountains, it was found to average double that of the Australian Alps—the highest section of the great Cordillera of that island. Mount Owen Stanley is 13,205 feet in height, being more than double that of Mount Kosciusko (6510 feet)—the highest mountain in Australia. Of fifteen other peaks in the range, whose altitudes are laid down on the Rattlesnake's chart, eight are above 7000 feet. Doubtless there are rich fields for discovery to future naturalists on these tropical-alpine ranges. At present, however, the hostile disposition of its savage occupants renders it inaccessible to European explorers.

General view of Guinea.

If we except the Louisiade Archipelago, New Guinea extends in a S.E. by E. direction from the Cape of Good Hope, nearly under the equator, to South-east Cape, in 10. 35. S., being in length about 1200, and medial breadth about 150 geographical miles. The accounts of all the navigators who have touched on the different parts of its coast, describe it as a rich and magnificent country, containing, in all human probability, from its situation and appearance, the most valuable vegetable products of the Moluccas and the several Asiatic islands. Forrest found the nutmeg-tree on Manaswary Island, in the Bay of Dory; and he learned that a people in the interior, called

[1] *Voyage of H.M.S. Rattlesnake, Captain Owen Stanley.* By J. Macgillivray, vol. i. p. 241.

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Haraforas, cultivate the ground, and bring their produce down to the sea-coast; that they are very poor, and some of them have long hair; and that they live in trees, which they ascend by cutting notches in them. The people of New Guinea, in many parts of the coast, live in huts or cabins placed on stages which are erected on posts, commonly in the water, and probably as a protection against snakes and other venomous creatures, though Forrest seems to think against the Haraforas. On these stages they haul up their proas or canoes. These people are invariably described as being hideously ugly. Their large eyes, flat noses, thick lips, woolly hair, and black shining skin, impressed the early navigators with the idea that they were of African origin; but closer investigation of late years has shown them to be a very mixed race indeed. Mr Macgillivray resolves them into several indistinct types with intermediate gradations. Thus, occasionally he met with strongly marked negro characteristics, but still more frequently with the Jewish cast of features; while every now and then a face presented itself which struck him as Malayan. Although the hair of these aborigines was invariably frizzled out into a mop, and woolly, instances were met with in both sexes where it was black, soft, and curly, while in others it was red and frizzly, and the males mostly beardless. The colour of the skin varies from a light to a dark copper shade; and their stature does not average more than 5 feet 4 inches. Instead, therefore, of considering them a pure race, these late investigations would lead us to suppose that the races from all the neighbouring Polynesian and Malayan islands had their representatives on this beautiful and fertile group of islands; who have amalgamated and formed the most warlike race in the Australasian seas. Their habits, however, are much the same as their neighbours; and they show equal skill in the management of their canoes and weapons, and in the building of huts. The Papuans also increase their natural deformity by passing bones or pieces of stick through the cartilage of the nose, and as already mentioned, frizzing out their curly locks like a mop, sometimes to the enormous circumference of 3 feet. They appear, however, to be one degree farther removed from savage life than the Australian aborigines, having permanent houses, and both men and women wearing wrappers round the waist, which are among the articles brought to them by the Chinese and Malays.

Animals.

The only quadrupeds known to exist on this island are dogs, rats, and wild hogs; but the feathered race are of great beauty and infinite variety. New Guinea is the native country of the bird of paradise. They are said to migrate in large flocks, in the dry monsoon, to the islands of Arroo, and other islands to the W. and N.W. of New Guinea. The great crown pigeon, parrots, lories, and minas, are natives of Papua.

The whole of this great country is indented with deep bays on every side, some of which nearly intersect the island; and the coast is surrounded on every side by a multitude of small islands, all peopled with the same description of blacks, excepting those already mentioned on the N.W., near the equator, most of which are under the government of Mahometan Malays, with whom both the Dutch and Chinese have long kept up intercourse.

New Britain, New Ireland, and neighbouring islands.

IV. There can be little doubt that this extensive range of islands was partially seen by Le Maire and Schouten in 1616, who, after discovering the Groene Island and the Marquen Islands, steered along the northern coast of New Ireland, as did Tasman also in 1642. Dampier, however, first ascertained New Britain to be an island distinct from New Guinea, by passing the strait which has since borne his name. He visited Port Montague on this island, and speaks of the black natives resembling the Papuans, their dexterity in managing their canoes, their woody hills, fertile

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vales, and delightful rivulets. He also anchored in Slinger's Bay, on New Ireland, which he conceived to be the same land with New Britain; but Carteret, in 1727, discovered and passed through a strait which separates them, and to which he gave the name of St George's Channel. The Admiralty Islands of Carteret, to the north-westward of New Britain, had previously been discovered by Schouten, and named the Twenty-five Islands. New Britain was seen by Roggewein in 1722, and by Bougainville in 1768.

D'Entrecasteaux, we believe, was the last navigator who passed along the N. coast of New Britain, and through St George's Channel, which divides it from New Ireland, and from thence to the Admiralty Islands; and from his voyage, published by Rossel, together with Labillardière's and Carteret's, we shall extract a few gleanings.

General description.

The extent of New Britain and Ireland is not exactly known, nor have they been sufficiently explored to enable geographers to lay them down with accuracy, or even to state what number of islands the group consists of. One of considerable extent lies off the N.W. end of New Ireland, which has been named New Hanover, and is itself surrounded by low woody islands. The whole group occupies a space between 2. 30. and 6. of S. Lat., and 149. and 153. of E. Long., and may probably contain an area not less than 10,000 geographical square miles.

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Natives.

Carteret, in passing through the strait, saw but few natives on the S. coast of New Ireland. These showed marked signs of hostility, and were armed with lances headed with flint; they had also slings and good fishing-tackle. They were black, and had woolly hair, but their lips, he says, were not thick, nor their noses flat; their cheeks were streaked with white, and their hair and beards were covered with a white powder. Their canoes were long and narrow, and had generally outriggers; one of them measured 90 feet in length, and was formed out of a single tree. The two large islands, and the whole group, in fact, were nearly covered with wood; and thick cocoa-nut groves skirted all the low parts of the coast. Labillardière says that New Ireland produces nutmegs; and he also mentions a new species of the Areca palm, 108 feet high, the stem consisting of hard solid timber.

The natives of the Admiralty Islands, lying to the N.W., were found by Carteret to be less black than those of New Britain and Ireland, with agreeable countenances, not unlike Europeans; their hair was curly, smeared with oil and red ochre, and their bodies and faces painted with the same material; the glans penis was covered with the shell called the *bulla ovum*, serving the same purpose as the wooden sheath of the Caffres in South Africa, whom, indeed, they seem to resemble as closely as the natives of New Guinea do those of the western coast of Africa. The women wear a bandage round the waist. The central island is tolerably large, and of a beautiful appearance, clothed with the most luxuriant verdure, and cultivated to the very summit. Among the groves of cocoa-nut trees are numerous habitations, and the natives have evidently attained to a higher degree of civilization than their southern neighbours: they use earthen vessels, and chew the betel leaf with chunam or lime. This central island is surrounded by nearly 30 small flat islets of coral, and reefs in the various stages of progress towards islets.

Proceeding to the westward and to the north-west, we meet with other little clusters of islands, as the Hermites, the Portland, the Echiquier (chess-board), vulgarly called Exchequer Islands, all of which consist, like the Admiralty Archipelago, of a larger central island surrounded by a chain of islets and reefs, most of them covered with beautiful verdure. The natives of these groups, as they approach the equator, gradually assume a lighter colour and longer hair, till they lose entirely the negro character, and merge into that of Malays and other Asiatic islanders.—See Schouten, Dampier, Carteret, Labillardière, &c.

Solomon's Islands.

V. This archipelago of islands was one of the first discoveries of the Spaniards in Australasia, though the credit of it is given to Alonzo de Mendana, who was sent on an expedition of discovery in 1567 from Callao by the viceroy of Peru. He anchored in a port on the island of Santa Ysabel, to which he gave the name of Porta de la Estrella; and he also built a brigantine to make further discoveries, in which she was particularly successful, having fallen in with no fewer than thirty-three islands, "of very fine prospect." Many of them were of considerable size, to which they gave particular names, as Galera, Buonavista, Florida, San German, Guadalcanar, San Christoval, Santa Catarina, and Santa Ana. Guadalcanar, however, was the most attractive, having a port which they named De la Cruz, and a river which they called Galego. Of this island Mendana took possession for the king of Spain. When the voyage was published, the name of Solomon's Islands was given to the group, "to the end that the Spaniards, supposing them to be those isles from whence Solomon fetched gold to adorn the temple at Jerusalem, might be the more desirous to go and inhabit the same;" but it has been said that Mendana's advice was, that they should not be colonized, "that the English, or others, who pass the Strait of Magelhanes to go to the Moluccas, might have no succour there, but such as they get from the Indians." The truth, however, is, that Mendana, on a second voyage for the discovery of the Solomon Islands, returned without being able to find them, which

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gave occasion to the remark, that "what Mendana discovered in his first voyage he lost in his second." He discovered, however, in this second voyage, the great island of Santa Cruz, which is situated at the S.E. extremity of Solomon's Islands, and may very fairly be considered as one of the group. This island, which has an excellent harbour, La Graciosa, was first revisited after Mendana's discovery by Carteret, in 1767, who changed its name to that of Egmont, and made it the principal island of a group which he called Queen Charlotte's Islands. Here Mendana died, and Quiros succeeded to the command; but the search for Solomon's Islands was abandoned when they were not more than 40 leagues from Christoval. It is a singular fact that Solomon's Islands, whose name was sufficient to tempt adventurers, were lost to Europeans for two centuries after their discovery, and that we know at present little, if any, more than Mendana gave to the world after his first voyage. They were revisited by Bougainville in 1768; by M. Surville in 1769, who, from a ridiculous mistake, called them the Archipelago of the Arsacides, to mark the natives as assassins; by Lieutenant Shortland of the British navy, in 1788, who chose to call them New Georgia; and frequently, since that time, by various British and French navigators.

Natives.

Santa Ysabel, says Mendana, was inhabited by people who had the complexion of mulattoes, with curly hair, and little covering to their bodies; who worshipped serpents, toads, and such like creatures; whose food was cocoa-nuts and roots; and who, it was believed, ate human flesh, "for the chief sent to the general a present of a quarter of a boy, with the hand and arm." Buonavista is twelve leagues in extent, very fertile, and well peopled, the natives living in regular villages or towns. On Florida, twenty-five leagues in circuit, the natives dyed their hair red, collected together at the sound of the conch-shells, and ate human flesh. Sesarga was well inhabited, produced plenty of yams and bread-fruit, and here the Spaniards saw hogs. In the midst of the island was a volcano continually emitting smoke. They saw bats which measured five feet between the tips of the wings. At Gaudalcanar they received in barter two hens and a cock, the first fowls that had been seen. At San Christoval the natives were very numerous, and drew up to give battle to the Spaniards, their arms being darts, clubs, bows and arrows; but they were dispersed by the fire of the muskets, which killed one Indian, and wounded others. In the neighbouring village was found a quantity of cocoa-nuts and almonds, sufficient to have loaded a ship. Santa Ana was well peopled and fertile. It has a good port on the E. side, where the Spaniards were attacked by the natives, who wounded three of the invaders, while a dart pierced through the target and arm of the Spanish commanding officer. The blacks had boughs on their heads, and bands round their waists. The Spaniards observed here hogs and fowls.

New Hebrides.

VI. To the S.E. of Solomon's Islands, and between the parallels of 14. 30. and 20. S. Lat., are found a number of islands, some of very considerable magnitude, called the New Hebrides or Hebudes. They were first discovered in 1606 by Pedro Fernandez de Quiros, who, with Luis Vaez de Torres, was sent by the king of Spain from Lima with two ships and a zabra (launch) to establish a settlement at the island of Santa Cruz, and from thence to go in quest of the Tierra Austral or southern continent. This voyage has been considered, and justly so, among the most celebrated undertaken by the Spaniards since the time of Magelhanes. In April 1606 they discovered an island, to which they gave the name of Santa Maria, from whence they saw another island to the southward, "so large," says Torres, "that we sailed for it." On the 2d May they anchored in a bay large enough to hold a thousand ships, to which they gave the appropriate name of San Felipe y Santiago. Quiros at once determined that he had now discovered the long-sought-for southern continent, and in this conviction named it the Australia del Espiritu Santo. Two rivers fell into the bay, one the Jordan, the other the Salvador. The surrounding country was beautiful, and is thus described by the historian of the voyage: "The banks of the rivers were covered with odoriferous flowers and plants, particularly orange flowers and sweet basil, the perfumes of which were wafted to the ships by the morning and evening breezes; and at the early dawn was heard, from the neighbouring woods, the mixed melody of many different kinds of birds, some in appearance like nightingales, blackbirds, larks, and goldfinches. All the parts of the country in front of the sea were beautifully varied with fertile valleys, plains, winding rivers, and groves, which extend to the sides of the green mountains."—Torquemada, as quoted in Burney's *Account of Discoveries in the South Sea.*

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Of this terrestrial paradise, which the Spaniards regarded as their own, it was intended to take immediate possession. They landed in great numbers; the islanders also were numerous, but became alarmed, made them presents, and signified a wish for them to return to their ships. They landed, however, from their boats, upon which the chief drew a line on the ground with the end of his bow, and made signs that the Spaniards must not pass that boundary. It is said that Torres, to show his contempt of the idea of being restrained by barbarians, immediately passed the line. A battle ensued, in which the chief was killed, and all the rest fled into the woods. This rash act, however, was fatal to the views of the Spaniards, who never afterwards could prevail on the islanders to have any friendly communication with them; and they left this country, after some ridiculous formalities of taking possession in the name of Philip III., and founding a city, dignified with the name of the *New Jerusalem.*

So anxious was Quiros of "adding the Australia del Espiritu Santo to the other possessions of the Spanish monarchy," that, after his return to Spain, he is said to have presented no less than fifty memorials to the king. One of these, which was printed at Seville, begins thus: "I, Captain Pedro Fernandez de Quiros, say, that with this I have presented to your majesty eight memorials relative to the settlement which ought to be made in *Australia Incognita.*" In these memorials he enumerates the many valuable productions of this supposed southern continent,—cocoa-nuts, plantains, sugar-canes, yams, batatas, oranges, limes, papas, pumpkins, almonds, nutmegs, mace, ginger, pepper in great quantities, and woods for "building any number of ships." The animals are hogs, goats, and dogs; fowls, and a variety of useful birds; various good fish, and pearl oysters. The climate is described as so fine, with such a freshness in the air, that neither by labour, exposure to the sun, or rain, or dews, nor by intemperance, did any of the Spaniards fall sick; and among the natives many aged people were seen. They wear a covering round the middle: Torres says they are all black and naked. They are described by Quiros as corpulent and strong, cleanly, cheerful, sensible, and grateful: their houses, built of wood and thatched, stood, not on posts, but on the ground. They weave nets, and make earthen vessels, have plantations inclosed with palisades, construct vessels which navigate to distant countries, and have places appropriated for burying the dead; and, he adds, as the last and decisive test of their progress in civilization, "they cut their hogs and make capons."

Description. Natives.

This archipelago of islands, like that of Solomon, was lost to the world for a century and a half, when Bougainville revisited them in 1768. Except landing on the Isle of Lepers, however, he did nothing more than discover that the land was not connected, but composed of islands, which he called the *Great Cyclades;* which, on being more accurately and extensively explored by Cook in 1774, underwent another change to that of New Hebrides, which they now bear in all our charts. According to the survey of our great navigator, they consist of Tierra del Espiritu Santo, the largest of the whole, St Bartholomew, Mallicolo, the Isle of Lepers, Aurora, Whitsuntide, Ambrym, Apee, Paoom, Three-hills, Sandwich, Montagu, Hinchinbrook, Shepherd's Isles, Erromango, Tanna, Immer, Annatom, and Erronan. The two which are more particularly described are Mallicolo and Tanna, the natives of which differ remarkably in their persons and language; those of the latter having curly but long hair, dark but not black, and without anything of the negro character in their features, which are regular and agreeable, their persons slender, active, and nimble. They were found to be

Australasia. hospitable, civil, and good-natured; but they displayed a jealousy of their visitors seeing the interior of the island, which could only be equalled in Japan or China. All the plantations were fenced, and laid out in a line; they consisted of sugar-canes, yams, plantains, bread-fruit, &c. The yams were remarkably fine, one of them weighing 56 pounds, every ounce of which was good; and they had pigs and poultry. The juice of the cocoa-nut and water appeared to be their only beverage. Their arms were clubs, darts, lances, and bows and arrows. Their canoes, clumsily sewed together, had outriggers, and were worked by paddles and by sails. The men wore a wrapper round the loins, and the women a sort of petticoat reaching to the knee.

The natives of Mallicolo are called by Captain Cook "an ape-like nation," the most ugly, ill-proportioned people he ever met with, and different from all others, diminutive in their persons, dark coloured, with black hair, short and curly, but not so woolly as a negro's; they had long heads, flat faces, and monkey countenances; and a belt round the waist, pulled tight across the belly, made them look not unlike overgrown pismires. The women were equally ugly; and the dress of both sexes was in other respects the same as that of Tanna, as were also the productions of the island. Their houses were low, and covered with palm thatch.—See Dalrymple, Burney, Cook, &c.

New Caledonia. VII. This large island, surrounded with coral islets and reefs, was wholly unknown till Captain Cook in 1774 fell in with the north-western extremity in steering south-west from Mallicolo, from which it is distant not more than about eighty leagues. He anchored within a small island called Balabea, and opposite to the district Balade. This great island extends between latitude 20. 5. and 22. 30., in the direction of N.W. and S.E., about 250 miles long by 60 broad. The land bears a great resemblance to that of New South Wales, and many of its natural productions appeared to be the same, but the natives were different.

Natives. The inhabitants are represented as a strong, robust, active, well-made people, courteous and friendly, and not in the least addicted to pilfering, in which respect they differ from every other tribe of Australasia. They are nearly of the same colour as the natives of Tanna, and appeared to be a mixed race between that people and those of the Friendly Isles, or of Tanna and New Zealand, their language being a mixture of them all. Of the same disposition as the natives of the Friendly Islands, they were found to excel them in affability and honesty; and the women, like those of Tanna, were chaster than the females of the more eastern islands. They wear a petticoat of the filaments of the plantain tree, "at least six or eight inches thick, but not one inch longer than necessary for the use designed." They paint and puncture their bodies, and wear ear-rings, and necklaces, and bracelets, of tortoise and other shells. Both men and women have good features and agreeable countenances; and some of the men measure in height six feet four inches. Their hair is frizzled out like a mop, and is very black, coarse, and strong, but different from that of a negro. The rough mop-heads make use of "scratchers," composed of a number of sticks of hard wood, about the thickness of knitting-needles, fastened together at one end like a sort of comb; the women have their hair cropped short. The men wear a wrapper round the loins, made of the bark of a tree. Their houses resemble bee-hives, with peaked roofs, entered by a hole just big enough to admit a man bent double. The sides are of spars and reeds, and both these and the roof well thatched with dry grass. They boil their roots and fish in earthen jars. They have nets made of plantain fibres, and the sails of their canoes are of the same material. These vessels consist of two trees fixed together by a platform. They have plantations of sugar-canes, plantains, bread-fruit, and cocoa-nut, but none of them very productive. The whole appearance of the country, indeed, is described as unable to support many inhabitants. The greater part of the visible surface consists of barren rocky mountains; and though the plains and valleys appeared to be fertile, Captain Cook was of opinion that "nature has been less bountiful to it than to any other tropical island we know in this sea."

D'Entrecasteaux passed the opposite extremity of New Caledonia in 1792, when on his search after the unfortunate La Pérouse, but was prevented by a barrier reef of coral from approaching the coast; and, in the following year, he visited Balade on the N.W. The account of the inhabitants, as given by Rossel and Labillardière, differs altogether from that of Cook. But their own account of their transactions there, the confidence with which they straggled over the country, and the readiness of the savages to serve them, by no means warrant the bad character they have thought fit to give them. Labillardière thinks the inhabitants, as well as the vegetable productions, resemble those of Van Diemen's Land. There was no want of different kinds of esculent plants, though a great scarcity prevailed from drought or other cause when they arrived. Australasia. The young shoots of the *Hibiscus tiliaceus*, the fruit of the *Cordia sebestina*, the *Dolichos tuberosus*, *Helianthus tuberosus*, *Arum esculentum*, and *Macrorrhizon*, *Hypoxis*, *Aleurites*, figs, oranges, plantains, sugar-canes, cocoa-nuts, and the bread-fruit, all afforded them articles of food. Yet Labillardière says they eat steatite, and that he saw one man devour a piece of this stone as large as his two fists. They also eat a species of spider. They had lost the hogs which Cook left them, but some half-dozen of cocks and hens were seen by the French.—See Cook, Labillardière, &c.

New Zealand. VIII. Though these islands geographically belong to Australasia, the natives are, in their physical character and language, Polynesians. They were first discovered on the 13th December 1642, by Abel Jansen Tasman, on his voyage of discovery from the Mauritius; and, on the 18th, the Heemskirk yacht and the fly-boat Zeehaan came to anchor in a bay to which they afterwards gave the name of Moordenaar's or Murderer's Bay, and to the island that of Staaten Land, in honour of the states-general, and in the possibility that it might join the Staaten Land to the east of the Tierra del Fuego. "It is a fine country," says Tasman, "and we hope it is part of the unknown S. continent." The expedition of Hendrik Brower to Chili the following year cut off the latter Staaten Land from any continental connection, and the name of the former was then changed to that of New Zealand.

On the 19th a boat with thirteen natives came within a stone's throw of the Heemskirk. The language in which they hailed was unlike that of the Solomon's Islands, of which Tasman had a vocabulary. Their vessel consisted of two narrow canoes, joined together by boards, on which the people sat; their paddles, about a fathom long, were pointed at the end; their clothing appeared of mats or cotton, but their breasts were naked. They were invited on board, but in vain. The ships, however, were moved nearer in-shore, upon which seven double vessels came off. A boat, despatched from one ship to the other, had previously been attacked. Three men belonging to the Zeehaan were killed, and one mortally wounded; one of the killed was dragged into the canoes. After this, despairing of getting water or provisions, they weighed and set sail, twenty-two of the native boats following them, eleven of which were full of people. The ships fired, and the canoes returned to the shore.

The next visitor, at the distant period of a hundred and twenty-seven years, was Captain Surville, who in 1769 put into a bay on the north-eastern extremity, and gave it the name of Lauriston Bay. In the same year Lieutenant (afterwards Captain) Cook of the Endeavour, made the land on the 6th of October, the enormous height of which became the subject of much conversation; and the general opinion was, that they had now discovered the *Terra Australis Incognita*. This voyage, however, and the circumnavigation of the islands of New Zealand, entirely subverted the theory of a great southern continent. In 1772 Captains Marion du Fresne and Crozet put into the Bay of Isles, where the former and some of the crew were murdered by the natives. In March 1773 Captain Cook in the Resolution, with Captain Furneaux in the Adventure, revisited New Zealand, where the latter had a whole boat's crew with a midshipman murdered by the inhabitants. In 1776 and 1777 a third visit was made to these islands by Captain Cook. In these several visits he was accompanied by men well versed in every branch of natural knowledge; and in the *Voyages* of Cook and Forster will be found every species of information that the ferocious disposition of the inhabitants made it practicable to collect.

Description. The two great islands of New Zealand extend between latitude 34° and 48° south, longitude 166° and 179° east; that to the northward, called Eaheinomawe, is about 400 geographical miles long by 90 in medial breadth. The name

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of the southern island is Tavai Poenammoo, which is about 450 geographical miles long by 95 broad. The former has a rich and fertile soil, well clothed with trees, some of them more than 20 feet in girth, and 90 feet high, without a branch. Some of them resembled spruce, and were "large enough for the mainmast of a 50-gun ship." The highest hills were covered with forests, the valleys with grass and shrubbery, and the plains were well irrigated with rills of clear water. The southern island is very mountainous; one peak, resembling that of Teneriffe, was estimated by Forster, but without sufficient data, at 14,000 feet in height: it was covered with snow in the middle of January. Both as to appearance and temperature, they may be considered as the British Isles of Australasia. Fahrenheit's thermometer in February was never higher than 66°, and was not lower in June than 48°.

A great part of the western side of these islands had, however, a desolate and inhospitable appearance; exhibiting ranges of yellow sandstone, or white sandhills, with scarcely a blade of verdure. It is worthy of remark, that this extraordinary difference prevails between the two coasts of South Africa, the two coasts of New Holland, and the two coasts of Van Diemen's Land.

Natives

The natives are stout and well-limbed, muscular, vigorous, and active, excelling in manual dexterity; their countenances intelligent and expressive, of an olive complexion, but not darker than a Spaniard. In the appearance of the women there is not much feminine delicacy; but on Cook's first visit they found them more modest and decent in their behaviour than any of the islanders they had met with. They were covered from the shoulders to the ankles with a sort of netted cloth made of the split leaves of the flax plant (*Phormium tenax*), the ends hanging down like fringes.

The black hair of the men is bound in a knot on the top of the head, that of the women is cropped; both sexes anoint their hair with rancid oil, and smear their bodies with grease and red ochre. The faces of the old men are covered with large furrowed black marks, generally spiral lines, and have a horrible appearance. The women wear in their ears pieces of cloth, feathers, sticks, bones, &c., and bracelets and anklets of bone, teeth, shells, &c. Captain Cook did not observe any appearance of disease, or bodily complaint, or eruption on the skin, or marks of any; and the most severe wounds healed most rapidly. Very old men, without hair or teeth, showed no signs of decrepitude, and were full of cheerfulness and vivacity. They are mild, gentle, and affectionate towards each other, but ferocious and implacable towards their enemies; and it unfortunately happens, that the little societies into which they appear to be divided, are in an almost perpetual state of hostility, which makes it necessary for them to dwell in happahs or villages, fortified with embankments, ditches, and palisadoes. They give no quarter, and feast with apparent relish on the bodies of their enemies, which they cut up and broil in holes dug in the earth; they suck out the brains, and preserve the skulls as trophies. They made no hesitation in devouring human flesh in presence of the English officers, and their provision baskets had generally a head or a limb of a human subject.

The only quadrupeds on the islands are pigs, dogs, and rats, the former of which they eat; but their principal food consists of fish, potatoes, and the bruised roots of fern. They cultivate, however, and with great neatness, sweet potatoes, eddas, and gourds, all planted in regular rows; and Cook observed near the villages both privies and dunghills. Their houses have a ridge-pole to the roof, which, with the sides, are built of sticks and grass, and lined with bark; they sleep on the floors covered with straw; and the furniture consists of a chest to hold their tools, clothes, arms, and feathers, provision baskets, and gourds to hold water, which is their only beverage; the New Zealanders being among the very few people, civilized or savage, who are ignorant of the means of intoxication.

Their double canoes or whale-boats are admirably constructed with planks from 60 to 70 feet in length, and their prows and sterns are tastefully and curiously carved and ornamented; all of which is performed by adzes and axes of a hard black stone, or green talc or jade, and with chisels of human bone or jasper. Of these materials also their offensive weapons are made: these are lances fourteen feet long, sharp at both ends, of hard wood neatly carved; and a battle-axe of jade or bone about a foot long. Their war canoes carry from 60 to 70 men each; they keep exact time with their paddles, singing, with great vociferation and distorted features, their savage war-song, when bound on any hostile expedition. Their war-dances are conducted in the same furious and extravagant style: the only musical instrument, if it can be called one, which they use, is a triton shell, which sounds like a cow's horn.

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They have, however, a taste for music, and the women are said to sing in a soft, slow, and mournful cadence, making use of semitones. When their husbands are slain in battle, they cut their legs, arms, and faces, with bone or sharp shells; and there are few of them who do not wear scars on their bodies as testimonials of their affection and sorrow for their deceased friends.

The natives of New Zealand exhibit a strange mixture of civilized and savage life. It was hoped, from the state of their cultivated grounds, of which several hundred acres were seen, that presents of hogs, kids, and poultry, would have been most acceptable, and considerable numbers were left with them on the first and second visits of Captain Cook; but, excepting the cocks and hens, which had bred plentifully, and flew about wild in the woods, the others had been wantonly destroyed. In 1791 Vancouver touched at Dusky Bay, and remained there for some time, examining the bays and creeks in the neighbourhood; but he did not see one human being. And in 1793 D'Entrecasteaux passed between the Three Kings' Island and Cape Maria van Diemen, but had no other communication with the natives except in their canoes. Unlike in some respects to the Tahitians, they have evidently a common origin; their language not differing more than the language of the two New Zealand Islands from each other. The few notions they have of superior beings also accord with those of Tahiti. (See Cook's *Voyages*.)

The following horrible transaction proves how well Captain Cook described the character of these cannibals. In December 1809, the ship Boyd, from Port Jackson, was at Wangaroa, in the Bay of Islands, and admitted, without due caution, too large a number of natives on board, when the crew were suddenly attacked, overpowered, and slaughtered. Captain Alexander Berry, of the ship Edinburgh Castle, being on the coast, was soon after apprised of this horrible event; and, proceeding to the bay, found the remains of the Boyd, which had been burnt by the savages. On landing, he discovered that the massacre had been directed by Tippahee, the old chief who had been so much caressed at Sydney. The bones of the unfortunate men lay scattered on the ground, where their bodies had been devoured by the savages. Sixteen were murdered and cut up on the deck of the vessel; five others, who had fled for safety upon the yards, were told by the old cannibal, that if they would come down their lives should be spared, which, after some hesitation, they consented to do. They were sent on shore, and in five minutes after their dead bodies lay on the beach. The only survivors which Captain Berry contrived to save, were a woman, two children, and a boy. Well might Captain Berry conclude the narrative of this horrid murder by an admonition, "Let no man trust a New Zealander."

The colonization of this group of islands by the British may well be considered an era in the history of Australasia. Little more than fifteen years has elapsed since the settlements of Auckland, Wellington, and other towns were established on the Waitemata, and the shores of Port Nicholson and other parts of the coast; and, though much bloodshed has followed the occupation of the lands of this warlike people—who are now known by their aboriginal name, Maori—the stranger may travel at the present day through their country, with as much security from robbery or violence as in civilized Britain. We speak from experience when we state that the stranger white man who goes amongst them with a peaceful object has everywhere the hand of fellowship held out to him, and is invited to partake of their hospitality. Strange to relate, but nevertheless true, the descendants of the old race of wild cannibals rarely speak of the practices of their fathers without horror, and exhibit the most pacific desire to trade with the Europeans, whom their progenitors never saw but to deceive and to devour. They have yielded to the all-powerful influence of Mammon; they love wealth; and they have become a subdued race by adopting the luxuries of the white man, which they cannot produce themselves. Where the missionaries failed in their attempts to bring them within the sphere of Christian civilization, and the strong arm of European warfare could not crush the indomitable spirit of these brave people, the slow but sure progress of commerce has laid that proud race submissively at the feet of the trading *Pakehas* (foreigners). The horrors of cannibalism are now becoming lost in the traditions of the past; for if the main cause of that practice was the desire for animal food, which could not otherwise be gratified in a region where no indigenous quadruped exists, the pigs, sheep, cattle, and vegetable produce of all kinds introduced by the settlers have now furnished them with abundance of the necessaries of life. A chief now, instead of leading his followers on to plunder and massacre the white men, may be seen walking into a banking office in Auckland or Wellington, and writing a cheque for a portion of his money deposited there; or sitting in a news-room perusing a newspaper

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printed in his own language. The history of the British in New Zealand is replete with interest; but it does not admit of more than a brief notice in this place. For further details see NEW ZEALAND.

To the eastward of New Zealand is an island of considerable extent and well peopled, discovered by Mr Broughton in 1791, when on a voyage round the world with Vancouver. He called it Chatham Island. The people and the productions are the same as those of New Zealand. (See Vancouver's *Voyage*.)

Auckland Islands.

The Auckland Islands, or Lord Auckland's Group, are in Lat. 50. 40. S. and Long. 166. 35. E., nearly 180 miles S. of New Zealand. They were so named by the discoverer, Captain Abram Bristow, master of a South Sea whaler belonging to Mr Samuel Enderby, in gratitude to the nobleman whose name they bear, for having procured him admission, when a boy, into Greenwich Hospital. This group was first seen on the 10th of August 1806; and on the 20th of October 1807, Captain Bristow came to anchor with his ship the Sarah in a fine harbour in the largest island, which he quaintly named Sarah's Bosom. This harbour, sometimes called Laurie Harbour and Rendezvous Harbour, has been renamed Port Ross by Mr Chas. Enderby in honour of Sir James Clark Ross, who surveyed the port. These islands have subsequently been visited and briefly described by Captain Morell of the American merchant service in 1829; by Commodore Wilkes of the United States exploring expedition; and by Admiral D'Urville of the French, and Sir James Clark Ross of the English navy in 1840.

The group consists of one large and several smaller islands. The principal island, Auckland, is about 30 miles long and 15 broad, and contains about 100,000 acres of land. The smaller islands, of which the principal are Adam's and Enderby, contain together about 20,000 acres. They are all of volcanic formation, composed of basalt and greenstone, and present a wild and picturesque appearance. The highest hill (Mount Eden) rises about 1350 feet above the level of the sea. Crawley's Harbour in the south of Auckland is described by Captain Morell and others as even superior to Laurie's Harbour. This island is fertile and well watered. The hills, except a few of the highest, are thickly covered with lofty trees of most vigorous growth, while the plains and valleys are clothed with luxuriant vegetation. Dr Hooker, who, in his *Flora Antarctica*, has given an elaborate account of the botany of these islands, says, "The whole land seemed covered with vegetation. A low forest skirts all the shores, succeeded by a broad belt of brushwood, above which to the summit of the hills extend grassy slopes. On a closer inspection of the forest, it is found to be composed of a dense thicket of stag-headed trees, so gnarled and stunted by the violence of the gales, as to afford an excellent shelter for a luxuriant undergrowth of bright green feathery ferns, and several gay-flowered herbs. The climate is described by Captain Morell as "mild, temperate, and salubrious. I have been told," he adds, "by men of the first respectability and talent, who have visited the island in the month of July, the dead of winter on this island, that the weather was mild as respects cold, as the mercury was never lower than 38° in the valleys, and the trees at the same time retained their verdure as if it was midsummer. At the time we were there the mercury seldom rose higher than 78°, although it answered to our July. The weather is generally good at all seasons of the year, notwithstanding there are occasional high winds, attended with heavy rain."

The domestic pig, introduced by Captain Bristow, is the only quadruped found in these islands. The woods abound with singing birds, and on the shores seals and seafowl are plentiful. "The only game observed," says Dr Holmes of the United States expedition, "were a few gray ducks, snipes, cormorants, and the common shag. The land birds are excellent eating, especially the hawks." Some officers of the French expedition, who visited the E. coast between the two harbours, found the banks full of fish, with a regular bottom varying from 15 to 20 fathoms.

The convenience of these islands as a station for the southern whale fishery was remarked by the various navigators who visited them, but has only recently been taken advantage of. Mr Charles Enderby, F.R.S., and his two brothers, sons of Captain Bristow's employer, having obtained a grant of these islands from the British Government, a company was incorporated in 1849 for the prosecution of this important object.

Kerguelen's Land.

IX. Between the parallels of 40. 30. and 50. S., and longitude 69° E., lies the barren and uninhabited land of Kerguelen, so named from the French officer who first discovered it in 1772, and who, on a second visit in 1773, discovered some small islands near it, but on neither occasion was able once to bring his ships to an anchor upon any part of the coast. Captain Cook was more fortunate. He had heard of Kerguelen's discovery at the Cape of Good Hope, and wondered he should not have seen this land when he passed it so closely in 1770. In 1776, however, he fell in with these islands, and as no account of Kerguelen's voyage had been made public, he gave new names to each island. Speaking of the main island, "I should," says Cook, "from its sterility, with great propriety call it the *Island of Desolation*, but that I would not rob M. de Kerguelen of the honour of its bearing his name." He changed, however, the *Baie de l'Oiseau* of the French, where they had landed in a boat and lodged a piece of parchment in a bottle, into *Christmas Harbour;* and called a round high rock Bligh's Cap, which had been named by M. de Kerguelen the Isle of Rendezvous,—although, says Cook, "I know nothing that can rendezvous about it but fowls of the air; for it is certainly inaccessible to any other animal." Kerguelen thought he had discovered the *Terra Australis Incognita*, but Cook soon determined that it was of no great extent.

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The hills were but of a moderate height, and yet in the middle of summer were covered with snow; not a shrub was found on this island, and not more than 17 or 18 different plants, one-half of which were either mosses or grasses. The chief verdure was occasioned by one plant not unlike a saxifrage, spreading in tufts, and forming a surface of a pretty extensive texture, over a kind of bog or rotten turf: the highest plant resembled a small cabbage when shot into seed, and was about two feet high. No land animals were met with, but great plenty of the ursine seal (*Phoca ursina*). Penguins were very abundant, as were also shags, cormorants, albatrosses, gulls, ducks, petterels, and sea-swallows. A few fish of the size of a haddock were taken with the line, and the only shell-fish were a few limpets and mussels.

The steep cliffs towards the sea are rent from the top downwards, but whether by rains, frost, or earthquakes, could not be determined. The productions of the hills were composed chiefly of a dark blue and pretty hard stone, intermixed with small particles of glimmer or quartz. Lumps of coloured sandstone, and of semi-transparent quartz, are also common. Nothing appeared like an ore or metal of any kind.—Cook's *Third Voyage*, vol. i.

St Paul and Amsterdam.

X. These small uninhabited islands are interesting only in a geological point of view. Situated in the midst of the great Indian Ocean, at the distance of 2000 miles from the nearest land, and removed but 18 or 20 miles from each other, they have no common point of resemblance; the one being the product of a volcanic eruption scarcely yet cooled, with a few mosses and grasses on its surface; the other composed of horizontal and parallel strata of rock, covered with frutescent plants—an appearance which led the scientific gentlemen in D'Entrecasteaux's expedition to conclude that an organization so regular could not proceed from a volcanic origin. A French seal-catcher from the neighbouring island had set fire to the shrubbery, which continued to burn when the navigators passed the island; and imagining that they saw smoke issuing from the crevices between the strata, some of them were disposed to consider this circumstance as infallible indications of subterranean fire. Perron, the seal-catcher above mentioned, with the gentlemen of Lord Macartney's embassy, who explored the southernmost island, Amsterdam, say that the shores of St Paul's abounded with pumice-stone.

Of the recent creation of Amsterdam there can be little doubt; indeed, it is scarcely yet cooled, and is altered considerably since its first discovery by Vlaming in 1696. From every part of the sloping sides of the crater, which is nearly 1000 yards in diameter, and into which the sea has forced its way, either smoke, or hot water, or hot mud, is seen to issue; and everywhere is felt a tremulous motion, and a noise heard like that of boiling water. In many parts of the crater, in the centre of which the water is 174 feet deep, the sea-water is tepid from the hot springs below; and numbers of these springs are found on the margin, below the high-water mark, of various temperatures, from 100° to the boiling-point. One very copious spring, slightly

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chalybeate, flows in a copious stream into the crater, nearly on a level with the lowest state of the tide.

Another singularity which this island presents is in its mosses and grasses, which are all European. To these may be added the *Sonchus oleracea*, or sow thistle; the *Apium petrosilenum*, or parsley; and the *common Lycopodium*, or club-moss, which grows luxuriantly on the bleak heaths of North Britain, and seems to thrive equally well on the boggy soil of Amsterdam, heated, at the depth of a foot below the surface, to the temperature of 186° of Fahrenheit's scale.

The crater abounds with an excellent perch of a reddish colour, which is easily caught with the hook, and may then be dropped at once into one of the hot springs on the margin, and boiled. So caught and dressed, we are told it affords an excellent repast. The bar across the mouth of the crater is represented as one mass of cray-fish; and in the sea, outside the bar, the vast multitudes of whales, grampuses, porpoises, seals, and sea-lions, render it dangerous for boats to pass. It was the same in Vlaming's time, who "found the sea so full of seals and sea-lions that they were obliged to kill them to get a passage through. When they steered from the shore there was also an astonishing number of fish."

Coral reefs and islets in the Australasian Sea.

XI. From the volcanic island of Amsterdam, we must now take a glance of those innumerable low islands and reefs of rocks which are scattered over the greater part of the Australasian Sea to the eastward and northward of New Holland, and which are produced by an operation of nature different from that which lifted up Amsterdam; less violent, indeed, in its character, than that by which the latter emerged from the abyss, but affording a basis equally, if not more, solid and enduring. A volcanic island not unfrequently breaks down its supporters, and sinks back into the cavity out of which it was hurled, as was recently the case with the Sabrina Island, near St Michael's; but the island of coral, created by slow and imperceptible degrees, hardens with time, and becomes one solid mass from the summit to the base.

Throughout the whole range of the Polynesian and Australasian islands, there is scarcely a league of sea unoccupied by a coral reef or a coral island; the former springing up to the surface of the water perpendicularly from the fathomless bottom, "deeper than did ever plummet sound;" and the latter in various stages, from the low and naked rock with the water rippling over it, to an uninterrupted forest of tall trees. "I have seen," says Dalrymple, in his *Inquiry into the Formation of Islands*, "the coral banks in all their stages; some in deep water, others with a few rocks appearing above the surface: some just formed into islands, without the least appearance of vegetation; others with a few weeds on the highest part: and, lastly, such as are covered with large timber, with a bottomless sea at a pistol-shot distance." In fact, as soon as the edge of the reef is high enough to lay hold of the floating sea-wreck, or for a bird to perch upon, the island may be said to commence. The dung of birds, feathers, wreck of all kinds, cocoa-nuts floating with the young plant out of the shell, are the first rudiments of the new island. With islands thus formed, and others in the several stages of their progressive formation, Torres Strait is nearly choked up; and Captain Flinders mentions one island in it covered with the *Casuarina*, and a variety of other trees and shrubs, which give food to parakeets, pigeons, and other birds, to whose ancestors it is probable the island was originally indebted for this vegetation. The time will come—however indefinite that period may appear—when New Holland, and New Guinea, and all the little groups of islets and reefs to the N. and N.W. of them, will either be united into one great continent, or be separated only by deep channels, in which the strength and velocity of the tide may obstruct the silent and unobserved agency of these insignificant but most efficacious labourers.

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A barrier reef of coral runs along the whole of the eastern coast of New Holland, "among which," says Captain Flinders, "we sought 14 days, and sailed more than 500 miles, before a passage could be found through them out to sea." Captain Flinders paid some attention to the structure of these reefs, on one of which he suffered shipwreck. "Having landed on one of these creations," he says, "we had wheat-sheaves, mushrooms, stags' horns, cabbage leaves, and a variety of other forms, glowing under water, with vivid tints of every shade betwixt green, purple, brown, and white." "It seems to me," he adds, "that when the animalcules which form the coral at the bottom of the ocean cease to live, their structures adhere to each other, by virtue either of the glutinous remains within, or of some property in salt water; and the interstices being gradually filled up with sand and broken pieces of coral washed by the sea, which also adhere, a mass of rock is at length formed. Future races of these animalcules erect their habitation upon the rising bank, and die in their turn, to increase, but principally to elevate, this monument of their wonderful labours." He says that they not only work perpendicularly, but that this barrier wall is the highest part, and generally exposed to the open sea, and that the infant colonies find shelter within it. A bank is thus gradually formed, which is not long in being visited by sea birds; saline plants take root upon it, and a soil begins to be formed; a cocoa-nut, or the drupe of a pandanus, is thrown on shore; land birds visit it, and deposit the seeds of shrubs and trees; every high tide and gale of wind adds something to the bank; the form of an island is gradually assumed; and last of all comes man to take possession. If we should imagine one of these immense coral reefs to be lifted up by a submarine volcano, it would be converted into an insular or continental ridge of hills of limestone.

It is worthy of remark, that, in this great division of the globe, fully equal in extent to that of Europe, there is no quadruped larger than the kangaroo; that there is none of a ferocious character, and, in many of the islands, none of any description. Man only in Australasia is an animal of prey; and, more ferocious than the lynx, the leopard, or the hyæna, he devours his own species, in countries too where nature has done everything for his comfort and subsistence.

The time is not far distant, however, when these inferior races must disappear before those exterminating influences to which we have already alluded, or their characteristic peculiarities be absorbed in the overwhelming tide of civilization. The same depopulating effects to which we have pointed in speaking of the aboriginal tribes in Australia and Tasmania, may be traced among the Maori race in New Zealand—a race which, fifteen years ago, was calculated at its lowest estimate to number 80,000 individuals. In vain do they strive to multiply their children, and to perpetuate their families by the most tender care. During our travels through the Kaipara country on the North Island, we observed chiefs with five, and as many as ten, wives, and only three or four sons and daughters; and we have heard Tirarau, chief of the Wairoa, lament in the following strain:—"I see the white man with one wife have ten children, while I with ten wives have only one child." It was melancholy to hear such remarks from these intelligent people, who are conscious of the decrease of their race; and that their lands will become peopled by the "Pakehas" when they are no more, as they are aware is the case throughout America. At a moderate calculation they are fewer by 12,000 now than they were fifteen years ago, when colonization was begun to any extent by Anglo-Saxon settlers, who have ever since kept up an indiscriminate intercourse with the Maori women. It is also observed, that the number of deaths is greatly above that of the births, which are chiefly a half-caste progeny. See NEW ZEALAND.

(J. B—W.) (S. M.)

AUSTRALIA,

Australia. Geography.

OR NEW HOLLAND, the largest island on the globe, is situated in the southern hemisphere; and, as described in the preceding article, forms the mainland around which are clustered those groups of islands which in modern geography constitute the *fifth* great division of the earth's surface. Wilson Promontory, its most southern angle, is in Lat. 39. 11. S., and Cape York, its northernmost headland, in Lat. 10. 43. S. Its greatest breadth from N. to S. is thus 1708 geographical miles, or 1965 statute miles. Cape Byron, the eastern limit, is in Long. 153. 37. E., and Cape Inscription, in 112. 55. E., forms its westernmost point; making the extreme length of the island from E. to W. about 2603 British miles, by an average breadth of 1200 miles—a tract of land well entitled to be called a continent, by which name it is frequently designated by geographers. Its superficies approximates to 2,690,810 square miles. That of the continent of Europe being 3,684,841 square miles, we can form some idea of its extent by comparison.

The nomenclature and geographical subdivisions of this island-continent have undergone many alterations from time to time, as the territory has become colonized. Before any settlement had been effected by the British Government upon its shores, the entire island was designated New Holland, not only by the Dutch—from whom it received its name—but on our own charts and maps. The E. coast, first discovered and explored by Captain Cook in 1770, was named by him New South Wales. The middle portion of the N. coast bore the name of Arnhem Land, after the ship of its discoverer Zeachen in 1618. The W. and S.W. coasts were named in like manner by their discoverers, the Dutch navigators, in the seventeenth century, De Witt's Land, Endraght's Land, Edel's Land, Leeuwin's Land, and Nuyt's Land. That of Van Diemen's Land was given by Tasman to what he supposed was the southern peninsula of New Holland, but which was afterwards discovered by Bass to be an island. The colonists have been anxious to name it after its discoverer, but the government still retain the first title.

Since this great territory has become the undisputed possession of Britain, other names, with the exception just mentioned, have, according to the law of nations, been substituted for the old Dutch titles. New South Wales is only applied now to about one-half the E. coast territory. The name of the entire island also is changed from New Holland to the more appropriate designation of Australia, by which it is now universally recognized and described. The subdivisions South, North, and Western Australia would be equally proper if their boundaries were defined according to the ordinary rules of geographical dissection. But while the first section, South Australia, is only the middle portion of the S. coast, trending inland to the central region; and the second, North Australia, embraces all to the N. of New South Wales; the third section, Western Australia, nearly bisects the island, leaving a small tract of land between it and South Australia with no name at all. A better division would be to draw a line right across from E. to W. in Lat. 26. S.; thus bisecting the island near its intertropical parallel; for although this line would be 3½ degrees S. of the Tropic of Capricorn, still the influence of the tropical rains and winds ascend even higher than this parallel. At all events this would be sufficient for us to designate the northern section *Tropical Australia*, and the southern *Temperate Australia*. Besides these two great meteorological divisions, they could conveniently be subdivided into four political sections by drawing another line from S. to N. in the meridian of 133. 30. Each of these sections might then be designated, according to its direction from the centre, South-western and North-western Australia, North-eastern and South-eastern Australia. And these again might be subdivided into provinces, as the last-named section includes the three colonies of New South Wales, Victoria, and South Australia. This arrangement would tend to simplify an important section of geography which at present is very much confused.

Australia. Geography.

If, for the better elucidation of our subject, we suppose these lines and boundaries to exist on the map, the northern or tropical division has little to do with the history of British colonization in Australia. It is within the temperate zone that our colonies have been planted and successfully nurtured. And this tract, again, separated by the meridian line suggested, confines to a still smaller compass the subject of our description. The group of colonies which absorb the attention of the statesman and merchant in that far-off land, are comprised within the last-named section, South-eastern Australia. On the W. it is bounded by a line drawn from the S. coast in Long. 132. E., meeting another line drawn at a right angle from the E. coast in Lat. 26° S.; the southern and eastern boundaries being formed by the coast line; which, by following the sinuosities of the gulfs and bays, comprehends a sea-board of nearly 2000 miles. Again, if a line be traced on the map, commencing about 150 miles inland from the head of Gulf St Vincent, and continued more or less (within half a degree) the same distance from the coast until it reaches the northern boundary line, the intermediate space will give a fair average of the extent of country at present colonized, which may be estimated in round numbers at 1500 miles long by 150 miles broad, or 225,000 square miles; or nearly three times the superficies of England.

This section of Australia is politically divided into three provinces; which, with the western colony and the unsuccessful settlements in the northern section, we shall treat of severally under the following heads:—

1. NEW SOUTH WALES.
2. VICTORIA, or PORT-PHILLIP
3. SOUTH AUSTRALIA.
4. WESTERN AUSTRALIA.

New South Wales.

I. NEW SOUTH WALES is bounded on the E. by the South Pacific Ocean; from Cape Howe to Wide Bay, forming a sea-board of 750 miles. A line drawn from Cape Howe in a N.W. direction inland, crossing the Australian Alps to the source of the Murray River, and continued along the N. bank of that stream, as far down as 141. E. Long. is the southern boundary. From this point a line traced upon the map due N. until it forms a right angle with the parallel of 26. S., the northern boundary, constitutes its limits westerly. The jurisdiction, however, of the executive government and legislature of the colony, extends beyond the northern boundary as far as Cape York and Port Essington.

General History.

In reviewing the history of New South Wales from its first settlement, there are three distinct eras in its political, social, and commercial progress, which mark its short but eventful annals to the present time. Firstly, its foundation and existence as a penal settlement; when it depended solely on support from the mother country. Secondly, the opening of the colony to independent and bounty emigrants; who rendered it a self-supporting colony; and, thirdly, the recent gold discovery, which has made it one of the most wealthy and self-dependent provinces of our colonial empire. Each of these distinct eras has been marked by a complete change in the previous condition of the body politic, according as its destinies were influenced by a penal, a pastoral, and a mining population.

First period.

During the first period referred to, the history of New

Australia. South Wales may be considered solely an account of British colonization in the Australasian seas.

New South Wales. It was after the separation of the United States from this country that it was first proposed to establish a colony for the reception of convicts from Great Britain on the eastern shore of Australia, or New Holland as it was then called; and in the year 1787 preparations were completed for carrying the design into effect. On the 13th of May 1787, a fleet consisting of eleven sail of ships, including a frigate and an armed tender, and having on board 565 male and 192 female convicts, with 200 troops, and several of their wives and children, set sail from Portsmouth; and after a voyage of eight months, arrived at their destination on the 18th, 19th, and

Phillip, 1788. 20th of January 1788. Captain Arthur Phillip of the royal navy was appointed the first governor of the colony. Botany Bay, where it was proposed to fix the settlement, was found ill adapted for that purpose. In seeking for a more eligible situation, Captain Phillip entered the inlet to which Cook had given the name of Port Jackson, which he found one of the most capacious and safe harbours in the world, navigable for vessels of any burden fifteen miles from its entrance, indented with numerous coves, sheltered from every wind, and possessing the finest anchorage. Within this harbour, on the shores of Sydney Cove, thinly wooded, and the haunt of the kangaroo, but now marked out as the capital of the future empire, the British ensign was hoisted on the 26th of January 1788. They immediately proceeded to clear the ground, to land the live stock and the stores, and to establish the colony, amounting to 1030 souls. In its early progress the settlers encountered numerous obstacles, which it required extraordinary courage, and perseverance, and untiring industry to overcome. These arose from various causes,—from the extremely sterile soil around Sydney Cove, from which no industry could extract a sufficient supply of grain for the wants of the people; from the profligate habits of the convicts, which occasioned continual disorders among themselves; from their outrages on the natives, and the retaliation which these produced. It was some years before an adequate supply of provisions for the maintenance of the colony could be derived from the ungrateful soil. The settlers consequently depended on foreign supplies, which did not arrive, and they experienced the severest privations. The loss of the store-ship the Guardian, under the command of Captain Riou, when proceeding to their relief with a large supply of provisions and stores, was a severe blow to the prosperity of the colony; and the general distress was greatly aggravated by the unseasonable arrival of a convict ship with 222 female convicts on board, thus increasing the number of consumers without any addition to the stock of provisions. The consequence was a severe scarcity, during which the weekly rations were, in April 1790, two and a half pounds of flour, two pounds of rice, and two pounds of pork; the governor sharing equally with others in the common calamity. Even this allowance, barely sufficient for the wants of nature, could not have been afforded if the governor had not sent off upwards of 200 convicts and troops to Norfolk Island, which is about 21 miles in circumference, with a fertile soil. Here the settlers, with even smaller allowance than at Sydney, would probably have perished, but for an unlooked-for supply from a flight of aquatic birds alighting on the island to lay their eggs. Owing to the length of their pinions, they take wing with difficulty; and they were so numerous that from 2000 to 3000 were taken every night, besides an incalculable quantity of eggs, which was a seasonable supply, and saved the lives of this detachment from the main body. Every effort was made to obtain supplies from China, India, and the Cape of Good Hope. There were not at one period four months' provisions in the store on the most reduced scale, and several persons had already perished. Shortly after, three other vessels arrived with convicts, a large number of whom perished of the scurvy during the voyage. For about three years the settlers were in danger of starvation, and it was not till June 1790 that relief was afforded, by the arrival of three transports from the Cape; and in the following year a ship of war arrived at Sydney, conveying ten vessels, with 1695 male and 68 female convicts, after losing 198 on the passage. The arrival of this fleet changed the aspect of affairs, and gave the necessary stimulus to the industry of this rising community. Amid the difficulties with which the colony had to struggle, its improvement was not altogether neglected. Cultivation was begun, farms were established at Rose Hill (Parramatta), at other places two towns were commenced, and a few convicts were emancipated, and obtained grants of land as settlers.

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Governor Phillip embarked for England in December 1792, when Lieutenant-governor Grose succeeded to the government. He was succeeded, on the 15th December 1794, by Captain Paterson of the New South Wales Corps; and, on the 7th August 1795, Governor Hunter, a captain in the royal navy, arrived, and immediately entered on his important office. From the year 1792 the improvement of the colony was decisive and rapid. It was in 1789 that the first harvest was reaped at Parramatta; and in 1793 the settlers were enabled to sell corn to the public stores, which was purchased at a given price. Trade began to make its appearance; passage-boats were established between the towns of Sydney and Parramatta, and the settlers visibly increased. The bulls and cows that had been originally brought to the new settlement had, by the carelessness of the keeper, been suffered to stray into the woods, and every subsequent search had proved ineffectual, when a fine and numerous herd of wild cattle was at length discovered in the interior of the country, evidently the progeny of the animals which had been so long lost to the settlers. At the close of the year 1795, the public and private stock of the colony consisted of 57 horses, 227 head of cattle, 1531 sheep, 1427 goats, 1869 hogs, besides a numerous breed of poultry. The total quantity of land in cultivation amounted to 5419 acres. At this period the storehouses were so completely exhausted, that, on the arrival of Governor Hunter, there were no salt provisions in store; and the settlement was, as before, reduced to rations. The colony was in danger of falling back; and it was only the speedy arrival of a store-ship at this critical and distressing moment that saved it from destruction in the seventh year of its establishment.[1] At the commencement of the year 1800, the inhabitants had increased to 6000. The stock consisted of 203 horses and mares, 1044 cattle, 1024 sheep, 2182 goats, and 4017 hogs. The quantity of land sown with wheat was 4665 acres, with Indian corn 2930 acres, and with barley 82 acres.

Hunter, 1795.

Governor Hunter quitted the colony in the year 1800, on the 27th September, and was succeeded by Captain Philip Gidley King, R.N., who had effected the settlement on Norfolk Island. His administration lasted six years, and was distinguished by what is termed the "Irish rebellion," which broke out about the year 1804. Several hundred convicts attached to the government establishment at Castlehill, about 20 miles from Sydney, struck work and demanded their liberty; having armed themselves with pikes, they prepared for resistance. They were, however, overthrown after a brief contest by the troops at Vinegar Hill, a few miles from Parramatta, on the Hawkesbury road; a few were shot by the troops; the leaders were apprehended; three of them were led to instant death; two others were executed the following day at Sydney, three others at Castlehill, and the remainder returned quietly to their labour. There is no other instance of any insurrection in the colony by the convict population.

King, 1800.

[1] Collins's *Account of New South Wales*, p. 253.

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A printing-press had been established in the colony about the year 1795, by Governor Hunter, and in March 1803 the *Sydney Gazette* was published by authority. In 1800 a copper coin was issued by the government. The colony was at this time governed by general orders issued by the government. Captain King does not seem to have been adequate to the magnitude of the trust committed to him. He quitted the colony in August 1806, and was succeeded by Captain William Bligh, R.N., who was even less qualified than his predecessor. He had given ominous proofs of his incapacity as commander of the Bounty, where by his tyrannical conduct he provoked the men to a mutiny; and his selection for the delicate task of rearing up this infant colony evinced a marked indifference to its welfare which merits decided condemnation. His administration produced exactly the consequences which might have been expected. So unwarrantable was his tyranny, and especially his persecution of one influential person, noted alike for his public spirit and for his private virtues, that the colonists, with all the honest indignation of freemen, declared against his authority; and being aided by the officers and men of the New South Wales Corps, they deposed him, and marching up to the government-house, they dragged him from his concealment behind a bed, and carefully protecting his person and property, sent him on board a sloop of war, in which he set sail for Europe, after he had been governor for 18 months. He was succeeded by General Macquarie on the 1st January 1810; the government having in the meantime, from 26th January 1808 to the 28th December 1809, been successively administered by Lieutenant-colonels Johnstone, Foveaux, and Colonel W. Patterson. During the government of General Macquarie, which lasted for 12 years, the settlement made great progress in wealth and improvement. The population was increased by the influx of numerous convicts, and some new settlers; though it was not till a later period that the full tide of emigration began to set in towards Australia. By aid from the British treasury, many public buildings were erected, roads were constructed, and the colonists, compelled by a season of drought in 1813, and animated by the spirit of discovery, made their way over the barrier of the Blue Mountains, hitherto deemed impassable. It was in search of new pasturage, and by following the course of the Grose river, that a pass was at last found, and a road commenced in the following year, over this mountain range, whose summits were considered by the aborigines to be inaccessible, and who often declared that there was no pass into the interior.[1] One great principle of Governor Macquarie's administration was to encourage and bring forward the convict population. It was his maxim to consider the European life of every convict as past and forgotten; their arrival on the shores of Australia as a new era in their existence, in which the errors of the past might be entirely redeemed. It was a most enlightened and benevolent policy; and if he erred in carrying it into effect with too little discretion, as was alleged, it was the error of a generous mind. Under his rule the convicts were patronized; some were chosen to be magistrates; he conferred on others colonial situations of trust, along with liberal grants of land. But his further endeavours to introduce into respectable society those who had been branded as felons, were opposed by the invincible antipathies of the European settlers, who, though they agreed in countenancing and rewarding good conduct in the convict population, could not be persuaded that any after purity of life could thoroughly efface their original disgrace. Such an intermixture of classes could only be effected by the debasement of European manners, and by lowering the moral tone of society in the colony.

Bligh, 1806.

Macquarie, 1810.

The departure of Governor Macquarie, on the 1st December 1821, marks the close of the first era in Australian history, embracing a period of 34 years. During that time the convict-pioneers had cleared the wilderness, tilled the ground, constructed bridges, roads, and other public works, unaided by free labour or private capital, at an average expense of L.300,000 per annum to the British treasury, and a total cost, up to this date, of nearly L.10,000,000 sterling. The armies of inexperienced immigrants who subsequently opened up the resources of the interior, thus found the most difficult preliminary task in colonization already accomplished to their hands. Until the year 1820 the British government assisted free settlers to emigrate, by paying their passages, and giving them grants of land, at peppercorn rents, upon their arrival; allowing them, also, convict servants under the assignment system, at the public expense, and frequently giving them a bonus of live stock to commence with. Very few, however, availed themselves of these inducements; for there was no spot on earth at this period the name of which sounded more abhorrent in the ears of the British public than that of *Botany Bay*. The white population, therefore, consisting at this date of 29,783 souls, were three-fourths of them either prisoners of the crown or emancipated convicts; while scarcely one-third were females. They were distributed in small detached settlements along the coast and within the county of Cumberland, mainly employed in constructing public works; while a few were engaged in tilling the ground, and tending the sheep, cattle, and horses, thinly spread over the 19 counties of the colony, as yet but imperfectly explored. The pastoral live stock at this period did not muster more than 250,000 sheep, 5000 head of horned cattle, and a few hundred horses. The capabilities of the colony, however, for the growth of fine-woolled sheep were by this time fully ascertained; and the four merino rams and twenty ewes, first imported in 1803, under the superintendence of Mr Macarthur, rapidly increased. Still the amount of wool exported—the only produce of the colony available in a foreign market—was but a trifling set-off against the enormous expenditure for the maintenance of the colony; an expenditure, however, which the subsequent unparalleled growth of the free colonies of Victoria and South Australia has amply justified.

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Let us now, before passing from our first period, give a cursory glance at the statistics of 1851, the close of the second. The 30,000 inhabitants had increased in 30 years to 359,158 in the parent colony and its two younger neighbours, of whom not 10,000 were convicts, and about five-sixths were females. In that year, just before the gold discovery, the extent of country occupied by the flocks and herds of the colonists covered more than four times the area of the original 19 counties of New South Wales; and they could muster, on good pasture land, not far short of 18,000,000 of sheep, 2,500,000 head of horned cattle, and 150,000 horses. The value of their exports of wool and tallow alone for the preceding year exceeded L.3,000,000 sterling; and the public purse of the colony was not only independent of bounty from the mother country, but the expenditure for military establishments and gaols was disbursed out of the colonial revenue—the first example of the kind in the history of our colonial empire.

Second period. Sir T. M. Brisbane, 1822.

Major-general Sir Thomas Brisbane, K.C.B., a man of acknowledged science and talent, succeeded General Macquarie; and with his arrival commenced that influx of free immigrants, which gives a distinctive character to his and the succeeding administrations. As New South Wales became more and more a community of free British subjects, the acts of the governors were of less importance in marking the progress of events, than the efforts of the colonists themselves. Heretofore the orders of the governor were supreme; and there was none to demur against their acceptance and enforcement as laws. But these mandates,

[1] See *History of Australasia*, by R. Montgomery Martin, F.S.S.

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although adapted to the constitution of the colony as a penal settlement, in fact a huge gaol or penitentiary, were opposed by the free and independent settlers, who found them oppressive, and questioned their legality. Consequently the absolute authority with which Sir Thomas Brisbane entered upon the duties of his administration, was modified in the second year after his arrival. In 1823, an act was passed authorizing the king to appoint a local council consisting of seven members to assist the governor in making laws for the colony, subject to His Majesty's approval. This concession, however, was not enough to meet the demands of the free colonists, and disagreements ensued, in consequence of which the governor returned to England before the expiry of his term of administration; delegating his power to Colonel Stewart, who acted as lieutenant-governor from the 1st December 1825 to the 18th December 1826. He was succeeded by Lieutenant-general Sir Ralph Darling, who, during his harsh administration of five years, made himself still more unpopular. The public press had by this time two representatives in the colony, and the acts of the governor were unsparingly criticized. General Darling was forced to yield to the superior strength of public opinion, and left the colony on the 21st October 1831. His irresponsible acts, however, probably accelerated the improvement of the internal government of the colony. In 1829 a legislative council was formed, which passed an act to establish trial by jury, and several other beneficial measures. The free immigrants about this period pressed rapidly forward into the interior, and settled down amidst their multiplying flocks. Towns began to spring up on a hundred spots in the interior, and steam-boats were first launched on the Australian waters. In the mother country the spirit of colonization was alive; and a new colony was projected on free principles to occupy the waste lands of Western Australia. The samples of fine wools which arrived in the London markets vied with the finest fleeces of Germany and Spain; and the mania for emigration began to spread among the upper classes.

Sir R Darling, 1826.

The eighth governor of New South Wales was Major-general Sir Richard Bourke; the most statesman-like, and withal the most liberal-minded ruler the colony has yet had. Steering a middle course between Darling's tyranny and Macquarie's amiable weakness, he organized anew the relations between the independent settlers and the convict population. With mild yet firm rule he brought together the contending interests of the free and the bond. And wherever he deemed it necessary, he unhesitatingly established the institutions of the mother country; endeavouring to make the gentlemen settlers and their families realize that, in staking their fortunes on the prospects of the colony, they had not forfeited the privileges and immunities of their native land. To the state of public morals he especially directed his attention, and caused acts to be passed to regulate and endow public schools and places of worship. The waste lands of the crown were no longer granted to absentee holders, or at peppercorn rentals, but put up to public auction and sold to the highest bidder; the proceeds being employed to assist the emigration of free labour. This fund increased from L.3617 in 1831 to L.132,396 in 1836. The revenue from the customs likewise increased rapidly, from the extending commerce of the city of Sydney; its harbour being pronounced by maritime authorities to be the finest commercial port in the world. The returns of the prosperous condition of the colony under the sway of its judicious governor, attracted an increasing number of emigrants from Britain; and the harbour of Port Jackson was thronged with richly laden vessels, freighted by respectable families of moderate means, in search of the "Golden Fleece" within the territory of the no-longer-dreaded shores of Botany Bay. Even foreigners who had formerly shunned these shores as if infected by plague, now landed their luxuries in safety, for which they obtained high prices; while the more fortunate colonists rolled along in their carriages through stone-built streets, lined with handsome warehouses and public edifices. In the country, gentlemen's seats sprang up on all sides; and good turnpike roads intersected the settled districts, which were thronged by vehicles of the agricultural population bringing their produce to market. In fine, before fifty years this antipodal offshoot of British civilization had taken deep root, and already began to extend its branches to an unforeseen growth. In the far interior the settlers found that the pastoral limits of the old colony were insufficient for maintaining their increasing flocks; and the neighbouring colonists in Van Diemen's Land found themselves in similar circumstances. Some adventurous settlers from that colony crossed Bass's Strait to the mainland, and settled on the shores of Port Phillip. The people and government of New South Wales were not long in following up the enterprize, and annexing the surrounding territory to their colony. The result has been the formation of the most flourishing province in Australia, the gold colony of Victoria. At the same time took place the establishment of South Australia, on the shores of Gulf St Vincent—a detailed account of which will be found under its proper head in this article. The importation of so much wealth to the southern shores benefited still more the parent colony on the east coast; and the colony of New South Wales, upon the retirement of Governor Bourke on the 5th December 1837, had arrived at a state of prosperity unexampled in the history of British colonization. To his representations and exertions was attributed, as his crowning effort in establishing free institutions among the colonists, the virtual abolition of transportation to New South Wales in 1839. At his departure, he was followed by the heart-felt acclamations of the colonists, who, in grateful acknowledgment for his services to their adopted country, have erected a statue to his memory at the western gate of the Sydney domain.

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Sir R. Bourke, 1831.

From the 5th December 1837 to the 23d February 1838, Lieutenant-colonel K. Snodgrass administered the affairs of the colony. He was succeeded by Sir George Gipps. This appointment was an unfortunate circumstance both for the new governor and the colony. His preconceived opinions of the high prerogatives belonging to the crown, in consequence of the settlement having been originally established without the aid of free capital or labour, rendered his administration, which lasted eight years and a half, a period of bitter political hostility between his government and the entire community, especially the higher class of free and independent colonists: and although no Australian governor's domestic life was of a more unsullied character than his, the acerbity of his temper banished from his presence many experienced men, whose private counsel would have been most beneficial to the newly-appointed governor. By this time the social and moral condition of the people had undergone a surprising degree of improvement from the influx of free immigrants; this was not merely amongst the upper circles in Sydney, and on the estates of landed and stock proprietors, but among the community at large. A moral tone prevailed in domestic society throughout the colony quite equal to that existing in the best localities of the mother country. Besides these beneficial effects from the infusion of fresh and uncontaminated blood into the body politic, many of the new settlers were related to families of rank, and with the advantage of wealthy connexions in Britain, had come to engage in colonial pursuits with large funds in hand. It was not uncommon to meet with gentlemen having L.20,000 in cash, ready to invest in land or to purchase stock; while private associations sent out managers with sums varying from L.50,000 to L.100,000 for the purpose of growing wool, and producing tallow for export as a means of profitable investment. Joint-stock companies, also, were formed in the great metropolis, who despatched their staffs of officers, with paid-up capitals rang-

Gipps, 1838.

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ing from L.250,000 to L.1,000,000 sterling, to facilitate the operations of banking, effecting insurances and mortgages, so as to obtain a high interest for their money. Wealth flowed likewise into the treasury from the land sales and customdues as it never had done before, until the governor found a large surplus in the public coffers. The imports of British merchandise, and the exports of colonial produce, averaged as many pounds per head of population as in the Canadian provinces it amounted to shillings. During the year 1846, when Governor Gipps left the colony, the former amounted to L.1,320,000, and the latter to L.1,481,000, amongst a population of 190,000 people. Thus the material prosperity of the colony had progressed, uninfluenced by the contentions of the higher powers; and notwithstanding the reckless speculations of the people, which brought about a general bankruptcy in 1841–3, it is but fair to state that the successful progress of the colony, throughout all its monetary difficulties, was maintained by the indomitable energy and high intelligence of the upper class of colonists—the merchants, squatters, landholders, and the representatives of the people in the legislative council. The independent members of the legislature expressed their judgment on the measures of the governor and executive, by passing a vote of censure on the government, and rejecting a bill brought forward by the colonial secretary for the maintenance of the border police. This proved a final blow to the administration of Sir George Gipps, and served to hasten his departure, which took place on the 11th July 1846.

Lieutenant-general Sir Maurice O'Connell, commander-in-chief of the forces throughout Australasia, acted as governor between 11th July and the 3d August 1846, when his successor arrived and assumed the administration of affairs. This was the tenth governor of New South Wales. Sir Charles Augustus Fitzroy, K.G.H., who holds the appointment at present, and who has lately been invested with the power and title of governor-general of the Australian colonies, which gives him certain jurisdiction over the lieutenant-governors of Victoria, South Australia, Van Diemen's Land, and Western Australia. Happily the instructions from the home government allow greater latitude to the colonists in the management of their own affairs than under Sir George Gipps. The government of Sir Charles Fitzroy has been in consequence infinitely more popular than that of his predecessor. Two significant facts have recently occurred, which tend to show the amicable relations between the government and the elected representatives of the council. One was the council's voting a considerable increase to the colonial secretary's salary,[1] and handing him over back pay, with the full concurrence of all the elected members. The other was his Excellency recommending to Her Majesty that their speaker should receive the honour of knighthood in virtue of his office. This title was recently conferred upon Sir Charles Nicholson; but, not to form a precedent in such cases, it was bestowed upon him in consideration of his private virtues and eminent abilities.

Fitzroy, 1846.

An important act came into operation during the first year of the present administration, under the sanction of an imperial ordinance, to the effect that the squatters, who were formerly considered yearly tenants at will, occupying crown lands, should henceforth obtain leases of their sheep and cattle "runs" for eight and fourteen years; with right of pre-emption, and compensation for improvements on the land. This was a great concession to the colony on the part of the then colonial minister, Earl Grey; and has proved a boon to the pastoral interests. If he had dealt equally justly with the agricultural population, and lowered the high minimum price of land from L.1 to 5s. per acre, submitting parcels for sale in small sections, as petitioned for by the colonists, he would have been bestowing a benefit on the community at large, and offering advantages to the introduction of a yeomanry-farmer class who have never emigrated much to Australia. But that high minimum price on crown lands is still in force; and as long as it is so, the mass of the people will be an erratic labouring class; whereas, with a cheap and easy tenure in the land, they will become a fixed population in spite of the attractions of the gold fields. What made his measures still more obnoxious to the colonists, that minister endeavoured to renew transportation to New South Wales after it had been virtually abolished by a predecessor in office ten years before; and despatched several ship-loads of convicts to Port Jackson and Port Phillip, where they were landed under the specious name of "Pentonville Exiles." The colonists were immediately up in arms. They assembled in public, they petitioned, and nearly opposed by force the landing of the convicts, until the local government had to warn the imperial legislature of the consequences. Ultimately, delegates from the inhabitants of the three colonies, who had united and formed themselves into an *Anti-Convict League*, were despatched for England to place before Her Majesty the disastrous effects of a renewal of transportation under any form to their shores. They showed with great truth that the evils resulting from the introduction of a felon class amongst a mixed population of emigrants, who were enjoying all the privileges and institutions of a free people, was fraught with the most demoralizing results, would utterly close their colonies to the importation of free labour, and thereby tend to ruin their prospects. We have already pointed out the fact, and commented favourably upon the policy of selecting *pioneers* for the purpose of encountering the first hardships of a new colony such as this, from among the malefactors of the parent country, both as a punishment and means of reformation for the criminal; but we do not advocate the *continuance* of this description of labour after the colony has an abundance of free labour for all its wants. Not only is it prejudicial to the moral and social condition of the colony, but transportation under such circumstances becomes a reward instead of a punishment. These crying evils becoming apparent from the revolt of some convicts on board the hulks at Chatham, who demanded to be transported, and above all, the gold discovery, not only induced the government to accede to the representations of the delegate from the *Anti-Convict League*, Mr. J. C. King of Victoria, but, what was of equal importance to the colonies generally, to rescind the order which made Van Diemen's Land a penal settlement. The growing wealth and prosperity of Port Phillip—which until 1851 was a dependency of New South Wales—likewise induced the Queen's government in 1850 to grant the petition of the colonists in that section of Australia to be separated from the parent colony, and declare it to be a distinct province of the British crown under the title and name of Her Majesty, Victoria; at the same time granting to the new colony a representative legislature, besides extending the constitution of New South Wales. These concessions on the part of the imperial government are hopefully regarded by the colonists as the precursors of a more liberal policy in future on the part of the colonial office.

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The political emancipation of the colonists in Victoria, and the extended privileges granted to the people of New South Wales, immediately preceded the astounding gold discoveries in 1851; and, as if still further to enable the political economist to draw his inferences from these events, it so happened that, in the month of March, two months before the gold discovery, the quinquennial census of the population was recorded. From it and the annual statistical re-

[1] This office is at present (1853) ably filled by Mr Edward Deas Thomson.

turns, may be exhibited a correct view of the social condition and material prosperity of the colony of New South Wales in this eventful year, when, two months after the gold discovery, Port Phillip was separated from it, marking at the same time the close of the second, or pastoral era, in the history of the country. Thirty years had elapsed since emigrants in any considerable number began to settle in this land of the felon; and they had since increased and multiplied so greatly, that the prisoner population was lost in the general multitude. These industrious immigrants had tilled and replenished the soil of their adopted country, until the solitary plains and forests swarmed with their flocks and herds; and fields of yellow corn sprung up in desert places.

The population on the 1st March 1851 (exclusive of Port Phillip) was 189,951, of which 108,691 were males and 81,260 females. The general statistics on the 31st December 1850 gave:—Live stock in the colony, 5,660,819 sheep, 952,852 horned cattle, 63,895 horses, and 23,890 pigs; 69,219 acres under cultivation, exclusive of vineyards, 995 acres producing 103,606 gallons of wine. Imports, L.1,333,413. Exports, L.1,357,784, including 14,270,622 lb. of wool, valued at L.788,051; and 128,090 cwt. of tallow, valued at L.167,858. Ordinary revenue, L.248,613. Coin in the colony L.690,852. Paper currency, L.266,602. Shipping inwards 421, of 126,185 tons. Shipping outwards 506, of 176,762 tons. Mills: steam, 64, water, 38, wind, 26, horse, 30. Six woollen-cloth establishments producing 200,000 yards, 5 distilleries, 20 breweries, 3 sugar-refining manufactories, 16 soap and candle, 15 tobacco and snuff, 4 hat, 4 rope, 36 tanneries, 5 salting and preserved-meat establishments, 93 tallow-melting do., 1 gas-work, 7 potteries, 1 glass-work, 1 smelting-work, 13 iron and brass foundries, and 5 ship-building yards.

Altogether the aspect of affairs, and the future prospects of New South Wales prior to the gold discovery were of the most encouraging description. And while her material prosperity was satisfactorily recovering from the depression consequent on the monetary confusion in 1841–3; her social condition had reached a climax of unexampled security and freedom from crime. These favourable symptoms of national progress likewise extended themselves to a greater degree amongst the lesser population of the newly-separated colony of Victoria at this time. Five years, we believe, had elapsed since a public execution had been witnessed either in Sydney or Melbourne; the greatest desperadoes in the country having emigrated to California. The newly-arrived stranger, on walking through these young cities, was struck with the peaceable demeanour of the inhabitants, and the respect they paid to the constituted authorities. But the gold discovery, like some sudden stage transformation, changed this state of general tranquillity into a chaos of public crime and domestic confusion, universal Mammon-worship and selfish aggrandisement, which at one blow, in the course of a few months, dislocated the structure of society, and the machinery of the government.

Third period. The Gold Discovery.

From a letter written by Mr Edward Hammond Hargraves to the colonial secretary, dated the 3d April 1851, we learn that on the 12th of February previous he had discovered the existence of gold among the alluvium of the surface rocks over a large area of crown lands within the settled districts of the colony; which subsequently turned out to be from 20 to 30 miles beyond the town of Bathurst, an inland town 125 miles from Sydney. He was led to prosecute a search for the precious metal in that locality, from the similarity of that mountainous section of New South Wales to the auriferous regions of California, where he had successfully worked as a gold-digger. Governor Fitzroy was doubtful of the discovery, from the circumstance of a similar statement having been made to him two years before, by a Mr Smith of Berrima, who allowed the matter to drop on the governor's refusing to pay him a large fixed sum for the discovery. At the same time, Sir Roderick Impey Murchison, president of the Royal Geographical Society, and other eminent geologists in the colony and in England, had predicted the discovery of gold in the Australian mountain ranges, from their presenting similar characters, both geographically and geologically, to the gold-bearing mountains in Russia. Partly from these representations, and partly from the general claims of the colony to have its mineral wealth scientifically investigated, the government had just recently appointed Mr Samuel Stutchbury as geological surveyor; and that gentleman at this period was prosecuting his *stereotyped* researches not very zealously in the mountain ranges at a short distance from Mr Hargraves. It is worthy of notice, that gold had been found in its native state from time to time some 20 years previous, by a Scotch shepherd, who was known to have sold a large quantity to the jewellers in Sydney; having kept the secret so long from a fear, as he stated, that if any one dogged him to the spot, they might murder him. Notwithstanding these and other evidences which need not be specified, no one had prosecuted the search systematically before Mr Hargraves, who demonstrated the fact publicly and without delay, To him, therefore, is due all the honour of the discovery.

After having intimated to the government that he was satisfied to leave to their liberal consideration any reward or remuneration they chose to offer him for his discovery, he posted off to Bathurst, and announced to the astounded inhabitants that they were living within a day's journey of the richest gold mines in the world. Followed by a number of the enterprising inhabitants, he led the way to Summer-hill Creek, and there, in a romantic vale, surrounded by hills, where this streamlet wound its course round a picturesque point of land, they dug the auriferous earth from the adjacent bank, washed it in the stream, and found that the soil was mixed with grains of gold. These gold-pioneers who thronged to the first "diggings," reminded of the resemblance between their country and the rich gold mines mentioned in Scripture, called this spot the Valley of Ophir.

This was in May 1851, and it became the signal for the colonists in other parts of the territory to be up and doing. "Ascertaining the nature and description of the rocks occurring in the vicinity of the gold deposits, they immediately set to work in their own localities to search for the hidden treasure, instead of flocking with the multitude to the Bathurst mountains, concluding wisely that these comprised only a small section of the great mountain chain where it existed. Like the industrious tenants of an Australian ant-hill suddenly roused, the whole community of bushmen became alive amongst the rocks and valleys of the colony. Stockwhips and shepherd's crooks were thrown aside for pick-axes and shovels, with which these adventurous men might be seen exploring the gold regions, and with what success is now well known to the world."[1] The Turon River, Muckerwa Creek, Louisa Creek, Meroo Creek, Frederick's Valley, Abercrombie River, and Araluen Vale, had their hidden treasures exhumed by the industrious diggers. And in three months after the workings at Bathurst had been set in operation, the newly-erected province of Victoria, within seven weeks from the time of her separation from New South Wales, disclosed her treasures at Ballarat; and before the close of the year, the Mount Alexander gold region gave forth that astounding yield of the precious metal, to which no record of ancient or modern times can furnish a parallel.

1 Mossman and Banister's *Australia Visited and Revisited*, p. 179.

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The result of the latter discovery not only arrested the departure of the Victoria colonists who were flocking to the Bathurst Mountains, but afterwards turned the tide of adventurers from the parent colony to the greater attractions of the Mount Alexander gold fields, which threatened at one time to decimate the populations of Sydney and the surrounding townships.

The gold was not merely found in the scales or grains which at first came from the stream-washings at Ophir, but it was now dug up in large masses, varying from several ounces to many pounds in weight, which were familiarly called "nuggets" by the diggers, after the Californian name given to these *pepitas* or nodules; and in one instance, at Louisa Creek, 106 lb. weight of pure gold was found by an aboriginal shepherd, imbedded in the quartz matrix, which formed one solid block of about 3 cwt. Neither was it found in the beginning at any great depth in the ground, but in many localities lay scattered among the surface soil, and hung to the roots of trees and shrubs. So easily and plentifully did it come to the hands of the gold-seekers, that it bore the aspect (and such was the belief of many of the less-informed diggers) of having only then sprung into existence from the earth, or having recently been scattered over the land by some mysterious agency; instead of carrying along with it the geological fact that its veins are coeval with the primary rocks. It was also discovered that the convicts had built a bridge across a small stream on the Bathurst road to Carcoar, above the gold formation, and that they had unconsciously paved the road with broken fragments of the gold-quartz veins. Even in the streets of Bathurst and Melbourne, small particles of the precious metal were picked up by children in its natural bed: and several farmers and gardeners found that they had been ploughing, digging, sowing, and planting their grain and trees in the auriferous soil. A knowledge of these facts industriously circulated by the colonial press, throughout a community possessed of all the modern facilities of information, and keenly alive to the speculations of money-making, could not but fairly upset the minds of the people. Consequently, a gold-mania seized every class of colonists, to the temporary suspension of all industrial pursuits.

Then followed a heterogeneous scramble for the coveted ore throughout the length and breadth of the land; which spread like wildfire to the neighbouring colonies of South Australia, Van Diemen's Land, and New Zealand, threatening to depopulate them of their male adult inhabitants. Masons and bricklayers left unfinished buildings in the towns; shopmen left their counters, clerks their desks, sailors their ships; and artizans of every description threw up their employments, leaving their masters, and their wives and families to take care of themselves. All other interests were absorbed in the search for gold; scarcely any other subject was talked of, or thought of; and the mass of the people ran off to the "diggings"—as this new occupation was termed. Nor did the mania confine itself to the labouring classes, for "these were soon followed by responsible tradesmen, farmers, captains of vessels, and not a few of the superior classes; some unable to withstand the mania and the force of the stream, or because they were really disposed to venture time and money on the chance; and others because they were, as employers of labour, left in the lurch and had no alternative. Cottages became deserted, houses to let, business was at a stand-still, and even schools were closed. In some of the suburbs not a man was left, and the women were known for self-protection to forget neighbours' jars, and to group together to keep house."[1] The ships in the harbour also were in a great measure deserted; and instances were known, where not only farmers and respectable agriculturists found that the only thing they could do, seeing that the people employed by them had deserted, was to leave their farms and join their men in the golden scramble; "but even masters of vessels, foreseeing the impossibility of maintaining any control over their men otherwise, agreed to make up parties among them, abandon their vessels, and proceed with their crews to the gold fields."[2] The towns and their environs being thus drained of their labouring populations, the prices of provisions rapidly rose. The common necessaries of life reached famine prices; which fell heavily upon those depending upon salaries. This, coupled with the high wages demanded by domestic servants, forced the upper classes of society to dispense with their services, and the ladies had to perform the household drudgery. Clerks and others under government, and in public and private offices, finding it impossible to make both ends meet, threw up their appointments and rushed to the diggings, and even the constabulary force were leaving the towns unprotected. During this state of affairs, the government were obliged to raise the salaries of their officers, in order to maintain a sufficient staff for the public service, and to preserve the public peace, which was becoming sadly disturbed. The banks and mercantile firms were obliged also to follow their example.

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Meanwhile, the governments of New South Wales and Victoria—the two gold colonies—looked with apprehension upon the probable result of this gold-revolution amongst a pastoral population widely scattered over the country; a portion of whom had but recently been reclaimed from the ranks of the felon. Therefore, how to regulate the prosecution of this new pursuit on crown lands became a matter of grave consideration. The crime and anarchy which had prevailed in California upon a similar discovery, brought the worst fears to their recollection. Precautionary measures were promptly taken, and all the available military force—which was but slender—was called into requisition, assisted by the mounted police to maintain order and authority at the localities where the diggers were working; for at some places communities had assembled, and erected tents, with the rapidity of a military encampment, in larger numbers than were to be found congregated within the ordinary townships scattered over the country. A proclamation was issued asserting the right of the Queen's government to all gold or precious metals found on crown lands; and that every person digging therein in search of it, or any individuals trading or otherwise profitably employed at the diggings, must take out a monthly license and pay the sum of 30s. This measure was at once acceptable to the people; and gold-commissioners were appointed to see that it was carried into effect. Notwithstanding the excitement which prevailed at the first blush of the discovery, and during the subsequent discoveries in other localities, which drew from time to time one-half of the adult male population to the gold fields, to the honour of the people of New South Wales be it said, that no greater amount of crime existed in that colony during the following eighteen months than the usual average. "Everywhere," as stated in the despatches of his excellency the governor-general, "the gold-diggers were loyal, orderly, and obedient to the laws," and they cheerfully paid the fee of one shilling per diem for license to dig. The same flattering testimony cannot be borne to Victoria, where a Californian state of anarchy at one time threatened the subversion of all law and order; the consideration of which will be reserved for our remarks on that colony. At the close of 1851, six months' experience had proved the most satisfactory results as to the extent and richness of the gold deposits. In New South Wales, upwards of 20,000 licenses were issued; and the export sheet from the port of Sydney

[1] Lieut.-governor Latrobe's Despatches.

[2] *Ibid.*

Australia. showed that 142,975 ounces, valued at upwards of half a million sterling, had left the colony.

New South Wales. By this time also, hundreds, nay, thousands, had ascertained that they were morally and physically unfit for the hard labour and privations to be encountered in the search for gold. The consequences were, that not only did many clerks, shopmen, and artizans, come back to their former occupations in the towns, but much distress was felt by those who had abandoned lucrative employments, which were shut against them on their return; in many instances impaired in health from exposure to the rigorous climate of the gold regions, which, it will be understood, were first worked in the winter season in Australia. The beneficial effects which accrued from this reaction in favour of the industrial pursuits, was the supply of labour to be had, although at exorbitant wages, for securing the wool-crop of the season. Not only was this evil result anticipated among others at the beginning of the gold discovery, but at many sheep and cattle stations in the far interior, the herds and flocks were abandoned by their keepers, and at that period nothing short of utter ruin to the pastoral interests of the colony hovered over the sheep-farmers and graziers. In one instance, an enterprizing squatter drove 26,000 sheep into one flock, which he shepherded with four trusty shepherds on horseback. Here, as in other matters, the gentlemen settlers and capitalists in the colony proved themselves equal to the occasion; and much consideration is due to them for assisting to maintain the peace and prosperity of the community, by their untiring energy and support given to the government, under such an unlooked-for event. And where at first the squatters anticipated a ruinous reduction in the value of their stock, the demand for sheep and cattle to supply the diggers with food raised the prices 50 per cent., while the landholders found new purchasers of land among the judicious and fortunate gold-diggers. So at the close of the year 1851, the prospects of New South Wales, on all sides, were most cheering, where the reverse was expected. The population had increased to 197,168 persons. The value of the imports was L.1,563,931, and the exports L.1,796,912. Thus, the average of the former for every man, woman, and child in the colony, would be at the rate of L.8 per head, and of the latter about L.9. The ordinary revenue = L.277,728; and the crown revenue L.208,969; the coin in the colony L.560,766; and the paper currency L.418,541. The wool exported = 15,269,317 lb., valued at L.828,342; the tallow 86,460 cwt., value L.114,168; and the gold 144,120 oz. 17 dwt., value L.468,336. Shipping inwards 553 vessels, of 153,002 tons, having 7955 men on board; and the shipping outwards 563 vessels of 139,020 tons, having 7988 men.

From the circumstance of gold mines having been hitherto only worked by barbarous or despotic nations, who from ignorance or policy shrouded their operations in mystery, our information regarding the extent and character of gold-bearing rocks throughout the world was of a very meagre description. The "great fact," therefore, of gold regions being discovered, and worked within territories claimed by the Anglo-Saxon race in California and Australia, is not only an event of considerable interest in the history of the world, but has proved of the utmost benefit to science, in determining this important question in auriferous geology. Not only was the gold found in the ordinary quartz matrix, but the reports of the geological surveyors of New South Wales have shown that it is found in granite at Araluen Creek; schistose or slaty rocks at the Turon; and in Frederick's Valley specimens were found of a ferruginous rock, beautifully dotted with globules of gold. It would seem, therefore, that gold is the most universally distributed of metals among the unstratified rocks, although found in greatest abundance in the quartz veins which intersect these rocks. However, the great bulk of the gold found in Australia has not been extracted from its matrices, but dug out of the gold alluvium formed by the disintegration of these rocks. Hence the gold mines in this region have received the familiar name of "diggings," from the practical-minded Americans and Australians. What are termed the "gold diggings," then, are spots where the miners have to dig pits from 10 to 50 feet deep before they arrive at the substratum of auriferous soil in which the particles of gold are found loosely imbedded. This subsoil is generally a stiff blue clay mixed with sand and gravel, and the pure metal appears in scales about the size and shape of bran or shellings; and in rounded grains and lumps varying from the size of a pin's head to the form and dimensions of flints as they occur in chalk, a specimen of which, when gilded, gives exactly the appearance presented by these gold nodules, or, as they are now universally called, "nuggets." This alluvium is collected and mixed freely with water in a tub, which is termed "puddling." After having undergone two or three washings, the residue is thrown into a cradle or wooden trough, with "cleets" or ribs fastened across the bottom, and a sieve at the head, which prevents large stones or lumps of gold from passing through. The cradle is then rocked and tilted to and fro, while water is poured over the auriferous sand or gravel. When sufficiently washed, the residue at the bottom of the cradle is examined carefully, the large pieces, if any, picked out, and the scales of gold separated from any foreign substance by further washing in a tin dish, until it is perfectly clean; after which a magnet is passed through it to extract small particles of iron-sand, which are frequently mingled with it. Upon reaching the "washing-stuff," as the "diggers" term the gold alluvium, they sometimes see the nuggets dotting the earth, and collected into heaps or "pockets," which they extract easily with the point of a knife. This pleasing operation to the fortunate digger is called "nuggeting." Again, a similar process is followed at some localities where the grains of gold lie on the surface of the ground, technically termed "forsicking."

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History, 1852. The crisis of the gold discovery having mingled among the records of the past, the colony of New South Wales was fairly started, in 1852, on the third era of her eventful history, which may be literally termed the golden era. Fresh discoveries of deposits of the precious metal occurred throughout the length and breadth of the land; but they all proved inferior in richness and quality to the gold fields of Victoria. At the same time the average yield per digger equalled that of the younger colony, where the population on the gold fields was five times greater. It would appear, however, from the reports of the government geologists, that the gold drift of New South Wales was more superficial, and contained a smaller percentage of metal than that of Victoria. It was in vain that the press argued the point, so as to turn the main tide of emigration to their shores, for while 2000 a-week were arriving in Port Phillip, there were scarcely so many per month landing on the shores of Port Jackson. Not only was the number of immigrants small, but there was a re-emigration of about three-fourths of them with old colonists to Victoria. The stockholders suffered immensely during that year, from the scarcity of hands to tend their herds and flocks. A large portion of live stock was sent to the boiling-down establishments, which increased the export of tallow from 86,460 cwts. in 1851, to 118,182 cwts. in 1852. On the other hand, the export of wool decreased from 15,268,473 lbs. in the preceding year to 11,068,974 lbs. Although that year did not produce such brilliant results in her material progress as that of the sister colony, yet she enjoyed a condition of comparative domestic comfort and public tranquillity. One great moral evil, however, was alarmingly on the increase amongst the labouring population, viz., that of drunkenness. Thus, whilst the government were rejoicing at the increase of revenue derivable from the customs, the sober colonists had

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to deplore the excessive importation of intoxicating liquors which furnished it. It was proposed to check the growing evil, by passing some stringent law similar to the Maine Liquor Law in America, but there were constitutional obstacles which would render such a law abortive.

1853.

The progress of the colony during 1853 compared with its previous advancement was in every way encouraging, both as regards its political condition and material prosperity; and so far as these concerned their own particular sphere, the community could look with pride upon the aspect of the country in the sixty-fifth year of its colonization. But in this year it became apparent that such a degree of progress was no longer any criterion to the world at large of its claims to be the first colony in the Australasian group. The gigantic strides which its former dependency Victoria had made in population and wealth during the previous two years, had raised that young province in the estimation of the world to be the most important British colony in the southern hemisphere. In the mother country the *prestige* of the parent colony was gradually being eclipsed by its offshoot, not only in the minds of the emigrating and commercial public, but in that of the government. Meanwhile the industrial pursuits of the colony were pursued with vigour, and many public and private works of utility, which had been stopped for a season, were resumed with energy. Amongst the most important was the commencement of a line of railway from Sydney to Goulburn, 125 miles on the road to Melbourne. The Australian Steam Navigation Company likewise had their fleet of steam-vessels increased, so that the means of transit, internally and externally, were being made more effective in opening up the resources of the colony. In common with the neighbouring colonies, New South Wales benefited by the establishment of steam communication with the mother country. A line of steamers was laid on between Australia and Singapore, by the Peninsular and Oriental Company, conveying a mail every alternate month to join the overland mail from India to Europe, which carried news from the colonies to England in sixty-five days. Besides this route, there were occasional steamers made the voyage out *via* the Cape of Good Hope, and it was expected this could be accomplished in sixty days, but hitherto without success. In Sydney the formation of three new Anglo-Australian banks gave a speculative tendency to commercial transactions. The amount of bills under discount at the close of the year amounted to L.3,138,200; while the total assets of the banks were L.7,660,900, against L.6,550,800 of liabilities, leaving only L.1,110,100 as the working capital. When gold was low in price and sovereigns scarce, the colonists petitioned the home government to send them a mint to coin sovereigns in the colony. It arrived about this time, and there were more sovereigns in the colony than was required for circulation. Consequently the expensive machinery of which it consisted became of no avail. Moreover, it was found that coins from the colonial mint would not be current as a legal tender beyond the Australian possessions.

1854.

Early in 1854, symptoms of neglect for the interests of the colony, and an evident leaning towards Victoria, on the part of the imperial government, showed that New South Wales did not hold the first place in the official mind at the colonial office amongst the Australian group of colonies. This was practically exemplified in the month of March, when it was announced that orders had been received for the removal of the commander of the forces and the entire military staff from Sydney to Melbourne. The colonists took umbrage at this, and denounced the measure "as a piece of gross injustice, and of marked disregard to the claims for priority, which the acknowledged metropolis of the Australian colonies undoubtedly possesses." They looked upon it as the precursor of still greater changes on the appointment of Sir Charles Hotham to the lieutenant-governorship of Victoria, who was expected to be made governor-general, on Sir Charles Fitzroy being succeeded by Sir William Denison from Van Diemen's Land. During this year the imports of merchandise far exceeded the demand, and there was the same glut in the markets of Sydney as at Melbourne. Considerable commercial distress was the result. Those among the merchants and shopkeepers who could not hold out until the goods were worked off, were obliged to succumb, and many failures happened in consequence. There was a marked increase of internal trade carried on between Sydney and the northern districts of the colony around Moreton Bay. No workable gold fields had yet come to light, and yet the exports of produce averaged half a million annually. A movement had taken place amongst the settlers in that distant part of the colony to petition the home government for separation from the parent settlement, as in the case of Port Phillip. But this proposition fell to the ground for want of support within the walls of the legislative assembly. That body had likewise discussed the proposition submitted to them by the government, of forming a new constitution for the colony. Like their neighbours, they had given it as their opinion that nominee members should not form an element of the future assemblies, that there should be a lower house similar to the present, and that an upper house be formed by members possessed of a high money qualification. The general affairs of the colony were in a progressive state towards the close of the year; and the tranquillity of the colony presented a contrast to the rebellious condition of Victoria.

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Topography. Pl. XXVI.

The colony of New South Wales, until the separation of Port Phillip, comprehended within its present boundary only nineteen counties, namely, Cumberland, Camden, St Vincent, Northumberland, Gloucester, Durham, Hunter, Cook, Westmoreland, Argyle, Murray, Brisbane, Bligh, Phillip, Wellington, Roxburgh, Bathurst, Georgiana, and King. The act which erected that district into an independent province, divided the squatting districts S. and N. of the nineteen counties into forty-nine more, namely, Cowley, Buccleuch, Dampier, Beresford, Wallace, Wellesley, Auckland, Macquarie, Hawes, Parry, Buckland, Pottinger, Inglis, Vernon, Dudley, Sandon, Raleigh, Gresham, Clarence, Richmond, Rous, Buller, Ward, Churchill, Stanley, Cavendish, Canning, March, Lennox, Fitzroy, Aubigny, Merivale, Bentinck, Drake, Clive, Gough, Hardinge, Darling, Napier, Gowen, Gordon, Monteagle, Clarendon, Selwyn, Lincoln, Ashburnham, Harden, Wynyard, Goulburn, making in all sixty-eight counties. They extend along the coast about 800 miles, and into the interior about 180 miles. Not only is the whole of that extent of country thoroughly explored and occupied by the settlers, but a trigonometrical survey has been nearly finished; so that the map of New South Wales, in the tracing of its mountains and streams, is assuming that detailed appearance presented by the ordinary maps of Europe.

General aspect of the country.

The general aspect of the country in the interior may be called mountainous or hilly; and covered with an open forest occasionally intersected by brushwood thickets. On the sea-coast, along which the great South Pacific Ocean rolls its tremendous surge, it is bold and rugged, and for five or six miles from the coast it wears a bleak and barren aspect; presenting a soil composed mainly of drift sand, scantily covered with stunted trees and shrubs. But this would give an inadequate and unfair description of the whole; for, like the entire island itself, it is the most chequered country of good and bad land in the world. In the interior, rich and fertile valleys lie in the lap of these ranges, such as the Vale of Clywd, to the westward of the Blue Mountains; and extensive undulating grassy plains, like those of Maneroo and Liverpool plains, are approached through a barren and rocky region. On the coast, also, the romantic and fertile district of Illawarra in Camden, a ma-

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ritime county to the S. of Cumberland, is surrounded by a desolate region of barren hills; and the rich valley of the Hunter River system of waters contrasts with the Clarence and Richmond to the northward. Again, the tropical aspect of the jungles and mangrove swamps of Moreton Bay are so different from the verdant prairies of the Darling downs almost destitute of timber, and with few streams, that the traveller approaching the former from the E. and the latter from the S. could scarcely imagine them to be in the same country within 1000 miles of each other; and yet they are contiguous. To give, therefore, the most succinct view of this territory, it would be necessary to describe each district. As our limits, however, prevent this, it will suffice to give the general character of the two great watersheds from the main range or cordillera which divides the eastern from the western streams. From Mount Kosciusko, 6500 feet high, —the highest of the Australian Alps—situated 120 miles inland from Cape Howe, this range of mountains extends in a northerly direction through the whole extent of the colony to the boundary line at Moreton Bay. The rivers which flow to the eastward have 100 outlets on the sea-coast; descending rapidly from their sources—which are on the average under 80 miles in a straight line from their outlets, and 1800 feet above the level of the sea; passing through a hilly region in a tortuous course. The streams flowing to the westward, deriving their sources from 1000 fountainheads, flow through extensive valleys and plains, describing a multitude of ramifications until they either join in one great river 400 miles from their sources, or lose their waters in extensive marshes. The land on the eastern streams is for the most part inferior in quality, both for agriculture and pasture, to that on the western streams. While the latter enjoys a cooler climate than the former, it consists also of a rich black and dry soil, covered with luxuriant herbage, interspersed here and there with valleys, open woodlands, and forests, whereon the herds and flocks of the settlers now graze, and a busy population of gold-seekers are digging up the ground for the hidden treasure. Again, on the river banks which face the rising sun, the orange, the banana, and the vine grow abundantly; and the day is not far distant when wine, tobacco, and cotton will be among the staple exports from this coast. Between the girdle of the coast and the mountain range, the country extends in gentle undulations for many miles, clothed with stately forests, which, where cultivation has made progress, are diversified with farms and tenements, and intersected by broad and excellent turnpike roads. Lastly, the coast is indented with numerous bays and harbours, unsurpassed for security and extent by any in the world; while the noble city of Sydney, with its classic buildings, and 100 other towns and villages, are visible throughout the length and breadth of the land; giving that air of dignity and of settled comfort to its inhabitants which belongs essentially to older countries, and which is not observable in the aspect of the newer colonies in Australia.

Soil and climate.

Australia being situated in the opposite hemisphere to Britain, its seasons are exactly the reverse of ours. July is the middle of winter, and January of summer. The festivities of Christmas and of the new year are celebrated here, not, as in the old country, with doors and windows shut, and a cheerful fire to dispel the winter cold, but amid the oppression and heat of summer, with doors and windows thrown open to invite the refreshing breeze. We no longer hear in this Australian climate of the "gentle south wind," nor of "rude Boreas, blustering railer." The north is here the region of heat, as the south is of cold. The summer extends from the 1st of December to the end of February; and the mean heat during these three months is about 80° at noon. This great heat is tempered along the coast by the sea breeze, which sets in regularly about nine in the morning, and blows with considerable force till about six or seven in the evening, when it is succeeded by a land-breeze from the mountains, which varies from W.S.W. to W. In very hot days the breeze often veers round from N. to S., and blows a hurricane. The hot winds to which the country is exposed, especially in the interior, three or four times every summer, blow from the N.W., like a current of air issuing from a heated furnace, raising the thermometer to 100° in the shade, and to 125° when exposed to their influence. They imbibe their heat from the great central desert alluded to in the article AUSTRALASIA. They are generally succeeded by a cold southerly squall, and by a thunder-storm and rain, which cools the air. The spring months are September, October, and November. In the beginning of September the nights are cold, but the days clear and pleasant. The thermometer varies from 60° to 70° towards the end of the month; and light showers occasionally prevail, with thunder and lightning. The days become gradually warmer, and in October the hot and blighting winds from the north begin to be apprehended. The three autumn months are March, April, and May. The first is rainy, and more fertile in floods than any other in the year. Towards the end of April the weather becomes perfectly clear and serene. The thermometer varies from 72° at noon to 60°, and in the mornings is as low as 52°. During May the thermometer varies from 50° at sunrise to 60° at noon, with a perfectly cloudless sky. During the three winter months of June, July, and August, the mornings and evenings are cold; hoar frosts are frequent, and become more severe in advancing into the interior. At Sydney the thermometer is rarely below 40°; at Parramatta it is frequently as low as 27° in the course of the winter. As the land rises from the ocean, the temperature declines. The winter at Bathurst, where snow falls in its season, is much colder than on the sea-shore. On the loftiest hills heavy falls of snow take place during the winter, and it remains for many days on their summits; and some high ranges penetrate the level of perpetual snow. In the valleys, however, the snow does not lie. The greatest defect in the climate is the prevalence of periodical droughts, in consequence of which the vegetation is parched, a general failure of the crops follows, and numbers of the cattle perish. Although in general a large quantity of rain falls throughout the year, yet the colony has hitherto been subject to severe periodical droughts. A drought took place in 1826, which continued till 1829; another in 1839; and more recently, in 1849-50, another severe drought took place, which occasioned general distress in the colony. The climate is, however, on the whole highly salubrious and agreeable. Out of a community of 1200 persons, it has been known that only five or six have been sick at a time; and at some of the military stations, seven years have elapsed without the loss of a man. The fact is now pretty well ascertained, that its dry healing influence is beneficial in pulmonary consumption. Hydrophobia is happily unknown, although dogs abound. The Asiatic cholera has never visited these shores: dysentery, however, is prevalent amongst newly-arrived people. Cases of organic lesion of the heart are frequent, and cause the majority of sudden deaths. Ophthalmia, too, is not uncommon in the districts of the Hunter and Moreton Bay. The only instance of an epidemic visiting this country was in 1849, when the influenza carried off a number of the inhabitants; yet notwithstanding these facts, and the assertions of inexperienced emigrants, the climate of New South Wales has been pronounced by good authorities to be one of the most healthy and salubrious on the face of the earth. As the aspect of the country, however, possesses no general feature whereby to describe its character, so the varieties of soil and climate in New South Wales cannot be classed under one general head. Not only are the warmer localities and poorer soils on the eastern shed of waters greatly different from the rich lands and cooler atmosphere on the western streams, but these

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again are diversified by the variations of latitude. The territory of New South Wales, as before stated, extends between the parallels of 26° and 38° S. Lat., or about 800 statute miles; hence it will be naturally supposed to possess the graduated influence of solar heat at the sea-level alone to cause local variations of temperature. And this, added to the higher altitudes of the country inland, produces a variety of meteorological phenomena which materially affect the indigenous as well as the imported subjects of the animal and vegetable world. In ordinary parlance, therefore, it is as erroneous to speak of the climate of New South Wales generally as if there were one uniform recurrence of weather throughout that territory, as it would be to designate as one description of climate the varied weather which simultaneously occurs between Switzerland and the African shores of the Mediterranean. For there is as great a difference in the weather which happens in the regions between the Maneroo plains, elevated 2000 feet above the level of the sea, and situated at the base of the Australian Alps, covered with snow, and the intertropical district of Moreton Bay, within whose waters turtle abound; these being the extreme S. and N. boundaries of the colony. In the former region, the gooseberry and the apple flourish in the frigid atmosphere; in the latter the pine-apple and the banana grow rich and luxuriantly in the open air. While the Maneroo settlers rear coarse-woolled sheep upwards of 100 lb. in weight, the Moreton Bay squatters have the finest-woolled merinos under 50 lb.: and their proprietors may be distinguished in the streets of Sydney, which lies midway between them, by the ruddy English complexion of the one, and the sallow Indian face of the other.

Vegetable produce.

The agricultural products of New South Wales comprehend all the cereals grown in Europe, and many which are confined to tropical countries. Of the former, wheat, barley, oats, and rye, with hay, lucerne, and other kinds of fodder for cattle and horses, comprise the farmer's list; of the latter, maize, tobacco, and lately cotton, have been profitably cultivated. The barren soil, however, around the environs of Sydney, renders the inhabitants of that city and its suburbs dependent upon Van Diemen's Land for their supplies of grain. The Hunter River and other districts being subject to droughts, the cultivation of cereal crops is precarious. So devastating were their effects in early times, that the government had siloes on the Egyptian plan sunk on an island (Cockatoo) in Sydney harbour, and filled with grain in case of famine. In the above-named district, a large quantity of maize or Indian corn is produced, mainly for the food of horses, pigs, and poultry. In 1852, there were 152,057 acres of land under cultivation, exclusive of vineyards. The culinary vegetables common in this country thrive admirably in New South Wales; such as potatoes, cabbages, carrots, parsnips, turnips, peas, beans, cauliflowers, lettuces, cucumbers, and pumpkins, besides sweet potatoes, yams, and plantains. Many of the former attain to greater perfection than in Europe, as the cauliflower and the brocoli; and green peas are to be had in Sydney all the year round; whilst a few degenerate, such as the bean. The colony is famed also for the abundance and variety of its fruits. Peaches, apricots, nectarines, loquats, oranges, grapes, pears, plums, figs, pomegranates, raspberries, strawberries, mulberries, and melons of all sorts, attain the highest degree of maturity in the open air. Added to these, the northern districts produce pine-apples, bananas, guavas, lemons, citrons, and other tropical fruits. Excepting on the high mountain districts to the westward and southward of Sydney, the climate is not so congenial to the production of northern fruits, such as the apple, the currant, the gooseberry, and the cherry. Grapes of the finest quality are produced in the colony, not only for the table, but for the manufacture of wine. Upwards of 1000 acres of vineyards are laid out in the most complete manner for the culture of the vine, which in 1852 produced 84,843 gallons of wine, and 1641 gallons of brandy. The Australian tobacco, both from its quantity and its quality, is now fast superseding the importation of American tobacco. In 1852, 12,530 cwts. were manufactured in the colony. The olive-tree, likewise, grows luxuriantly, and a superior sample of oil has been produced. The cultivation of cotton upon the Brisbane River at Moreton Bay realized to the experimental planters in 1852 a clear profit of L.12 per acre. Altogether, the capabilities of this varied soil and climate for the production of the universal staple commodities of cotton, tobacco, and wine, are unlimited. All that the colony requires to raise them in sufficient abundance for her own consumption and foreign export, is capital and labour. Already much has been done by the enterprizing colonists in this direction. While we write, Mr Hickey of Osterley, Hunter's River, has produced before the wine-tasters in the London Docks samples of his vintage of light wines, which have been pronounced equal to the best hock and Sauterne imported into London; while a parcel of cotton has been sold in Manchester as high as 2s. 6d. per lb. from the Moreton Bay district; and a company is now forming to introduce the cultivation of the cotton plant there by free labourers, so that the Manchester cotton manufacturers may be independent of the American planters, which may ultimately tend to abolish negro slavery throughout the United States.

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Animal produce.

Of the indigenous animals in Australia, we have given some account in the preceding article. We shall notice here, therefore, more particularly the capabilities of the country for rearing imported stock, poultry, &c., and those birds and fishes used as food by the colonists. The extent of pasture land within New South Wales occupied by the herds and flocks of the settlers is not far short of 50,000 square miles; upon which there were grazing at the end of 1852, 116,397 horses, 1,375,257 horned cattle, and 7,396,895 sheep. The climate is peculiarly congenial to the growth and increase of these animals. The breed of horses, both thorough-bred, and half-bred hacks, is such, that they are exported to India for the purpose of supplying the East India Company's cavalry and artillery. The horned cattle are, in many instances, of a gigantic size, weighing from 13 to 14 cwt. The sheep are mostly of the fine merino breed; but, on the elevated downs, the Leicester breed crossed with the merino, thrive best, and give a heavier carcase, with a greater quantity of coarse wool than the pure-bred stock. From the dry nature of the herbage, the mutton and beef has not that rich flavour which is so much prized in English-fed cattle and sheep. Swine are abundant, the number of pigs in 1852 amounting to 65,510. They are mostly fed upon the "graves" of the tallow-melter; which neither produces as sweet pork nor such solid flesh as the ordinary methods of feeding. Goats are not numerous; and asses and mules are seldom reared. A few Timor ponies have been imported; and the camel has been introduced, but hitherto has not thriven.

Birds.

Domestic fowls of every description thrive admirably, and may be reared at small expense. Geese become fat upon the native grasses; and the barn-door fowl picks up sufficient food in summer amongst the insects in the bush. Ducks likewise require very little artificial food; only they are subject to some unknown disease which checks their increase; while turkeys and pea-fowl, which are delicate to rear in Europe, require little or no care. Guinea-fowl also are easily reared; and all of them fatten better upon cracked maize than upon oats. The same holds true, also, in the feeding of horses. Besides the domestic fowls, game birds also are abundant, including the quail, snipe, land-rail, water-rail, duck, pigeon, and the native turkey, or bustard of the plains. Parrots are found in myriads, and at certain seasons make a tolerably good pie; and the cockatoo also is

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eaten. We may here mention that the tail of the kangaroo makes a richly-flavoured soup, which may be considered the only part of an indigenous quadruped fit for food.

Fishes.

Fish are plentiful in the bays along the coast, but they are not so abundant in the rivers. The fresh-water cod-fish, however, in the Murray River, are of a large size, weighing sometimes as much as 70 lb., and 30 lb. being common. Eels are also caught in the marshes and lagoons, 12 and even 20 lb. in weight. The salt-water fish are numerous. The schnapper is like our cod, and the best and largest fish in the Australian seas, with the exception of the trumpeter at Hobart Town. Rock-cod, flat-heads, taylor-fish, mackerel, soles, and guard-fish, constitute the ordinary kinds brought to Sydney market; but few of them have the substance and flavour of British fishes, from which they are distinct in species. Cray-fish are abundant, and fine flavoured; the crabs are of the most beautiful colours, but none of them edible. Prawns and shrimps are sold in the markets. Fresh-water mussels are found of a large size, but not wholesome to eat; and the salt-water mussels are small. Oysters, however, of three kinds are plentiful: the rock-oyster, the stream-oyster, and the mud-oyster, which are all edible; the stream-oyster being of the most delicate flavour. Turtle are found at Moreton Bay, where the aborigines are employed by the settlers in procuring them for the Sydney market; they are, however, not equal in flavour to the West India turtle.

Minerals.

Now that the mineral treasures of Australia have become the leading item in the wealth of the country, the attention of the government, and of the colonists generally, has been directed to the geological structure of the country. To give the most brief synopsis of this important subject would occupy more space than we can afford. A general view of the gold fields has been given in the section treating of the discovery: we must content ourselves here with noticing those other minerals which have been productive of wealth and utility to the colonists. Between the Blue Mountains and the sea-coast are those extensive sandstone plains where the strata are lying in a horizontal position with a slight dip to the westward. On this the city of Sydney is built, and the great mass of its buildings are constructed of this rock, which is more friable than ordinary freestone. The roads are "mettled" with the whinstone or basalt obtained from the Blue Mountain ranges. In the county of Argyle, a beautiful grained marble has been found, which makes up into handsome chimney-pieces. Copper has been worked for several years in the mountain ranges around Bathurst; but the ores that are the richest (pyrites) are found only in small quantities, while those most abundant are of inferior quality. Oxydulated iron ore, from which is manufactured the finest description of steel, has been worked at Berrima, but not successfully. Potters' clay and rock porcelain exist also among the rocks N. of Sydney harbour. But by far the most valuable mineral worked in New South Wales, prior to the gold discovery, has been coal. The coal measures on the Hunter River extend over the great basin of that river and its tributaries, down to the sea-coast at Newcastle, where the seam of coal is seen cropping out on the beach. Until within the last eight years, these coal measures were worked under a monopoly held by the Australian Agricultural Company. This, however, has been infringed upon successfully by the adjoining proprietors of land containing coal, who work now under sanction of the authorities. About 10 pits are in operation, and a considerable trade is carried on between Port Hunter and the adjoining colonies, as well as with New Zealand and California. For further particulars upon this subject, and an analysis of the soils as applied to agriculture, we refer the reader to the excellent work of Count Strzlecki.

An account of the aborigines of Australia will be found under the article AUSTRALASIA.

Australia. New South Wales. Population.

We shall now proceed to notice the increase of the European settlers in New South Wales. From our own experience, and the evidence of competent authorities, we know of no region on the globe where natural phenomena combine to render mere animal existence more desirable to the Anglo-Saxon constitution, or more propitious to the increase of the race.

It will be remembered that the colony, when first established at Sydney, as detailed in the first section of this article, consisted of 1030 individuals, 700 of whom were convicts; and that notwithstanding the famine and distress which occurred at intervals, and the discouragement of emigration by some of the authorities, the population, owing to the fineness of the climate and the number of convicts sent out, rapidly increased. A census taken at eight different times gives the following result in the month of March in each year:—

	Males.	Females.	Totals.
1810	...	...	8,923
1821	...	...	29,783
1828	...	...	36,598
1833	...	...	71,070
1836	55,539	21,557	77,096
1841	87,263	43,549	130,812
1846	114,709	74,813	189,522
1851	106,229	81,014	187,243

The apparent decrease at the last census was in consequence of the separation of Port Phillip, at which period it numbered an additional population of 77,000, giving a total of 264,000 for the old boundaries of the province before the gold discovery.

At the date when the following statistics were computed, transportation had virtually ceased for eleven years; hence it was not necessary to specify the number of convicts in a return of the population. Moreover, their influence on the social and political condition of the colony had become absorbed, and they were scarcely recognizable in the influx of free emigrants. Our information from the colony brings up the census to April 1853, exactly two years after the details given in the annexed table; and includes a fluctuating population attracted to her shores during nearly all that period by the gold discovery, and a re-emigration to Victoria upon the announcement of the superior gold-fields there. "The tide of emigration," however, as stated by his Excellency the Governor-general in his prorogation speech to the Legislative Council on the 28th December 1852, "is now steadily setting back to the colony." During 1852, 21,816 persons arrived in the colony, and 14,397 left it; 13,511 of whom went to Victoria and the other sister colonies, and of these 9886 returned; showing an excess of arrivals over departures of only 7419. The total population on the 31st December 1852, according to the government returns, was 197,168; 113,032 males, and 84,136 females; to which add the excess of arrivals over departures in 1852, and we have a total of 204,587 on the 31st December last. During this year, 1846 emigrants arrived at the public expense, and 756 at their own. The number of births registered during the year was 7675; of marriages, 1915; of deaths, 2600.

The proportion of the colonists from the United Kingdom and their descendants may be taken thus: out of 10 individuals there are 4 English, 3 Irish, 2 Scotch, and 1 other nations. Of course no apparent nationality of character has as yet resulted from this intermixture; but if we may judge from the few native-born men and women we have met, there is every likelihood of the future Australian people resembling their cousins of Anglo-Saxon descent on the other side of the Atlantic.

The following table exhibits a more particular classification of the inhabitants in the colony of New South Wales, within the restricted boundaries, according to the last general census taken on the 31st March 1851:—

New South Wales Census, 1851; *classified with reference to Sex and Age.*

NAME OF DIVISION.	SEX AND AGE. MALES. Under Two Years.	Two and under Seven.	Seven and under Fourteen.	Fourteen and under Twenty-one.	Twenty-one and under Forty-five.	Forty-five and under Sixty.	Sixty and upwards.	FEMALES. Under Two Years.	Two and under Seven.	Seven and under Fourteen.	Fourteen and under Twenty-one.	Twenty-one and under Forty-five.	Forty-five and under Sixty.	Sixty and upwards.	TOTALS. Males.	Females.	General Totals.
COUNTIES.																	
Argyle	202	487	376	2 6	1,322	389	91	208	489	408	273	804	130	30	3,123	2,342	5,465
Bathurst	244	515	437	267	1,703	480	92	241	566	447	320	932	140	21	3,738	2,667	6,405
Bligh	31	84	59	42	348	76	10	43	82	55	23	140	9	2	650	354	1,004
Brisbane	67	130	117	65	460	176	29	68	152	126	79	223	40	1	1,044	689	1,733
Camden	402	881	819	483	1,891	706	190	386	915	837	566	1250	262	75	5,372	4,291	9,663
Cook	119	279	321	208	598	295	114	145	326	320	212	437	122	45	1,934	1,607	3,541
Cumberland	2488	6,779	6,544	4085	15,460	4,923	1756	2509	6,672	6,775	6,129	13,584	2664	746	42,035	39,079	81,114
Durham	336	730	721	373	1,662	517	75	382	779	710	372	1,066	227	38	4,414	3,514	7 928
Georgiana	61	148	114	74	401	112	23	62	153	91	50	197	34	5	933	592	1,525
Gloucester	128	313	295	195	734	164	42	109	283	242	137	425	70	12	1,871	1,278	3,149
Hunter	40	93	108	68	175	99	39	35	96	99	51	122	29	9	622	441	1,063
King	92	264	172	127	584	194	43	91	212	236	98	323	63	6	1,476	1,029	2,505
Macquarie	51	148	109	74	337	117	66	65	146	157	84	228	41	14	902	735	1,637
Murray	154	376	312	184	936	306	48	151	335	277	165	526	100	16	2,316	1,570	3,886
Northumberland	614	1,436	1,361	718	2,989	979	183	590	1,391	1,314	852	2,232	461	87	8,280	6,927	15,207
Phillip	20	60	56	33	182	70	12	22	50	50	17	76	24	2	433	241	674
Roxburgh	95	242	227	95	640	168	52	95	218	179	127	341	51	8	1,519	1,019	2,538
St Vincent	95	233	204	129	597	208	34	97	205	210	136	337	79	8	1,500	1,072	2,572
Wellington	51	139	109	59	441	170	26	60	140	100	55	209	46	4	995	614	1,609
Westmoreland	57	158	135	82	333	113	34	67	138	116	64	201	36	7	912	629	1,541
Total in the 20 counties	5347	13,495	12,596	7617	31,793	10,262	2959	5366	13,348	12,749	9,810	23,653	4628	1136	84,069	70,690	154,759
Stanley (reputed County)	194	336	279	165	1,762	180	25	162	346	240	262	785	42	9	2,941	1,846	4,787
Total within settled Districts	5541	13,831	12,875	7782	33,555	10,442	2984	5528	13,694	12,989	10,072	24,438	4670	1145	87,010	72,536	159,546
SQUATTING DISTRICTS.																	
Bligh	38	84	81	45	512	145	13	31	91	58	30	141	17	2	925	366	1,291
Clarence	78	123	99	71	683	87	5	76	128	92	52	235	21	1	1,116	665	1,781
Darling Downs	65	89	66	95	1,229	159	26	51	98	56	32	295	11	2	1,701	469	2,170
Lachlan	116	242	203	135	848	267	50	99	243	160	124	335	61	9	1,861	1,031	2,892
Liverpool Plains	69	118	132	103	1,106	213	24	56	135	120	48	231	25	5	1,765	620	2,385
Macleay	14	18	15	19	132	36	8	15	29	25	19	52	9	...	242	149	391
Manaroo (including Auckland)	163	315	296	214	971	272	52	135	303	260	147	483	67	11	2,283	1,406	3,689
Moreton (excluding Stanley)	2	5	8	11	191	13	4	3	5	7	7	15	...	1	234	38	272
Murrumbidgee	149	382	304	196	1,744	283	54	141	342	256	157	591	61	11	3,112	1,559	4,671
New England	140	308	247	195	1,652	309	44	124	263	216	132	510	54	3	2,895	1,302	4,197
Wellington	40	120	87	38	616	169	28	46	86	75	32	155	18	2	1,098	414	1,512
Burnett	17	19	19	70	552	58	5	15	19	6	20	46	6	...	740	112	852
Maranoa	2	2	2	6	56	6	...	2	4	1	1	3	...	...	74	11	85
Wide Bay	6	19	10	14	253	16	1	3	14	12	7	44	6	1	319	87	406
Western Lower Darling	3	3	2	4	75	9	...	3	4	4	6	14	5	...	96	36	132
Eastern Lower Darling	6	13	9	15	161	20	2	9	17	9	6	22	1	1	226	65	291
Gwydir	18	39	25	33	361	45	8	21	51	38	18	72	7	1	529	208	737
Total in Squatting Districts	896	1,903	1,605	1265	11,142	2,087	321	833	1,825	1,395	848	3,155	372	59	19,219	8,178	27,697
Total in New South Wales	6437	15,734	14,480	9047	44,697	12,529	3305	6361	15,519	14,384	10,920	27,593	5042	1195	106,229	81,014	187,243

Australia. New South Wales.

A visitor to the city of Sydney, if he mingles among the higher circles of its inhabitants, will find them surrounded by those elegancies, and possessing much of that refinement in their domestic relations with each other, which give the charms to civilized society. The governor-general and his official circle, of course, form the central sphere around which the lesser revolve; and these combine upon state occasions, when the hospitality of government-house is laid under contribution, to display a goodly assemblage of fashionable and elegant people. Altogether the stranger is pleasingly impressed with the facts that there is much wealth and liberality, and a tone of high intelligence, about the society of this fair city, and on the estates and homesteads of the settlers in the interior.

Government.

When the colony of New South Wales was first established, the whole powers of the government necessarily centred in the governor alone. In 1824, a council was appointed to aid and to control him in the exercise of his authority. Several alterations have since taken place, and the supreme authority is now vested, 1. in the governor; 2. in an executive council, which consists of the colonial secretary and treasurer, the commander of the forces, the auditor-general, and the attorney-general; and, 3. in a legislative council, consisting of the members of the executive council, with the addition of four other official and nine non-official crown nominees, and thirty-six elected members, making in all fifty-four members; who are presided over by a speaker elected from one of their number. The legislative power is vested in the governor and this legislative council; a majority of which must concur before any law can be passed, the speaker having a casting vote. Any member has the privilege of introducing a measure upon giving notice, as is customary in the House of Commons; the governor being represented by the colonial secretary, who brings forward all government bills. The recent act passed "for the better government of her Majesty's Australian colonies," after erecting the "district of Port Phillip" into the "colony of Victoria," enacts (§ 2), that the legislative council of New South Wales shall consist of such a number of members as the governor and council shall determine, of which one-third shall be appointed by Her Majesty, and two-thirds to be elected by the inhabitants. Electors are qualified to vote on possessing freehold estate of L.100 clear value, or occupying a dwelling-house for six months at an annual rent of L.10, or holding a depasturing license of the yearly value of L.10. The bills passed by the council must not be repugnant to the laws of England; and they do not become the laws of the land until they obtain the governor's assent; who has also the power of referring any measure before coming into operation, to obtain the sanction of Her Majesty, which entails great delay, if the act is obnoxious to the local government. For the sole administration of the laws there is a supreme court, over which preside a chief and two puisne judges. The supreme court is a court of oyer and terminer, and gaol delivery; it is also a court of equity, and a court of admiralty for the trial of criminal offences within certain limits: it is empowered to grant letters of administration, and it is an insolvent debtor's court. From the supreme court lies an appeal for all actions for less than L.500, to the governor or acting governor, who is directed to hold a court of appeals, from whose decision lies a final appeal to the queen in council. There are courts of general and quarter sessions, which have the same powers as those in England. Courts of requests have been established for summarily determining claims not exceeding L.30; and their decision is final. Juries now sit in civil and criminal cases. A very vigilant police has been established throughout New South Wales. There are benches of stipendiary as well as unpaid magistrates in Sydney and other principal towns, aided by head-constables and a civil and military police force at each station. The city of Sydney is incorporated, and divided into six wards, each ward electing four councillors. From these twenty-four councillors, six aldermen are chosen; and from the aldermen and councillors, the mayor is elected annually.

Australia. New South Wales.

Internal intercourse.

The country of New South Wales, recently a pathless forest, is now intersected in all directions by excellent roads, The royal mail proceeds from Sydney to all the different towns in the interior, and letters are delivered with punctuality and despatch. Postage stamps are used for letters as in Britain. Stage-coaches with four horses also start daily from Sydney, and from other places; so that there is every facility of internal intercourse by land; while numerous steam-vessels leave Sydney and ply along the coast to the different sea-ports. A railway also has been projected between Sydney and Goulburn; and there is every likelihood of the line being in operation in 1854.

Education.

Great efforts have been made in New South Wales to promote education among all classes, and numerous excellent seminaries have been established. Sydney College was instituted in 1830, where the youth of the colony are taught the ancient languages, English literature, and the rudiments of the sciences. On 11th October 1852, Sydney University was inaugurated by the governor-general. A classical professor, a professor of mathematics, and a professor of chemistry and the philosophy of physics, were appointed. The first session closed satisfactorily, with 24 matriculated students, in December 1852. It is founded upon the same liberal principle with regard to the exclusion of religious tests, as that recognized by the government in extending its support alike to all religious denominations. The number of schools in the colony on the 31st December 1852 was 423; number of scholars, 11,118 males, 10,002 females; total, 21,120. Of these schools, 227 were private, and 196 public ones. The city of Sydney possesses a mechanics' school of arts, a female school of industry, an infirmary and dispensary, a benevolent asylum, an Australian subscription library, a chamber of commerce, a museum and botanic gardens, a botanic and horticultural society, and various other societies connected with religion, literature, and science. The press, as usual, lends its aid to the diffusion of knowledge. In Sydney there are two daily and eight weekly newspapers, besides one three times, and two, including the *Government Gazette*, twice a-week: also one in Goulburn, two in Bathurst, two in Maitland, and one in Brisbane, published weekly.

Religion.

There is here, as in the mother country, a variety of religious sects, a statement of whose respective numbers will be found in the annexed classified population table.

It is here to be remarked, that all classes, of whatever creed, enjoy equal rights, and are equally eligible to offices of honour or emolument. One-seventh of the land was formerly appropriated to the support of the Episcopal Church: it is still applicable to the general purposes of religion and education, but without any distinction of sects, all of which participate equally in the government fund. The Episcopalian Church was formerly within the diocese of Calcutta; but is now subject to two bishops who reside in the country. There are, besides, 80 priests of this church, who have the charge of different districts in the country. There are six ministers of the Established Church of Scotland, and of the Roman Catholic clergy an archbishop, a bishop coadjutor, a suffragan bishop, vicar-general, and 38 clergy. The Wesleyan Methodists have 150 congregations, and about 10,000 attendants at public worship, with 24 ordained ministers and catechists. The clergymen of the synod of Australia in connection with the Established Church of Scotland are 16 in number. Those maintaining the principles of the Free Church of Scotland are 10. There are also 11 ministers belonging to the Presbyterian synod; five Congregational churches; one Baptist church; one German evangelical church, and a Sydney Bethel Union.

New South Wales Census, 1851; *classified with reference to Religion.*

Australia. New South Wales.

Name of Division.	Religion.								General Totals.
	Church of England.	Church of Scotland.	Wesleyan Methodists.	Other Protestants.	Roman Catholics	Jews.	Mahometans and Pagans.	Other Persuasions.	
Counties.									
Argyle	2,511	499	237	43	2,086	75	5	9	5,465
Bathurst	2,686	695	698	59	2,234	21	2	10	6,405
Bligh	513	47	8	8	419	2	...	7	1,004
Brisbane	965	231	32	5	483	15	...	2	1,733
Camden	4,810	1,145	563	119	2,912	4	16	94	9,663
Cook	1,947	330	245	18	968	2	12	19	3,541
Cumberland	40,526	6,046	5,182	4,964	23,247	667	112	370	81,114
Durham	3,701	1,513	534	83	2,014	5	1	77	7,928
Georgiana	680	215	26	2	600	1	...	1	1,525
Gloucester	1,710	623	188	18	609	...	...	1	3,149
Hunter	805	40	25	2	190	...	1	...	1,063
King	1,076	94	148	44	1,131	...	1	11	2,505
Macquarie	1,051	207	35	6	326	11	1	...	1,637
Murray	1,835	323	78	77	1,506	38	17	12	3,886
Northumberland	7,799	1,451	1,111	198	4,537	53	10	48	15,207
Phillip	402	60	20	...	188	...	...	4	674
Roxburgh	1,271	274	163	10	819	1	...	...	2,538
St Vincent	1,065	485	47	11	949	13	...	2	2,572
Wellington	934	118	11	17	527	1	...	1	1,609
Westmoreland	508	123	173	...	729	...	7	1	1,541
Total population in the twenty Counties	76,795	14,519	9,524	5,684	46,474	909	185	669	154,759
Stanley (reputed County)	1,964	526	262	451	1,396	9	168	11	4,787
Total within the Settled Districts	78,759	15,045	9,786	6,135	47,870	918	353	680	159,546
Squatting Districts.									
Bligh	578	182	24	40	442	3	12	10	1,291
Clarence	1,111	196	17	34	345	2	12	4	1,721
Darling Downs	1,091	280	19	37	563	2	174	7	2,173
Lachlan	1,181	187	44	52	1,420	7	...	1	2,892
Liverpool Plains	1,494	228	4	11	602	16	21	9	2,385
Macleay	270	19	9	2	86	...	3	2	391
Maneroo (including Auckland)	1,765	429	12	22	1,446	14	...	1	3,689
Moreton (excluding Stanley)	106	35	3	3	73	1	51	...	272
Murrumbidgee	2,417	500	56	47	1,637	7	2	5	4,671
New England	2,257	621	4	52	1,228	4	27	4	4,197
Wellington	727	158	14	2	596	...	7	8	1,512
Burnett	412	104	7	19	204	1	102	3	852
Maranoa	59	6	...	3	16	...	...	1	85
Wide Bay	207	29	7	9	66	...	86	2	406
Western Lower Darling	63	31	...	1	35	...	...	2	132
Eastern Lower Darling	153	36	...	...	100	1	1	...	291
Gwydir	487	70	2	3	170	3	1	1	737
Total in the Squatting Districts	14,378	3,111	222	337	9,029	61	499	60	27,697
Total in New South Wales	93,137	18,156	10,008	6,472	56,899	979	852	740	187,243

Finance.

The following is an abstract of the revenue of New South Wales in the years ending 31st December 1851 and 1852 respectively:—

Head of Revenue.	1851.	1852.
Customs	L.153,540	L.217,021
Licenses, postage, fines, fees, &c.	124,253	134,704
Revenue derived from gold	33,810	61,817
Territorial revenue	89,534	86,871
From the clergy and school estates	4,461	5,243
	L.405,598	L.505,656

The revenue of the customs chiefly arises from a duty on the importation of spirits, tobacco, wine, tea, and sundry other articles. The territorial revenue includes licenses and leases to occupy crown lands.

Commerce.

For the last twenty years, the trade of this important commercial colony has been forcing itself gradually upon the attention of our merchants and manufacturers. The rapid increase in the quantity and value of its exports, and the large proportionate consumption per head of British merchandise by its inhabitants, have ranked it among the first of our trading colonies. So great is the demand for manufactured goods, according to the latest advices, that the warehouses and stores are actually becoming empty, and the colonial traders are reaching an unheard-of anomalous condition in the history of commerce, namely, having an increasing market with wealthy customers, but lacking wares to sell to them. Even laying aside the value of the gold

Australia. New South Wales.

exported, the staple commodities of wool and tallow raised in the colony are sufficient to purchase for the colonists in a foreign market as much as L.8 per head of ordinary imports. The first of these articles demands some further notice. The imports of this valuable staple from the Australian colonies have increased so abundantly, that it has not only superseded entirely the importation of German and Spanish wools, but lately the French manufacturers have been large purchasers at the London sales of Australian wool, which they consider the best wool in the world for their fine fabrics. The origin and progress of this important branch of industry is remarkable. In 1810, only 167 lb. of wool were imported into Britain from Australia and Van Diemen's Land; a portion of which was sold for 10s. 4d. per lb. In 1815, 73,171 lb. were imported; in 1825, 323,995 lb.; in 1830, 1,967,309 lb.; in 1836, 3,564,532 lb.; and in 1852, it has reached in the aggregate from all our Australian colonies the enormous quantity, in round numbers, of 45,000,000 lb. Of this total weight, New South Wales contributed 15,268,473 lb. The colony was indebted for the introduction of merino sheep to the enterprizing spirit of Mr J. M'Arthur, in 1793. The flocks now in Australia, Van Diemen's Land, and New Zealand, number on their united pastoral lands, in 1853, upwards of 20,000,000 of sheep. The quantity of tallow produced is also important, and materially affects the quotations of Russian tallow in the British market. In 1850, the export of this article was valued at L.167,858, quantity 128,090 cwt., which decreased in 1851, for want of labourers, to 86,460 cwt., valued at L.114,168; and in 1852, notwithstanding the absorption of labour at the gold fields, the tallow exported was 84,464 cwt., valued at L.114,168. Gold, now forming the largest item on this export list, shows a continued increase, even by the month, at the rate of 50 per cent. From June 1, to December 31, 1851, the amount exported was, at colonial valuation, L.468,336; during 1852, it rapidly increased to L.2,744,961 for the year; and from January 1, to April 1, 1853, L.800,000. Hides also form a considerable article of export. The number shipped in 1851 was 68,641; in 1852, 73,104. Whale oil formerly composed a large staple export from New South Wales; but it has decreased latterly, and only a few whaling ships leave the port of Sydney. The bulk of the sperm oil exported is obtained from the American whalers which frequent Port Jackson to refit their ships. In fact, our more enterprizing neighbours in this peculiar pursuit seem to monopolize the whole trade in the southern seas, where it is estimated that they have upwards of 600 whaling ships afloat. New Zealand flax (*Phormium tenax*) also formed once a promising export from that country through New South Wales; but the Maori race have almost given up the labour of dressing it, and the little that is prepared is manufactured into ropes in the country. A small quantity of timber, consisting of cedar-planks, is also exported. Coals, as we have before remarked, form a large item in the intercolonial export trade with the colony; and grain, an import of considerable value. The total value of the imports in 1852, according to accounts laid before parliament, was L.1,563,931; of the exports, according to various official returns in the colony, including the amount of gold at 65s. per oz., L.4,604,034. In 1853, the total amount of exports was L.4,312,897, showing a considerable decrease, while the imports increased enormously, being not less than L.5,000,000. The shipping has increased along with the commerce. In 1850, the shipping inwards consisted of 421 vessels, of 126,185 tons, and outwards 506, of 176,762 tons; in 1851, 553, of 153,002 tons, carrying 7955 men, inwards, and 503, of 139,020 tons, with 7988 men, outwards; and in 1852, 673, of 183,002 tons, 9377 men inwards, and outwards 654 ships, of 139,020 tons, and 8130 men. Ship-building has not increased in proportion with the requirements of the colony. In 1841, 35 were built, of 2074 tons, and 110 vessels registered, of 11,250 tons; and in 1849, only 38 ships were built, equal to 1834 tons, and 126 were registered, equal to 8504 tons; the decrease being still greater in 1852.

Australia. New South Wales.

Prior to 1817 the currency consisted principally of the private notes of merchants, traders, shopkeepers, publicans; and the amount was sometimes as low as sixpence. In that year the Bank of New South Wales was established, with a capital of L.20,000, whose notes superseded this objectionable currency. Subsequently the capital was increased to L.300,000, and the bank exists in a flourishing state to this day. The same cannot be said, however, of the second bank, established by local shareholders in 1825, known as the Bank of Australia, with a capital of L.300,000 paid up; for after eighteen years' mismanagement, the directors had to prop up their bankrupt circulation by borrowing at a large interest from other banks, which ultimately not only swallowed up the assets of the company, but the unfortunate shareholders sustained further loss than their shares. In 1834, British capital and experience was brought to bear upon the commercial transactions of the colonists, by the establishment of the Bank of Australasia, with a paid-up capital of L.900,000, which obtained a charter of incorporation, and, with varied success, still exists. The most successful bank in Australia, is the Union Bank of Australia, an Anglo-Australian joint-stock bank, with unlimited liability, having a paid-up capital of L.820,000. From a report of the directors now before us, the amount of profit for the six months ending in the colony June 1852, was L.107,344, enabling them to pay a dividend, by way of interest, at the rate of 13 per cent. for the half year. The great profits shown by these results—unparalleled in legitimate banking—led to the formation of three new Anglo-Australian banks. These were the Joint-Stock Bank of Australia, the London and Australian Chartered Bank, and the English, Scottish, and Australian Chartered Bank. They began operations in Sydney during 1853; and at the close of that year showed a circulation in notes amounting respectively to L.71,400, L.15,200, and L.3300. The effect of this competition on the Australasian and Union Banks was to reduce their circulation in proportion. The aggregate amount of deposits in all the seven banks in December 1853 was L.5,065,700. Besides these joint-stock banks, there is a savings-bank under the control of the government, conducted on the same scale as British savings-banks. The private banks give no interest upon deposits. The following table shows the amounts of their respective circulation, total liabilities, coin assets, and capital paid up, in 1852.

Currency

Banks.	Notes in circulation.	Total Liabilities.	Coin and Bullion.	Total Assets.	Capital paid up.
New South Wales	L.311,174	L.1,602,119	L.565,216	L.1,996,280	L.300,000
Commercial	146,899	588,627	224,794	784,203	198,556
Australasia	182,074	651,623	297,297	599,052	900,000
Union of Australia	238,424	726,847	341,567	743,970	820,000
	L.878,571	L.3,569,216	L.1,428,874	L.4,123,505	L.2,218,526

Australia. The whole amount of British coin in the colony, at the end of the first quarter of 1853, was estimated in round numbers at L.2,000,000.

Victoria. II. VICTORIA has been a separate and distinct colonial government only since 1st July 1851. Prior to that date its territory comprised the southern portion of New South Wales, and hence sometimes officially designated the Southern District, in contradistinction to the Moreton Bay country, which was called the Northern District, the intervening territory being the Middle District. These names, which were imposed by the home government in 1842, are now superseded by later territorial changes, the last of which, in 1859, detaches the northern section as a new colony under the name of Queensland. The Port Phillip district, or briefly Port Phillip, was another of the early names for Victoria, and derived of course from the distinguishing feature of the harbour; besides which, as the late Sir Thomas Mitchell, while exploring the interior, had termed a portion of it Australia Felix, the ambitious colonists, improving the hint, had willingly extended so attractive a name to the whole territory. Some confusion that was likely to arise from these diversities was promptly arrested in 1851 by the gracious wish of her Majesty to distinguish the young colony by her own name.

Boundaries Victoria thus occupies the south-eastern extremity of the great territory of Australia. Its southern coasts are washed by Bass's Strait, into which its projecting headlands penetrate as far as 39. S. Lat. From Cape Howe, the eastern extremity, a straight line to the nearest source of the Murray separates Victoria from New South Wales, the river continuing the division till it passes 141. E. Long., which marks the South Australian frontier, to both the other colonies. Victoria is thus left with about 86,000 square miles, and is somewhat closely circumscribed between the spacious areas of the two sister settlements. The Murray, in its course along the north makes a great southerly deflection towards Port Phillip, which was probably not accurately known seventeen years ago, when the dividing line was fixed, but which leaves a large area on the north side territorially connected with New South Wales, but commercially and otherwise with Victoria. In the same way, Portland, the western seaport of Victoria, commands the commerce of adjacent parts of South Australia. The mining wealth of Victoria, by enabling that colony to construct railways and roads more rapidly than its neighbours, will presently still further disturb these boundaries. For the moment, however, the success of South Australia in the steam navigation of the Murray, and more lately also of the Darling, has been the most prominent circumstance in aiding a promising portion of the commerce of the interior, as well as appropriating it as the reward of that colony.

Discovery and name. This colony of Victoria is now from recent events so familiar to us, that we are apt to forget how brief an interval has elapsed since its territory, and even its coast-line, were totally unknown. At the beginning of this century Bass had only just ascertained that the southern coast of Australia was not continuous to Van Diemen's Land, but separated by the strait now bearing the discoverer's name. Bass, who made his important observations in 1798, by means of a whale boat from Sydney, reached only to Western Port. The discovery of Port Phillip, only about 25 miles farther west, was reserved for Lieutenant Murray, R.N., in February 1802, in the small government brig the Lady Nelson. In April following the celebrated Flinders came independently upon the same harbour, having also detected its not very distinguishable entrance. He noticed the strong eddying current caused at the entrance by the tides rapidly traversing a comparatively narrow channel with a very variable depth. This circumstance has caused the deposition of extensive sand-banks in the still water inside the Port Phillip Heads; and the process is so obvious and uniform that one is almost tempted to estimate the extent of the geological era that has elapsed since the ocean first broke into the great lake, and deposited the first of its daily tribute of sand. Flinders also observed the pastoral adaptation of the surrounding country, having landed between the present sites of Melbourne and Geelong, and walked across the grassy plain to Station Peak, where some observations were made. This country, then silent and empty, is now traversed by railways and electric telegraphs. The subsequent capture by the French, and long imprisonment at Mauritius of this distinguished navigator, prevented the results of his voyage from being given to the public until 1814. It is amusing now, when we consider the celebrity and importance of this well-known colony, and of its adjacent contemporary sister South Australia, to look back upon the time, little over a century, when these places were so utterly unknown that Swift selected this "north-west of Van Diemen's Land" for the scene of his Lilliputian extravagances.

Australia. Victoria.

Early colonization. The permanent colonization of the Port Phillip country dates only from 1835. The imperial government projected an earlier settlement by despatching, in 1803, a party of convicts under Collins, whose temporary location is still visible between the Port Phillip Heads and the hill called Arthur's Seat. The convicts were next year transferred to Hobart Town. The circumstance is interesting, from several of them who had run off having been left behind, one of whom, Buckley, the sole survivor, betook himself to aboriginal life, and met the colonists, above thirty years afterwards, as they arrived from Van Diemen's Land to retake possession. This was in the year 1835. Eleven years earlier, an overland expedition under Hume and Hovell had penetrated from New South Wales to the Port Phillip shore near Geelong; and during the previous year, in 1834, a pastoral and whaling settlement at Portland Bay had been effected from Launceston in the north of Van Diemen's Land, thus first occupying simultaneously at their respective extremities the two colonies of Victoria and South Australia.

Port Phillip. Portland failed to achieve much consequence. The great attraction was Port Phillip, so called from one of the New South Wales governors, Captain Phillip King. There were two parties of colonizing adventurers under their respective heads, Batman and Fawkner; the former having been first on the ground, the latter party having selected and settled upon the site of Melbourne. The former having procured an aboriginal conveyance of all the country hereabouts, came to repeated disputes with the later invaders, but were unable to evict the enemy. The claim was set up with but little of precedent for guidance, and good hopes of success were entertained by Batman and his friends; for, under the stimulating influence of some flour, blankets, tomahawks, &c., Jagga Jagga and other aboriginal worthies had very freely parted with their paternal acres, and that too with all the English formalities of signing their "mark," and delivering the handfuls of their lightly-held soil. In this case, as in the similar one subsequently of New Zealand, the government refused to recognise such contracts. Had it been otherwise, 600,000 acres would have thus passed into private possession, and including, as this area did, the towns and suburbs of Melbourne and Geelong, the property might, within twenty years, have been valued at many millions sterling. Batman's party was awarded a small remuneration of L.7000. Melbourne is already a large city, with extensive suburbs, representing an immense colonial trade, and containing 100,000 people; while Geelong contains one-fourth of that number. The early history of colonies is commonly barren of great public interest; but in this case the contrast is extreme, even in the uniform success of our colonial experience.

Australia. Victoria.

Mitchell's account of Australia Felix, and the great success and greater hopes of the earlier colonists of Port Phillip, fell contemporaneously upon the ears of the home public, and forthwith emigration to this country became a mania. The considerable capital that the emigrants took with them operated somewhat, as the gold discoveries did on a much greater scale a dozen years afterwards. Property "went up." In 1837 the chief towns of Melbourne, Geelong, and Portland had been laid out. In the two first there was already a busy scene of speculative buying and selling. All who aspired to fortune attended the land auction sales, government as well as private; and he who bade boldest generally came off best, as he was sure to resell at a profit. The end of this was a crisis in 1842–43, and a sore depression for a time, from which, however, the colony emerged, industrious and again prosperous.

Administration.

The Port Phillip shores having been first settled from Van Diemen's Land, the government of that colony put forward a claim to the administration of the new country. Its territory was comprised, however, within the ample area that had some time before been allotted to New South Wales, and the government and people of that colony were not slow in feeling alive to the awakening importance of the southern district. A magistrate was despatched from Sydney in 1836, and in the following year the governor himself, Sir Richard Bourke, visited the new scene. The settlement whose administration was thus coveted soon began to entertain ideas of its own independence. It was undergoing a very rapid development, so far as regarded the external aids of population and capital and the unrivalled pastures of the interior; while, from the seat of government being 600 miles distant, and the local subauthorities having very limited powers, public works and improvements, although urgently required, were very slowly and reluctantly granted, and by no means in proportion to the revenues contributed by the thriving young settlement. In December 1840 an assemblage of colonists, termed comparatively a great public meeting, passed with general consent resolutions approving of separation from the Sydney government. The subject was diligently followed up, and Dr Lang's motion in its favour, in 1844, in the New South Wales legislature, where he and several others represented Port Phillip, although greatly outvoted at the time, was the first of a series of steps that seven years afterwards resulted in the desired accomplishment.

Early statistics.

At this date of separation, when, on 1st July 1851, Victoria took its position as a distinct colonial government, only sixteen years had elapsed since Batman erected his hut upon Indented Head, to the south of the Geelong arm of Port Phillip, and not quite that interval since Fawkner's party squatted upon the grassy slope and open forest of gum trees that are now the busy market-square of Melbourne. The population, by the census of 2d March previous, was 77,345 colonists, and Melbourne contained 23,143; while the second town, Geelong, numbered above 8000. For that year the value of the imports was L.1,056,437, and of the exports L.1,422,909; the latter still consisting, as before, chiefly of wool (L.734,618), although for the last quarter of this year the Australian gold had begun to expand the colonial commerce, and amounted to L.438,777. The shipping entered inwards was 710, with a tonnage of 128,959. The public revenue was L.316,532. These were respectable attainments for so young a colony, and might even to-day have been much more copiously alluded to, were it not that all preceding colonial pretensions were utterly dwarfed by the expansion consequent upon the gold-mines.

Features peculiar to the country.

It is worth devoting a moment of attention, however, to the commerce that characterised Victoria, and indeed Australia generally, prior to the present absorbing and prominent gold-mining. We could only fully appreciate the lightly-timbered or open grassy country of Australia by observing the slow and toilsome process of removing a North American forest. Ere one, perhaps, of its innumerable giants had been cut down, the corresponding expanse of Australia was quietly occupied by sheep which browsed the natural grass, and each year yielded up the wealth of its valuable fleece without the cost of capital and almost without the effort of labour. Ere the whole forest was swept off, the Australian downs had perhaps already assumed a new phase. Well-made roads passed between fields of grain, and the smoke of towns and villages told of industry and prosperity to increasing numbers of colonists. The sheep had disappeared, driven off with ready step to remoter pastures, equally accessible and useful to them, although as yet shut to the slower march of agricultural and city industry. The wealth derived from the facile export of the wool had already contributed to social amelioration and progress, and the labour power that was not required for the extirpation of a colossal forest had been free for application in other ways that may have proved more congenial to comfort and wellbeing. These considerations explain the prompt and rapid development of Australian commerce, and the marked prosperity of its colonization. Victoria was a country ready made at nature's hand. The squatter or sheepholder at once used it, and as fast as he could breed or import his stock he spread them over its fifty-five millions of acres, of which two-thirds were available to him for pasture. In 1837 there were about 175,800 lb. of wool exported; in 1850 this quantity had increased to eighteen millions of pounds weight, with the additional export of 4500 tons of tallow. In the earlier years the young settlement was still importing sheep and cattle from the two senior colonies to the north and south; but four years had scarcely elapsed ere the fat stock of the Port Phillip pastures were already a promising article of export, and the subject of a trade whose increase and prosperity was interrupted only by that great event that has latterly made Australia the world's object, and introduced a marked change in this and many other of these colonies' earlier commercial and social developments.

Gold discovery.

We have now arrived at the great era of this colony, the discovery of its gold-fields. The accounts from California had early drawn attention to the probability of gold-mines being found in this part of Australia, and this idea was strengthened by the repeated assurances of Sir R. I. Murchison in England, and the observations and hints of Strzelecki and the Rev. Mr Clarke in the colonies. So early as 1849 there was a rumour of gold having been found at Clunes, and as this place has since proved a real gold-field, the report was probably true. At this stage, however, the question slept, until the colonists were startled into fresh life two years afterwards by the discoveries of Hargraves near Bathurst in New South Wales. These discoveries, which took place in February 1851, and were made public in May, caused a general and immediate search throughout all the quartz and gravel regions of Victoria, and the necessity of the case soon added the convenient word "prospecting" to the colonial vocabulary. Anderson's Creek, 16 miles east of Melbourne, discovered in August, was the first ascertained of the gold-fields; but although still worked, it has never attained to any celebrity. In September the great field of Ballarat, about 80 miles to the westward, was occupied, and its riches partially ascertained; while only a month later, and as the colonists flocked from all quarters to this attractive scene, the earlier diggers were already swarming off to the newer fields, for the time more attractive, around Mount Alexander. A few months more, and the yet greater marvels of Bendigo were proclaimed. For some time this field became the most conspicuous, and extraordinary quantities of gold were taken from it. By the middle of 1852 above 50,000 per-

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sons were collected there, and the sudden demand for the necessaries of life raised the rate of carriage to 20s. per ton per mile, and advanced the price of flour from L.25, its rate at Melbourne, to L.200 per ton.

For several months during the spring of 1852 (August to November) the yield of gold in the colony was greater than it has ever since attained, and was estimated at 400,000 ounces, or L.1,600,000 per month. It was derived chiefly from Bendigo, and in particular from a district called the White Hills, which, however, were soon undermined and exhausted of their rich deposits, that were mainly contained in a very thin layer of the drift. In September the government had instituted an armed escort for the purpose of conveying, at a moderate charge, the gold to the shipping ports; and for a time these great results brought more than one rival escort company into the field, as the impatient diggers were provoked by the leisurely character of official procedure. Meanwhile, the news of these acquisitions had brought tens of thousands from the adjacent colonies, and towards the end of 1852 this stream was largely augmented by that which rolled in from the other hemisphere, from India, Europe, and America, but especially from the mother country. The population was doubled in twelve months, and the port at length so crowded with shipping that as much time and expense were involved in conveying the merchandize by lighters nine miles up the River Yarra to Melbourne as in the whole preceding voyage of half the world's circuit.

The natural effects of all this wealth and commerce soon appeared. At first, from the general desertion for the gold fields, landed and house property actually fell in value, especially the latter, as many tenements were left entirely empty, and were gladly let or sold at great reductions. This depression lasted but a brief interval. During 1852 and 1853 rents advanced tenfold, and many estates, town allotments, &c., yielded an annual rental of several times more than the fee-simple value just prior to the gold discovery. There were instances of fancy suburban sites being purchased for L.1 an acre, and re-sold for L.1000. But this upward rush in valuation could not go on for ever. It came to a halt towards the end of 1853, and then the lively colonists found that, like the oscillations of a pendulum, they had travelled beyond the right mark, and must be content partially to retrace. With little intermission, these inflated values have ever since been gradually subsiding; and, although they are still far in advance of the humble estimates prior to the gold-fields, yet they exhibit a very unsatisfactory appearance to the sanguine investors who went in for investment at the culminating season.

Population.

The progress of Victoria since 1851 is a series of marvels which no British colonial experience had ever previously exemplified. We have already given the results of the census of March 1851. A hurried and probably very imperfect census, taken in April 1854, gave the population as 236,000; but one more carefully completed in March 1857 made it 410,766, which number included 25,424 Chinese and 1768 aborigines. Exclusive of these races, there were 383,574 nearly all of European blood, but disproportionately consisting of 237,761 males and only 145,813 females. Of the Chinese only 23 were females. The aborigines were reduced to this slender enumeration from probably ten times the number at the first settlement of the colony twenty-two years previously. The distribution of the colonists in 1857 was as follows:—Melbourne and suburbs, 92,300; Geelong, 23,338; rural districts, 109,000; mining districts, 166,550. In the beginning of 1859 the population was estimated at 487,000. This number included about 30,000 Chinamen, a race whose presence in such large numbers in the colony has been the subject of much debate and difference of opinion, resulting, however, in the imposition of certain legislative restrictions having the object of checking the strength of the immigration. Australia.

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The imports for 1851, as we have seen, had attained the considerable amount of L.1,056,437; in 1857 they amounted to L.17,256.209. But these large figures scarcely exemplify the suddenness of the increase of the colonial commerce; for so early as 1853 the imports had attained to L.15,843,000, and the following year to no less than L.17,743,000; but the market having for a time been overdone by these efforts, subsequent years showed a diminution. The imports of 1857 were derived in these proportions:—From Britain, L.10,122,201; from British possessions, L.5,601,841; United States, L.784,643; other foreign places, L.747,524. The chief feature in these amounts is the large trade which they indicate with the United States, whence breadstuffs, furniture, mining-tools, &c., with increasing supplies of the great luxury of ice, are now regularly imported. The value of the importation from the States for 1851 was only L.122.

The exports in 1851 had amounted to L.1,422,909. In 1852 they are officially set down as L.7,451,509, but are known to have amounted to nearly L.15,000,000, as large quantities of that great yield of gold already alluded to had been ascertained to have left the colony unrecorded at the custom-house. In 1857 the exports amounted to L.15,079,512, of which L.10,987,591 represented gold, while the wool was L.1,335,642. The exports are nearly all shipped direct to Britain. The shipping inwards in 1851 numbered 710, of tonnage 128,959: while in 1857 it was 2190, of tonnage 694,564.

Estimate of gold produce of Victoria.

The yield of gold has fluctuated considerably in each year since 1851; but on an average, after due allowance for what has escaped official record, it amounts for the seven years ended in 1858 to about L.12,000,000 annually, and this large quantity is yet more remarkable as being about the same as that yielded by California. The fluctuations, under the rude mode of mining still pursued, are due materially to the regular supply or otherwise of rain for aiding the process of washing and supplying the numerous "puddling machines." The year 1854, which is lowest in gold production, was unusually dry; while 1856, which stands highest (next to the estimate for 1852), was remarkably of the opposite character. The following table will be interesting as furnishing three different views or estimates of the gold produce of Victoria. The first column gives the quantity brought down by the armed escorts, including, with those of the government, the temporary escort service in 1852–3 of two private companies; the second gives the quantity exported, according to the customs returns: the third exhibits the true yield of the mines for each year, as estimated by Mr Khull of Melbourne and others, and generally agreed to as correct, a due allowance having been made for the large quantities in the earlier years that escaped unrecorded at the seaports, and also overland into South Australia and New South Wales.

Gold Produce of Victoria, 1851–58.

Year.	From Mines by Escort.	Exported.	Estimate of Actual Produce.		
			Produce.	Value per oz.	Total Value.
	Oz.	Oz.	Oz.	s.	L.
1851 ...	104,154	145,137	345,137	60	1,035,411
1852 ...	2,039,382	1,988,526	4,247,657	70	14,866,799
1853 ...	1,874,409	2,497,793	3,090,342	75	11,588,782
1854 ...	1,476,666	2,144,699	2,192,699	80	8,770,796
1855 ...	2,132,398	2,751,535	2,964,073	80	11,856,292
1856 ...	2,625,968	2,985,991	3,533,527	80	14,134,108
1857 ...	2,481,020	2,762,460	2,606,040	80	10,424,160
1858 ...	2,371,269	2,555,263	2,421,461	80	9,685,844
Total..	15,105,266	17,831,404	21,400,936	...	82,362,192

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If we estimate the whole at its proper value of 80s. per oz., instead of the lower rates that at first prevailed in the colony, there is still to be added L.3,241,551 to this large amount, making it L.85,603,743. This, then, will represent the total yielded by the Victoria mines up to the end of 1858. But in order to find the quantity exported (that being the usual mode of reckoning the gold and its effect upon the world), there must be deducted 216,501 oz., or L.866,004, as the quantity on hand in the colony on 31st December 1858, leaving the exact value of the quantity exported at L.84,737,739. The produce of New South Wales for the same interval, together with a small allowance for the other colonies, will add L.5,000,000 more to this last total. The New South Wales results can be arrived at only by the escort quantities, as the gold imported from Victoria, and afterwards re-exported, swelled the exports of the earlier years, and was thus reckoned twice over, while the operations of the local mint at Sydney subsequently diminished them. These details are given somewhat minutely, as they not only furnish a result of great interest, but correct many widely different estimates on the subject that have been made in this country and elsewhere.

Estimate of gold produce of New South Wales, &c.

Agriculture.

Agriculture, checked at first by the attractions and success of pastoral pursuits over the rich and extensive pastures of the young colony, was a second time depressed by the still more complete absorption of the gold-fields. Latterly, however, this state of things has been entirely altered, and during the present year (1859) Victoria has probably a greater breadth under cultivation than any of the adjacent colonies, not excepting even South Australia, where agriculture has been long and eminently successful. In 1851 there were but 57,298 acres cultivated. In 1857 these had increased to 179,082 acres; and in the following year to 237,729 acres, including 87,230 acres under wheat, 40,118 of oats, and 20,693 of potatoes, with a total value of crop of L.3,025,254.

Live stock and wool.

The effect of the gold discoveries has been to check, in a marked manner, that rapidity of increase in sheep-breeding and the production of fine wool that was previously the great feature of the colony. To a great extent this was the result of the sudden and large increase of the population, whose meat-consuming powers are beyond all the usual ratio of older countries and poorer masses of population. It was due partly also to the more precarious tenure of those large pastoral areas that were once occupied only by sheep and cattle, but now by tens of thousands of mining families. In 1853 the sheep numbered 6,033,367, which was the highest quantity attained. In 1858 they were reduced to 4,766,022, notwithstanding yearly accessions from the flocks of New South Wales. The other kinds of live stock have, however, steadily increased; cattle in the latter year numbering 614,537, and horses 55,683. The wool production has fallen off with the sheep. In 1854 the export had reached 22,998,000 lb., and in 1855, 22,353,000 lb.; while in 1857 it was only 17,176,920 lb., and in 1858, 20,645,334 lb., or an average of nearly 19,000,000 lb. These quantities of wool are beyond the proportion yielded by the corresponding number of sheep—a circumstance that arises from the fact, that a considerable part of the New South Wales clip is annually directed across the frontier of that colony for shipment at the nearer seaports of Victoria.

Other exports.

Tallow was another article which, following in the wake of the wool, gave promise of a large yearly trade, but which has been similarly depressed by the gold-fields' influences. The quantity exported for 1850 had risen to 4489 tons, but in 1855 it fell to 598 tons. There has since, however, been a considerable recovery, the quantity in 1857 having been 2632 tons, and in 1858, 1015 tons. Hides are now an export of increasing importance, as the facilities of inland communication induce nearly all to be despatched to market, where they arrive in better order than formerly. Sheep and cattle are still occasionally exported, chiefly to Tasmania, although this branch of business has much fallen off since the advance of prices caused by the gold. The black sand, or ore of tin, found in the remote gold district of the Ovens, adds a second metallic export, but it is as yet of comparatively small amount. Large masses of antimony are also met with in this vicinity; but the value of this article is insufficient to repay the cost of bringing it to market, and it awaits, therefore, like many other latent treasures, the future day of railway communication.

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Upon nothing did the gold operate with more immediate and powerful effect than the public finances. The revenue for 1851 had been L.316,532, and towards the end of that year the legislature had sanctioned estimates for 1852, framed upon some like amount, with the addition of a modest and usual ratio of increase, which it was hoped the gold would at least not tend to diminish. But the revenue of 1852 proved to be L.1,577,181. That of 1853 was L.3,202,139, no less than a million and a half having resulted from the land sales. The land sales have since fallen off to a half or two-thirds of this amount, but the customs revenues and other items have steadily advanced; and the revenue of this young settlement, containing not half a million souls, has been maintained at about L.3,000,000 yearly. In 1857 it was L.3,175,888, and in 1858, L.3,039,791. These sums are exclusive of loans, with whose tempting facilities the colony is already getting familiar. After the first surprise of the government at the overflowing treasuries of 1852–53, the art of spending became so easy that during the following year the colony was already in debt. It is true that at this inflated time money went but a small way as compared with its former power, and the colony clamoured for public works and improvements to meet its expanding society and commerce. The legislature interposed a severe but effectual check on this extravagance, which was the more necessary, as a reactionary crisis had already set in which was diminishing the income, while the government were immensely increasing the expenditure. Prior to the era of self-government in 1856 there had been contracted a debt of about L.2,000,000, chiefly for the construction of water-works for Melbourne, costing altogether about L.800,000, and of aids for improvements of L.500,000 to Melbourne, and L.200,000 for Geelong. But subsequently to that period, a loan of L.8,000,000 was sanctioned for the construction of railways. Of this large amount, L.7,000,000 were to be raised in London, and already (1859) L.2,170,000 of the stock has reached that great monetary capital. The railway constructions proceed vigorously; and the debt is now rather over L.4,000,000. The revenues are derived chiefly from customs duties, which include an export duty of 2s. 6d. per ounce on gold, and from the sale of the public lands. For 1858 the former amounted to L.1,650,917, and the latter to L.699,846.

Revenues and public debt.

General progress.

The first inflations of the gold discoveries have passed away, and given place to steady industry and extensive and substantial progress. Melbourne, the colonial capital, as a creation of the last twenty-two years, is perhaps the most surprising object of its kind that has ever exhibited the marvels of human industry. The city and immediate suburbs, containing about 100,000 inhabitants, have an outward aspect of traffic and extent of commerce far beyond the usual proportions in other countries of even so considerable a place. Its streets and houses are lighted with gas, and both are plentifully supplied with fresh water. Three railways issue from its busy centre, besides long lines of good macadamized roads, one of which penetrates by way of Mount Alexander to the famous Bendigo, now the site of the large corporate town of Sandhurst. This road is above 100 miles in length, and is constructed for the most part at the enormous cost of from L.2000 to L.6000 per mile. There are

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spacious theatres, hospitals, benevolent asylums, an university of the most ambitious dimensions, a public library (which, still unfinished, has already cost L.20,000, with L.7500 for the purchased portion of its library); and lastly, a Parliament-house, which takes position in the empire next to the magnificent palace of legislation erected at Westminster. Telegraphic communication is already complete throughout the south-eastern colonies, and across the intervening strait to Tasmania; and steamboats or other traders ply almost daily between the various seaports of the Australian group.

Crime.

The fame of her gold treasures brought a severe trial to Victoria's society. The adjacent penal settlement of Van Diemen's Land, for several years at first, resembled an open gaol, whence a resistless stream of the most depraved criminals spread themselves over the gold fields and highways, committing everywhere the boldest and most atrocious crimes. Intensity of feeling produced strong remedies, and the "Convicts Prevention Act," promptly passed by the legislature, alike required the Tasmanian immigrants to prove themselves non-convict, and also excluded those "conditionally-pardoned" offenders who were excluded from the mother country. The objection of the imperial government, that this measure interfered with the Prerogative, fell with decidedly light effect upon the angry Victorians, and did not prevent the act being renewed for those short periods that are permitted by the constitution, and that have more than once saved unseemly results between the imperial mother and her colonies, when there was less of mutual forbearance and consideration than is happily the case now. These evils have gradually ceased. The police became more efficient, and crime diminished, although the population rapidly increased. The number of convictions for felony was in 1851, 152; in 1852, 368; in 1853, 499; in 1854, 308; in 1855, 137; in 1856, 237; in 1857, 374. The year 1855, and the greater part of 1856, were times of commercial depression; a circumstance that suggests that these alternations of a generally thriving colony produce that marked diminution of crime that is usually the result of the opposite or prosperous seasons of our home country.

We shall conclude this part of our subject by a brief glance at the history, political and general, of the colony.

Victoria had formed the southern district of the colony of New South Wales until the year 1851, when it was erected into a separate colony under a lieutenant-governor, the governor-general for Australasia occupying the senior colony of the group, New South Wales, from which Victoria had been detached. The country, prior to this separation, bore, as already mentioned, the name also of the Port Phillip district, and sometimes Australia Felix. Only three counties had been at first marked off in the young settlement,—namely, Bourke, Grant, and Normanby. These respectively encircled the spots selected by the early colonists, and these spots have since become the chief seaport-towns of the colony, Melbourne being the capital of Bourke, Geelong of Grant, and Portland of Normanby. After the passing of an act of Parliament, and certain Orders in Council founded upon it in 1847, a further creation of twenty-one counties followed in the succeeding year. There are now therefore twenty-four counties, which have broken up the several large squatting districts into which the country had been previously distributed. Gipp's Land comprises seven counties,—viz., Howe, Combermere, Abinger, Bruce, Haddington, Douro, Bass; the central region has eight,—Mornington, Evelyn, Anglesea, Bourke, Grant, Talbot, Dalhousie, Rodney; the remaining nine are in the western district,—viz., Follett, Dundas, Normanby, Villiers, Heytesbury, Hampton, Ripon, Grenville, and Polewarth. The rest of the colony is comprised in three pastoral districts,—viz., the Wimmera, the Loddon, and the Murray.

Mr Latrobe, who had arrived in 1839, and had acted as "Superintendent" under the New South Wales government, was appointed the first lieutenant-governor, and remained till May 1854. Of a quiet and literary turn of mind, he was perplexed with the hurry and tumult after the gold discovery, and yet more by the disputes about the tenure of the squatters, or pastoral occupants of the waste lands, this powerful body having succeeded in obtaining from the imperial authorities certain long tenures and other privileges, well known as the "Orders in Council of 1847." Sir Charles Hotham arrived in the following month, June 1854, but died on 31st December of the year succeeding, in consequence, to some extent, of mental anxiety connected with the condition of the colony, social and financial, and the impending change to self-government. The financial troubles have been alluded to. Those of a social character were serious, although happily temporary, and culminated in the outbreak at Ballarat in December 1854. This unusual spectacle in British society had several causes. The rough and irritating task of levying monthly a direct personal tax of considerable amount was conjoined with a diminishing yield of gold to the miner; while a vexatious and suicidal parsimony of the government with the public lands, and a want of recognised political standing in the mining body, prevented that settled order and contentment which should rather have been a matter urgently promoted than otherwise towards the miners. A commission of inquiry, appointed by the governor, met the mining population in a cordial spirit; and the government having carried out the various recommendations, the gold-fields have since presented no exception to the common quiet and loyalty. Major-General M'Arthur, commander of the forces, assumed the acting governorship for twelve months, until the arrival of the present governor, Sir Henry Barkly, on 23d December 1856.

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Government.

The acting governor inaugurated the first legislature of the free government. The colony had previously enjoyed the intermediate step in the customary progress,—namely, that of a legislature consisting of two-thirds representative, and one-third nominee, with a governor and executive responsible only to the crown. Now, however, the system was parliamentary. The colony and its old legislature, in drafting out in 1854 its new constitution, which was to receive the imperial sanction, had decided, in common with the other colonies in like circumstances, upon two houses of legislation. Both were elective, but the Council or Upper House was placed on the narrow foundation of a very high qualification: L.5000 of real estate, or L.500 a year for a member, and L.1000, or L.100 a year, for a voter, shows what princely ideas prevailed during these golden times of 1854. This body, consisting of thirty members, cannot be dissolved, but one-fifth of its number retires every two years. The assembly, sixty in number, is of three years' duration. Both bodies, in conjunction with the colonial public, have been latterly most active in shaping out the political future. The new constitution had been framed during times of hurry and gold excitement, and by a legislature composed partly of nominees, and otherwise meagre in its popular relations by the undue proportion of the squatting or crown-tenant element with which the old regime had instinctively fortified itself. It was therefore no sooner at work than it began to be attacked. The principle of the ballot had already been adopted by the old legislature; the new one added the manhood suffrage and the abolition of property qualification for the assembly, and increased that body to seventy-two members, with an electoral distribution based chiefly on population.

Religion.

The religious system is that of the perfect equality of all sects and citizens before the law, excepting as regards a state aid of L.50,000 annually secured by the Constitution Act, and distributable amongst the various Christian sects. This system has been abolished in South Australia, but continues in New South Wales and Victoria. It is, how-

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ever, incessantly a bone of contention; now, by the limitation and inequality, as to civil rights, implied by the words "Christian sects" in the act; and again, by the anti-state aid views of certain sects, and perhaps of colonial opinion generally, when drawn out by repeated discussion. By a considerable majority, the new Assembly condemned the system; but a small majority of two in the Council still maintains the contention for a farther season. The census of 1857 gave the religious condition as follows, in a total population of 410,766:—Church of England 175,418, including 15,520 subscribing as "Protestants," and 221 as "Free Church;" Presbyterians, 65,935; Wesleyan Methodists, 20,395; other Protestants, 27,521, including 10,858 Independents, 6484 Baptists, 6574 Lutherans, 1480 Unitarians; Roman Catholics, 77,351; Jews, 2208; Mahommedans and pagans, 27,254; residue, 6774.

Education.

The state assistance continues to be bestowed on the two rival systems, the denominational and the national, of which the former, the longer established of the two, is by far the most prevalent. In 1857 the denominational schools numbered 399, the pupils 24,973; while the national schools were 101, and pupils 6113. The considerable grant of L.125,000 for that year was distributed in these proportions. The private schools numbered 138, with 3437 pupils. There are thus 638 schools, or 1 in 600 of the population; while the 34,523 scholars are 1 in each 11. The number of persons who could read and write in 1857 was 249,386, or upwards of 60 per cent. By a provision of the Constitution Act no person who, attaining to twenty-one years after November of this year, and being unable to read and write, is entitled to the franchise.

Present political condition.

Victoria, in common with the sister colonies, may still be regarded as in the act of re-adjusting the social and political state consequent upon the late introduction of self-government. They are, as it were, descending from the stilts of the old regime, and great interest must naturally attach to the question of the position into which, collectively or separately, they at length subside. Although it would be premature to pronounce positively and completely on this subject, yet something may be said of those features already assumed, which, as being to all appearance common to the Australian colonial picture, may the more certainly be regarded as normal and permanent. The tendencies are decidedly, we might say irresistibly, to those democratic equalities that in older countries are checked by the actually existing and old hereditary form of an opposite social fabric. The fact that every one has emigrated to better his condition by some kind of labour has a levelling influence upon class prestige, and this effect is strengthened by the independent position, and, in general, the ample wages of the labouring classes. In short, equality is alike the public opinion and the actual fact.

Prominence of Victorian example.

The surpassing importance of Victoria, which contains about half the total colonial population of these settlements, and whose capital seaport of Melbourne represents more commerce than all the others put together, has naturally given to it the lead in the political movement. So early as 1855 a principle tantamount to general or manhood suffrage was introduced successfully in this colony with reference to the peculiar case of the mining population, and was soon afterwards extended to the entire territory. South Australia and New South Wales have since followed this step. In the question of religion, the tendencies are unmistakeably towards entire separation from the state, which, administered as it may be by an executive of all variety of persuasions, cannot in any individual or sectarian sense be religious. The present state aid to religion, representing the only state tie, was introduced prior to representative government in these colonies. It has been already abolished in South Australia, and it seems to survive in the other colonies only by means of some protracted electoral inequalities of the past regime. The question with the colonists becomes one of civil rights, and the public feeling decidedly tends towards a perfect liberty and equality, religious as well as civil. In these circumstances, colonial orders of nobility, or colonial religious establishments, giving to particular classes or sects any status or privileges beyond what the rest of society enjoys, would probably be found, as far as may now be judged, not only an unpopular but an impossible intervention.

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Comparisons, social and political.

These colonies have grasped the reins of their own self-government with an ardour that is truly the most gratifying response they could make to that imperial confidence which entrusted them with so grave a responsibility. Their Parliaments, unpaid as they still are in these countries of "working-men," sit for most of the day, and very often also for most of the night, over the public interests. The first assembly of Victoria's free government sat, with very slight exceptions, throughout a whole year; and the writer recalls the circumstance, that one of the debates, upon the important subject of the public land regulations, continued uninterruptedly for twenty hours, having commenced at noon and lasted till eight next morning. Earnest and energetic business has thus succeeded to the semi-amateur legislation of the past. The ranks of government are open to the ambition of persons from every class, and political and even social position are much less exclusively the result of polished education or accredited connections than of personal merits or usefulness. With this practical energy and adaptation to its own case the colonial picture wants the refinement characteristic of an old society. There is a constant fracturing of the upper crust in order to elevate to its envied stage successive masses of the competing crowd beneath. The curious in social questions may speculate on the alternative of the high polish that fringes the mass destitution of home society, and the ruder surface that covers the substantial wellbeing of colonial life.

Lessons from the past

Important lessons have resulted from past colonial experiences. A few years ago it was thought dangerous to give colonists much liberty. They were democratic, rebellious, and wickedly disposed to break off from home ties on every opportunity. These notions have proved quite unfounded. Self-government has promptly developed, indeed, those extreme popular ideas that may be regarded as representing the normal state of new and detached societies of our countrymen; but it has also strikingly increased their loyalty to the empire. Indeed, there can now be no doubt that the restrictions heretofore imposed on colonial liberty by imperial distrust were the sole cause of whatever savoured of disloyalty or discontent in the past. Perpetual interference with local concernments stirred up in the colonists everlasting antagonism to their governments, local and imperial. There is now in all this a manifest change. The colonists' differences are reserved for their own political parties, and the imperial authorities, by abandoning direct interference, have acquired a most powerful indirect influence that must ever be for good to the lively but inexperienced offshoot.

Our country may not henceforth be engaged in founding many more colonies. The earth is, after all, but a limited sphere, since we sport so nimbly over it by steam and rail; and there is no inexhaustible supply of empty areas to be still taken up in temperate and attractive climes. Were it otherwise, our thoughts might be profitably directed, and in no scant measure, to certain alterations in the old and established procedure for the nurture of British colonies. But even now, as the subject is still interesting, a brief allusion will be excused.

Against convict colonies.

In the first place, we must hope that there are to be no more bright visions of colonies founded by convicts; just as though vice were some imaginary attribute that made no difference to society, or might be balanced off by some

Australia. Victoria.

amount of money or other material consideration. Speaking as colonists, our imperial mother has for many long years been relieving, at our moral cost, the difficulties of her superabundant crime. But speaking also from the home view, has not this facility of transportation operated with fatally lax effects upon all preventive efforts, and brought annually unimpaired numbers to replenish the criminal field? It is fortunate for humanity that Britain is the only one among the teeming populations of civilized countries that has succumbed to the difficulty and responsibility of regulating within itself its own criminal elements. But at length the transportation system, under a stricter view of our duties, is likely to be abandoned, and for that purpose awaits only some adequate attainment in the neglected studies of preventive remedies and criminal discipline. As the protracted experiment has been enormously costly, so the windfalls of British expenditure to the favoured penal colonies have maintained a vexatious confusion in the argument. Eastern Australia has successfully resisted; but simultaneously the isolated and slow settlement at the western extremity has allowed the material to outweigh the moral balance. Britain, after a brief trial, was not prepared for a sudden and complete change; and accordingly West Australia, which opportunely offered, may be regarded as the medium by which our country is to graduate into the practice of its difficult but necessary duty.

Injurious political training.

So much for the moral training of colonies in certain striking instances; and next as to political training. The old proverbial discontents show that colonists are actuated by other than mere material wants. This should be the glory of our countrymen. But the grand error in past imperial management has been the ignoring or disliking of this circumstance, and permitting colonial liberties to be wrested, step by step, from the reluctant and resisting authorities. But in truth no private right should have been more sure to each colonist than this public right to the collective body, so soon as it was willing to undertake the responsibilities, and in a position to meet the expenses of its own government. The irresponsible administrations that were placed over young colonies had ever before them a vista of interminable warfare. The enemy was the colonial public, less some proportion, more or less considerable, of such upper-class life as might have arrived in the emigrating tide, and naturally attached itself by tastes and sympathies, and the hope of appointments, to a colonial court. The vicegregal circle might be small, but it had not the less an effective influence in its own locality, as the depositary of all power and patronage, and as standing indisputably at the head of fashion and society. If not always exclusive as to persons, it was inexorable as to principles; and so the Cavalier court and the Roundhead public stood irreconcilably at bay. The governor was a temporary personage of five or seven years' reign, but Government-House was a perennial corporation, true to the last for its anti-popular sentiments, and its revenue emoluments sweet because not beholden to popular sanction, and fighting to the end for its social and political supremacy against the vexatious progress of its vulgar foe.

Here we have a scene of permanent mischief-making, most of which might have been avoided by a simple understanding at the outset between the authorities and people as to the political future. The effects are injuriously lasting. The imperial government is slow to yield; but long after a decision in that quarter has been arrived at to grant steps of freedom to the colonies, the local authorities still strive, and not unsuccessfully, to defeat the imperial intent. New South Wales and Victoria, at first comprising one colony, are a case well to the point. When elective legislatures were given to Australia in 1843, imperial precaution required that one-third of the body should be of crown nomination. But to the colonial authorities this seemed a most inadequate protection against the common foe. The electoral arrangements were in their hands, and the squatters were the convenient medium of the occasion. Accordingly, the new Assembly emerged with a majority consisting of crown nominees and crown tenants,—a state of things that can hardly be said to have ceased until the recent advent of self-government. Hence a long anti-popular dominancy, with official powers and invidious class privileges and expectations that should never have been even thought of, and squatting antipathies on the part of the colonists which now threaten their sure re-action. When the people at last find themselves in power, most of the conspicuous colonists, and of those accustomed to public affairs, are those who have been arrayed against them. The altered circumstances do indeed open a door of escape that is not very vigilantly scanned in the general jubilee. Yet human nature is reluctant to stoop. To such causes must we in a great degree attribute the fact, that many colonists, of an education and position best suited to public affairs, do not come forward under the new condition, while many more, dwarfed and discontented, quit the colony. There are exceptions enough to show that the colonists can appreciate the higher attainments, and are not too categorical upon the exploded past.

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Successful examples.

The examples of Victoria, South Australia, and New Zealand may teach us that the most prosperous colonies may be established without costing one farthing to the mother country. We can suppose there is no call now for establishing others. The later colonizing experiments in New Zealand are the successful solution of a long-vexed problem. The solution, too, is eminently pleasing, notwithstanding that any ideas of permanent dominancy either of Presbyterianism at Otago or of Anglican Episcopacy at Canterbury, are as futile as, in a liberal view of civil fraternity, they are undesirable. The ironical complaints of the New Zealand colonists, that the grass overspreads the untrodden approaches to the courts of justice, is only the natural result of a young colony favoured by a climate and country that alike stimulate and reward industry. Australia, on a larger and more noticeable scale, should have powerfully supplemented this happy picture, only for the social misfortune of its early convictism. Possibly we are not yet at the end of such inspiring instances of colonization, and the fact of the recent great clearance of official cobwebs with regard to colonies will not a little aid the emigrating enterprise of our day. Although the field of choice is contracted, yet the dangers and expenses are surprisingly diminished by facilities of navigation and the enlivening ubiquity of our race. The omnivorous wants of modern commerce will find in most new countries something having a value for exportation. Who can complain of the exile of colonial life when a few weeks now convey us to or from the antipodes? Colonizing expeditions, open to all classes, and headed by their future rulers and magistrates, are among the probable things of the present time, and broad and unclaimed acres are not wanting for their purpose. When such occasions offer, our home government, more discriminative than in past times, may better judge how to commit frankly to a young and remote society the administration of its own affairs, and may feel, too, that a fresh imperial domain thus acquired is the preferable alternative to an unclaimed waste, abandoned to nature or occupied by a handful of cannibals.

Under such reflections, we may regret the oversight that left the beautiful island of New Caledonia, with its unrivalled climate and capabilities, to pass, so lately as the year 1853, into the unfruitful hands of French colonization. If there were no other loss or inconvenience, the fact that this circumstance has resulted in the urgent demand for a powerful naval station at Australia, will illustrate how a momentous contingency may grow out of apparently very

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slender premises. It is a commercial and common-sense axiom, to have a real purpose in view for every labour and outlay. But when rival wooden walls and bristling guns are accumulated at the antipodes, all perhaps under the cross grains of mutual misapprehension, it is allowable to hope that the whole may eventually prove a total waste of means, and that those waters that roll between the two colonial nationalities are still to be regarded as in every sense a Pacific Ocean.

Tropical colonies peculiar.

As experience makes us familiar with the diversified features of our colonial empire, two great classes of colonies will rise distinctively before us,—those of tropical and those of temperate latitudes. We may perceive already, in the instances of East and West India, as compared with Canada, the Cape, and Australia, that these two classes of settlements are respectively on a different path, and that a widely different destiny lies before each. We have hitherto alluded only to the latter class of colonies—to those that reproduce a British society; and nothing can be said here regarding the other class.

With respect to tropical Australia, it may just be remarked that, distinct as it is in its social destinies from the self-governed states of its more temperate latitudes, it should be distinct also in its political relations, and be retained as a crown colony, subject to imperial administration.

South Australia.

III. South Australia. When Captain Sturt discovered and explored the Murray River in 1830, and traced its course down to its embouchure into Lake Alexandrina,—now called Victoria,—he was of opinion that to the westward of that river, towards Gulf St Vincent, a rich and fertile land existed; and that probably the lake disembogued into the gulf. His men at the time had suffered so much from fatigue and privation, that it would have endangered the safety of the party if he had attempted to prosecute his researches further than ascertaining generally the extent of the lake. On his return to Sydney, however, he represented the matter so strongly to Governor Darling, that he sent instructions to Captain Barker, Commandant at King George's Sound—who was under orders for New South Wales—to land at Cape Jervis and explore the eastern shore of the gulf, and ascertain the outlet of the lake. Unfortunately that gallant officer, just as he had completed his task, was inhumanly murdered by the aborigines at Encounter Bay, while in the performance of a perilous portion of his duty. Mr John Kent of the commissariat department, who accompanied Captain Barker during the expedition, has recorded the particulars of this first exploration of the Adelaide country. The party, consisting of seven persons, landed on the eastern shore of the gulf, and proceeded inland in a north-easterly direction, ascending a range of mountains, of which Mount Lofty formed the highest peak; from whence they could overlook the gulf to the westward as far as York Peninsula. To the northward this range trended in an unbroken line, which settled the point that the lake had not an outlet in that direction: they descended accordingly and traversed the country through some fertile valleys and rich lands on Sturt's Creek, until they reached Encounter Bay, where the lake disembogued itself into the sea through an insignificant channel between hummocks of sand. Here Captain Barker gallantly stripped and swam across the channel, with a compass to ascertain its position. Mr Kent, in his MS. narrative, describes the circumstance in these words: "Curiosity prompted me to time his crossing. The current was running out strong; but he accomplished the feat, at 9·58 A.M., in 3 minutes. On arriving at the opposite shore, he ascended the sandhill, gazed around for a few moments, and disappeared." He was never seen afterwards. It was, however, subsequently ascertained that three aborigines had speared him, as he rushed into the water to escape from them: his body was carried away by the tide. Mr Kent on his arrival in Sydney gave a favourable report to Captain Sturt of the country explored, coinciding with that gentleman's own impressions. This partial exploration was described by Captain Sturt in his account of his discovery of the Murray River, in which he pointed this out as a desirable locality for the establishment of a new colony. Here accordingly the colonization commissioners of South Australia fixed the site of the future province; and forthwith despatched a surveying staff, followed by crowds of emigrants and a governor, before anything further was known of the capabilities of the country. The territory claimed by the ambitious and fallacious colonizers of this province was not less than 300,000 square miles—about 3½ times the size of Victoria; but notwithstanding the subsequent explorations of Captain Sturt to the N. and E. of the Gulf St Vincent, and Mr Eyre to the westward of Spencer's Gulf, the country traversed by Captain Barker and Mr Kent, including what they saw from the Mount Lofty range, comprises nearly all the arable or pasture land occupied by the settlers at the present day—an area not exceeding, at the most, 10,000 square miles of ordinary pasture-land.

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Geography. Plate CI.

The boundaries of South Australia, according to the statutes of 4th and 5th Will. IV., cap. 95, are fixed between 132° and 141° E. Long., for the eastern and western boundaries; the parallel of 26° S. Lat. for the northern limit; and the southern boundary defined by the sea-coast, including Kangaroo Island. As already observed, this extensive tract of country measures nearly 300,000 square miles, or about 192,000,000 acres; the greater portion explored having been ascertained to be a barren waste, diverging into the stony desert of central Australia. The portion of this immense territory actually occupied by the colonists may be described as all that tract of land situated between Lake Victoria, ascending the Murray River as far as the "Elbow" in 34° S., on the E., and the eastern shore of Gulf St Vincent to the westward. The attempts to form small settlements at Spencer's Gulf and on Kangaroo Island have failed; and even York Peninsula possesses very little available country for the sheep-farmer or agriculturist.

History.

This colony was occupied as a British province on the 26th December 1836, by Captain Hindmarsh, R.N., who was appointed the first governor of South Australia. The powers with which he was delegated, and the constitution of his government were very different from those possessed by the early governors of the older colonies in Australia. With Mr Edward Gibbon Wakefield originated the new scheme of colonization. That gentleman wrote a series of pamphlets and letters to prove that colonization may be reduced to an art; of which he believed he had discovered the true principle. He held that, by placing a high value on the unreclaimed lands of a new country, and forwarding a labouring population out of the sale of those lands, the emigrants would of necessity work at *low wages*, as the purchase of the *dear lands* would be above their means; thereby securing to the capitalist investing in the land, a large interest for his money; and forming at once a community of labourers and artizans who would minister to the benefit of the landholders. But, besides these large landholders, a class of small farmers were to be induced to emigrate, by disposing of the land in small sections, to be cleared and cultivated by their families. The allotments of an embryo city, 9 square miles in extent, were to be thrown open at once to purchasers; so that the whole population should be concentrated around the emporium of trade. The principle contended for, therefore, was the opposite of what had been pursued in the pastoral colonies of Australia; for, while the latter consisted in the *dispersion* of the settlers, the new scheme was that of *centralization*. Which of them may be considered the most successful plan of colonization, the sequel will show. Meanwhile, by the industrious promulgation of these views before the British public, the press, and ultimately the government, looked favourably upon the

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scheme. The result was the formation of a company called the "South Australian Colonization Association," and in 1835 they obtained a grant from government of the immense tract of land we have already described. The conditions were, that the land should not be sold at less than L.1 per acre; that the revenue arising from the sale of such lands should be appropriated to the emigration of able-bodied labourers to till the soil; that the control of the company's affairs should be vested in a body of commissioners approved of by the colonial office; and that the governor of the province should be nominated by the crown.

Hindmarsh, 1836.

Under these auspices, Governor Hindmarsh landed on the swampy shores of Holdfast Bay in December 1836, and with difficulty found his way to the contemplated site of the proposed city of Adelaide. The distance from the intended port being seven miles, he was at once impressed with the error of the commissioners' agents in fixing upon such an ineligible spot for a seaport town—a fault common, however, to new settlements in these distant colonies. His arguments upon this and other points with the local officers of the company, led to an unseemly discussion; so that after two years' administration of affairs he was recalled, and left the colony in 1838.

Meanwhile the emigrants, consisting mostly of "surveyors, architects, engineers, clerks, teachers, lawyers, and clergymen," with traders and adventurers of every description, were landed in thousands upon the mangrove swamps around the anchorage of the future Port Adelaide. After a very short time the majority of these settlers saw the nakedness of the land, and the absurdity of forming a colony without cultivating a foreign export. They thought it better, however, to keep silent, leaving the unscrupulous representations of the local agents to go forth, so as to induce others to come out, that they might dispose of their lands to better advantage. Then commenced a system of land-jobbing which can only find a parallel amongst the gambling transactions during the great railway-mania in England. The land-orders issued by the commissioners were negotiated like railway-scrip; and where the land had been actually surveyed, it passed nominally through, in some instances, as many as twenty purchasers, rising in value as it was conveyed from one party to another; payment being made generally by bills at long dates. In this manner town allotments which were originally set up to auction at L.2, 10s. per acre, soon reached the apparent value of L.2000 and L.3000; while country sections obtained at the upset price of L.1 per acre, realized as much as L.100 per acre. Those who had secured special surveys of 16,000 acres upon payment of L.4200 for that number of acres selected from the whole, sold allotments in imaginary townships at enormous prices. To this land-mania were added building speculations on an equally extravagant scale; and the wages of ordinary labourers increased to 15s. and L.1 per day. These facts, set forth in the most attractive light, were extensively circulated throughout England and Scotland, till the emigration fever rose to a pitch hitherto unprecedented; while the South Australian commissioners in London fanned the flame by publishing reports to raise the value of the land-orders issued by them. These, in several cases, were negotiated on 'Change at a premium of L.500 upon the order for 80 acres issued at the upset price of L.1 per acre.

Gawler, 1838.

Colonel Gawler was appointed to succeed Captain Hindmarsh, in 1838; and he arrived in the colony on the 13th October of that year. The apparent success of the land and building speculations deceived the new governor into a prodigality of expenditure during his administration, for which he has been unjustly condemned. It was, in fact, not more than equivalent to the apparent revenue of the country, but was found, however, at the close of three years, to exceed that income by L.400,000. Like the majority of the colonists, he imagined that all this interchange of *paper* gave *value to the land;* and as there was plenty of it belonging to the commissioners, there was little fear of the territorial revenue decreasing. As to ordinary revenue there was an increasing amount from the customs alone, which promised to meet all demands in time. But in 1839 the reaction took place, followed by a universal bankruptcy amongst the landholders, and the ruin of most of the small moneyed settlers. As the colony was established at its commencement upon an insecure foundation, it was no wonder that the inexperienced settlers, induced to build up the superstructure, should have failed in the attempt; for they were mostly townspeople who knew little or nothing about growing sufficient food for themselves. Hence their means were all expended on purchases from the neighbouring colonies. After three years' occupation of the country—while they had been buying and selling land by the thousand acres, and building towns and villages throughout the country—there were not 1800 acres of land under cultivation, and that mainly consisted of vegetable and flower gardens in the vicinity of their mushroom city. In 1840, when the writer of this article arrived in the town of Adelaide, there was a population of 8489 persons in the town, and only 6121 in the country, making a total of 14,610 for the colony in the fourth year of its existence. The exports for that year were L.15,650, or a fraction over L.1 per head; while the imports from Great Britain and the neighbouring colonies were above L.273,000, or at the rate of L.18, 10s. per head of population. While the revenue was not more than L.30,199, the expenditure amounted to L.169,966. This state of affairs was bolstered up as long as there was sufficient English capital brought by the emigrants to disburse private accounts, and money raised upon the governor's debentures to balance the public debts. But when the former ceased, and the latter were returned dishonoured, then the bubble burst. Great distress existed among the inhabitants of Adelaide at this time; food had risen to famine prices; and house accommodation was not to be obtained at any price. Consequently the incoming emigrants, unaccustomed to hard labour, suffered all the privation and disappointment which have so recently been renewed on a more gigantic scale in the neighbouring colony of Victoria. The writer of this article has paid 3s. 6d. for the 4 lb. loaf, and 1s. 3d. per lb. for meat; and he has seen 100 sovereigns paid for a ton of flour—the surplus stores of an emigrant ship. These facts are mentioned to show that there is nothing new in the high price of provisions quoted at Melbourne in 1852: it is merely the recurrence of a periodical state of affairs in the history of Australia. It will readily be supposed that much distress and privation occurred amongst these intelligent, well-educated, well-intentioned, but misguided colonists; the record of which should be a warning lesson to those amongst the middle classes who put faith in the schemes of colony-mongers.

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The Anglo-Saxon race, however, are not easily crushed by disappointment; and it may be said with truth, that nowhere in the southern hemisphere has the energy of the race been better vindicated than here. The men rose up from their despondency ashamed of their unproductive hands, when they saw with what cheerful activity the weaker sex turned from the refinements of drawing-room life, to all the drudgeries of household work. Hundreds who had never put a spade in the ground before, left the town, and, on the fertile lands of the Mount Lofty range, and in the interior, cultivated the soil, and herded cattle and sheep. The result was that the colony not only became self-supporting but actually exported its grain, besides wool, tallow, and beef. Here were the true elements of colonial wealth and prosperity. It was by this labour, and these animals that *value was given to the land;* and it was at length found that the true principle of self-support was that of *dispersion* instead of *concentration.* The healthy progress of the colony for the next five years is honourable to the industry and perseverance of the

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people of South Australia; and the flourishing condition of the colony in 1845, compared with 1840, as laid before a parliamentary committee in 1847 by Mr T. F. Elliott, is a bright spot in its history.

	1840.	1845.
Total population	14,610	22,390
In town	8,489	7,413
In the country	6,121	14,977
Number of public houses	107	85
Convictions of crime	47	22
Acres in cultivation	2,503	26,218
Exports of colonial produce	L.15,650	L.131,800
Revenue	30,199	32,099
Expenditure	169,966	36,182

Grey, 1841.

Meanwhile Governor Gawler was recalled in 1841, and succeeded by Captain Grey (now Sir George Grey, Governor-general of New Zealand), who had some previous knowledge of the colonial affairs from a residence in Western Australia, and who had visited the notorious model colony on the way home. By a course of strict retrenchment he reduced the expenditure in two years from L.104,471 to L.29,842. Added to this also was the discovery of copper in 1842, which increased the value of exports. The great yield of the Burra Burra copper mine did not occur, however, until after the above statistics were taken. This new article of export gave a fresh impetus to the trade and commerce of the port, which was by this time shifted a mile lower down the creek, while a good road was constructed between it and the capital. The history of copper-mining in Australia—as represented by the Burra Burra mines—like every other discovery and produce in this wonderful land, eclipses all that has been recorded of such workings in the Old World. It was not mining in the ordinary sense; it was quarrying. The leviathan mass of oxidated and carbonated copper ore lay on the surface in a kind of hollow where it was connected with a vein afterwards worked in the rock below. Success attended the efforts of the colonists in every direction as this new source of wealth distributed its benefits to all around. The fortunate discoverers and early shareholders realized fortunes; and one proprietor, who bought 100 shares at L.5 each, was in the receipt of L.11,000 per annum three years after it had been worked. Miners were brought direct from Cornwall; and every description of machinery was used to excavate the ore. Coal not being found in the colony, smelting operations were but slowly proceeded with. Many cargoes, however, were shipped to Sydney to undergo this process. Altogether the province of South Australia stood in as fair a position to rival its neighbour Port Phillip in the beginning of 1851, with the large export of its copper, and the probable yield of lead, silver, iron, and other valuable metals ascertained to exist in its mountain ranges at that date, as the most sanguine colonists could wish. That year, however, brought about a second period of depression in its short history which threatened to annihilate its commerce.

Discovery of copper, 1842.

Effects of the gold discovery.

The gold discovery, which was the precursor of unexampled prosperity to New South Wales and Victoria, proved deeply injurious to South Australia. The very fact of her population having become more a mining than an agricultural or a pastoral people militated against her. In twelve months after the discovery of gold in the Bathurst Mountains, it has been calculated that, out of a population of 70,000, 12,000 adults, and 4000 children, almost entirely of the male sex, left that colony. The city of Adelaide was left nearly destitute of able-bodied men, the mines were deserted, the stations abandoned, and almost every industrial occupation was at a stand still; while the government of the colony was for a time paralyzed. It was but for a time; for the legislative council—recently elected by the colonists—and the governor, Sir H. E. F. Young (Sir George Grey having gone to New Zealand), passed an act making ingots of gold, stamped by authority, a legal tender throughout the colony. This, added to the successful attempt of Mr Tolmer in forming a practicable route from Adelaide to Mount Alexander, brought a large portion of the gold from the colony of Victoria, and some from New South Wales, into the coffers of the South Australian merchants and the treasury. Those also who had left their families behind—which four-fifths had done—sent their earnings by this overland escort. These, to a certain extent, were expended in the country, while large quantities were purchased by the merchants, which drained the coin and bullion out of the banks. According to an estimate made by Mr Khull, bullion broker at Melbourne, the quantities of gold dust taken to Adelaide by land and sea from Victoria were as follows:—

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"By overland escort, March to December 1852, 228,533 oz.; shipped from Melbourne, 17,331 oz.; taken by private hand, 178,160 oz.; estimated quantity taken in addition to above, 166,687 oz.; shipped from Adelaide to London, February to December 1852, 263,564 oz.

"Amount remaining in the banks, assay office, and private hand at Adelaide, 299,816 oz."

Valuing the gross amount at 76s. per oz., this would give a sum not less than L.2,215,167 added to the wealth of the colony; which, during the quarter ending on the 23d March 1853, has been the means no doubt mainly of swelling the exports to the enormous sum of L.954,760, a sum out of all proportion for the ordinary exports of that now insignificant colony when compared with its flourishing neighbour. With all their undoubted and praiseworthy energy, the South Australian colonists have not been successful in discovering a profitable gold field of any extent within their territory. The Echunga diggings, which promised much at first, have been almost abandoned. The following notice, which we extract from the *South Australian Register*, of the 7th February 1853, gives some idea of the latest yield of the Adelaide gold fields.

"Although there is at the diggings everything to indicate gold in large quantities, none have succeeded in realizing their hopes. The majority content themselves with what they can get on Chapman's hill and gully, knowing that, if a fresh place is discovered, they will stand as good a chance as those who have spent months in trying to find better ground. The quantity of gold taken to the assay-office having, during four consecutive weeks, amounted to less than 4000 oz., the governor has proclaimed that after the 17th of February 1853 the office will be closed."

With these favourable returns, a reaction has taken place in favour of the copper mines. Many who had been unsuccessful at the gold fields, or who preferred working for the baser metal, returned to the colony where they had more comfortable homes. The Kapunda, Burra, and other mines, which had ceased working for more than twelve months, were again put into operation; and the shares of the latter which had fallen from L.270 to L.60, were quoted in March 1853 at L.134½. Land likewise had risen in value. On the 1st June 1853, town lots were selling as fast as they were offered, at an average value of L.115 per acre; amounting to L.26,000 per month. The government had transmitted L.45,000 to the emigration commissioners in London, for the introduction of labour, although the colony had L.141,000 in the hands of that body for the same purpose. Agricultural operations were likewise progressing satisfactorily, and high prices obtained; while the ensuing harvest promised to be abundant. Until, however, this colony can raise from her own soil an equal amount to that which she now borrows, she cannot be classed along with the rich colonies of Australia. That no community in that land is more deserving of such a position is allowed on all hands. "Our neighbours of South Australia," says Mr Westgarth, in allusion to the delays, expense, and obstruction on every hand, which swell up an enormous account against the colony of Victoria, "have in these respects set us an example. Inferior in natural resources, they have surpassed us in energy of character, both of government and

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people. The misfortunes of 1840 and 1841 with which they were bowed down had scarcely passed over ere they appear again erect and prosperous before us, as producers of the finest wheat on the London Corn Exchange; an expression equivalent, I may add, to that of the finest in the world. The gold fields of Victoria have again depressed them, but they are up and doing, as before, to make the best of what is left. Our highly auriferous soil is an accident, but the immediate projection of a road between Adelaide and Mount Alexander is a principle; and the first escort that traversed the new line, bringing with it L.21,000 worth of gold, gave alike the triumph and the renewal of such energy."[1]

Topography.

The settled lands of this partially explored colony were divided at an early date into nine counties, namely, Adelaide, Hindmarsh, Gawler, Light, Sturt, Eyre, Stanley, Flinders, Russell. In August 1851, two new counties were added—Robe and Grey. The territory is also divided into hundreds, each averaging about 100 square miles. The capital of the province is the "City of Adelaide," which is laid out upon nine square miles of land, of which about one-ninth is built upon and inclosed. Within the environs of this town are scattered a number of villages; including Klemzig, a village composed entirely of German immigrants. Twenty-five miles over the Mount Lofty range there is a larger hamlet of the same people called Hahndorf.

General aspect of the country.

If we speak of the general aspect of South Australia as contained within the limits of its available country, it comes under the general description of the Victoria territory and New South Wales; the greater proportion, however, being what is locally termed a "broken country" more allied to the east-coast ranges of the latter, than the extensive undulating open forest lands of the former. The Mount Lofty range, at the same time, is not more than ten or twelve miles distant from the eastern shore of Gulf St Vincent; whereas the ranges in New South Wales are seldom less than 80 miles distant from the coast. The shed of waters, likewise, which flows from the hills through the narrow flat where the town of Adelaide stands, consists of a few insignificant streams; and although they have mostly been denominated "rivers" by the company's surveyors, there is not one deserving more than the ordinary appellation of "creek." The only navigable stream amongst them is an inlet, through a mangrove swamp from the gulf. On the eastern shed of the Mount Lofty range lies the great lake Victoria, and its equally gigantic feeder the Murray, which we have described elsewhere. The two peninsulas which form Spencer's Gulf, are at the best indifferent forest land, with small particles of alluvial soil, the great mass being barren and worthless. The settlement at Port Lincoln has been abandoned on account of the poverty of the country.

The country between the eastern boundary of Lake Torrens and the Darling has been stated to be available for pasture land. We must be cautious, however, in accepting the reports of explorers despatched purposely to find good land in a barren country. The explorations of Captain Sturt to the northward, and Mr Eyre to the westward—on whose accuracy we can place implicit reliance—described the great mass of this territory as a region of desolation, where the hardiest indigenous plants and animals cannot find sustenance.

Soil.

On the alluvial slopes of the Mount Lofty range there is some of the finest agricultural land in Australia. The common average of wheat grown there is 45 bushels to the acre. So abundant was the yield in 1845, that after exporting about 195,000 bushels, chiefly to the Mauritius and England, the farmers had upwards of 150,000 bushels on hand over and above what was required for home consumption. And it is a fact significant of the progress of the colony, and the energy of the settlers, that, while in 1840 they were dependent almost solely upon foreign supplies of flour and grain, having only 2503 acres under cultivation, it increased in 1841 to 6722 acres; in 1842, to 19,790; and in 1843, to 28,690, of which nearly 23,000 acres were in wheat crop. In the year ending April 1850 there were 64,728½ acres under cultivation; of which 41,807 were in wheat crop; potatoes, 1780; gardens, 1370; vineyards, 282; and 13,000 acres in hay. In 1851 the land under crop was not less than 71,728 acres.

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Climate.

The climate at Adelaide and its environs is about the same average temperature as Sydney; although the latter city is more than 1° in Lat. N. of it. From its situation, likewise, on a sand flat, very little elevated above the waters of the gulf, and its distance from the cool sea-breezes on the S. shore of Kangaroo Island, the atmosphere is in general more oppressive than the open country around Port Jackson. At the same time South Australia enjoys the salubrity of climate generally maintained throughout the temperate regions of Australia from Cape Leeuwin to Cape Howe; and it has also its share of the Austral simoom. According to the observations of Mr Wyatt, communicated to the government by the colonial surgeon, James George Nash, "the thermometer in summer averages 73° Fahr., and in winter 55° Fahr., shewing a mean temperature for the year of 65° Fahr.; being only 1° higher than the mean temperature of Madeira." "There is no endemic disease in South Australia. Bilious, remittent, and intermittent fevers are scarcely known. The prevalent fever is closely allied to the congestive fever of Bengal, and chiefly affects persons newly arrived. Eight-ninths of those cases that terminate fatally occur in persons who have not been one year in the colony. Organic disease of the liver is rare. Dysentery is one of the prevalent diseases, but yields readily to treatment."[2]

Diseases.

Vegetable and animal produce.

As already shown in treating of New South Wales under this head, the soil and climate is equally adapted for the growth of grain and of European fruits and vegetables. The indigenous grasses, however, which have made the pastoral productions of Australia equal to the most extensive in the world, are but limited. The live stock within the colony in 1851 was estimated at 1,350,000 sheep, 105,000 cattle, and about 7000 horses. Cattle thrive better on the pasture lands than sheep. Within the hundreds, pastoral leases are annual; without, they are of 14 years' duration; and the present leases comprize about 10,686 square miles. The revenue derived from occupation of land for pastoral purposes is only L.7984.

Animals.

The native birds are similar to those of the other south-eastern colonies; and poultry of every description thrive equally well. The fish in the gulf are also of a like kind; and the fresh-water cod found in the Murray River are so large and abundant, that at one time some enterprizing colonists preserved them for market. Like many other useful pursuits, this has been temporarily abandoned during the gold mania.

Minerals.

The mineral productions of this colony are numerous and varied; including jasper, chalcedony, and opal; iron, lead, and copper. The quantity of copper ore exported in the year ending 31st March 1852 was 7122 tons; and of smelted copper, 39,225 cwts.

Population.

In 1840 the population was 14,610; in 1845, 22,390; in 1850, 63,900, of whom 7000 were Germans. This latter element in the population of South Australia gives it a distinctive character from any of the other Australian colonies; and it is pleasing to see these industrious Saxon emigrants live so peaceably amongst their Anglo-Saxon brethren. "In the course of 1851 as many as 4221 emigrants were reported to have left the colony for the gold fields. This emigration subsequently increased to such an extent, that at one time the capital was said to be almost abandoned by its male population. Subsequent accounts, however, appear to show

[1] Mr Westgarth's *Report to the Melbourne Chamber of Commerce*, April 1, 1852.
[2] *Thirteenth General Report of the Colonial, Land, and Emigration Commissioners*, p. 141.

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that the emigration is in great measure only temporary—that the bulk of the emigrants leave their families behind them, and after a short stay at the gold-fields return with the profits of their venture, which in many instances they invest in the purchase of land."[1] "At the end of 1851 the inhabitants, exclusive of a small detachment of military and the aborigines, are estimated at 66,538, and on the 31st March 1852 at 61,218."[2]

Government.

Before the promulgation of the recent act granting to all the Australian colonies a free constitutional government, the administration of affairs was vested in the governor, assisted by an executive council, composed of the colonial secretary, the advocate-general, the surveyor-general, and the assistant commissioner: to these were added four crown nominees. The elective principle has now been introduced into the legislature; and the governor-general of Australia is empowered to act as local governor within the province, when he visits it in person.

Religion and education.

In this colony, as in Victoria and New South Wales, there is no dominant church recognised by the state. From 1847 to 1851 an act existed empowering the governor to grant a sum out of the public funds in aid of religion (not less than L.50, nor more than L.150), to any religious body collecting an equal amount by voluntary contributions. The new legislative council, however, refused a renewal of this act, when it expired on the 31st March 1851. The number of churches and chapels, during the year ending at that date, which had received public bounty in aid of buildings and stipends, was 103, and the sum appropriated L.4431. The number of schools receiving aid on the same terms, a continuance of which was sanctioned by the new legislature, was in 1851, 132; the amount of aid being L.3310, and the number of scholars 4276.

Finance.

The revenue of the colony has increased in a satisfactory manner from the period of reaction in 1843, though unfortunately burdened with the debt incurred during Colonel Gawler's administration. This debt originally amounted to L.405,433 in 1841. In that year, however, Parliament struck off L.155,000 for necessary disbursements, and the treasury agreed to pay L.45,936; thereby reducing the debt to something more than L.200,000. This became a colonial bonded debt, represented by debentures guaranteed by the government. Governor Grey reduced this sum to L.85,800 in 1848, at the period of his departure for the governorship of New Zealand. From that date until October 1851, the present Lieutenant-governor Young has reduced it to L.10,300, having refrained from paying it off entirely on account of the depression of the Land Fund revenue. A comparison of the revenue and expenditure for the years 1840, 1845, and 1851, will show the revolution in the finances of this colony since it became a British province, independent of the company and the colonization commissioners. The latter body was dissolved shortly after its declared inability to meet the drafts from the colony, and the former association has recently become extinct.

	1840.	1845.	1851.
Revenue	L.30,199	L.32,099	L.169,469
Expenditure	169,966	36,182	143,981

The items for 1851 are exclusive of the territorial revenue, which amounted to L.107,201, and the expenditure to L.72,292. The amount expended under the head of public works in 1851 was L.18,228.

Commerce and currency.

The commerce and currency of South Australia have undergone various fluctuations. In 1841 the imports from Great Britain and the colonies amounted to about L.273,000, and the exports to L.53,500; in 1842 the former fell to L.163,000, and the latter to less than L.40,000. The latter gradually rose as the corn and copper swelled the import list, until 1849, when it amounted to L.485,951; and it fell slightly in 1850, on account of a decrease in the mines, to L.[illegible]. For the quarter ending 23d March 1853, the imports were L.440,328, and the exports L.954,760. The export of wool in 1849 was 2,243,086 lb.; in 1850, 2,841,131 lb.; and in the year ending 31st March 1852, 3,281,648 lb. The export of tallow was in 1849, 3867 cwt., and in 1850, 5271 cwt. The tonnage inwards and outwards at Port Adelaide for the year ending April 1849 was 112,338 tons; in 1850, 160,497 tons; in 1851, 166,950 tons. The currency, which was of a very objectionable kind issued by private traders at the commencement of the colony, was superseded by the establishment of the South Australian Bank, and a branch of the Bank of Australasia, and latterly a branch of the Union Bank of Australia. These banks gave great facilities to the mercantile portion of the community by negotiating their paper currency; which, at the time of the gold discovery, had reached an unusual amount. This event influencing the local trade, created a panic amongst the merchants; but with their usual judgment and foresight, they shipped off their surplus stock of merchandise to the gold colonies, receiving the dust in payment, which at once relieved them from their engagements. "The amount of current paper under discount in the three local banks before and after the panic is reckoned thus:—South Australian Bank before, L.280,000, after, L.120,000; Bank of Australasia, L.160,000, afterwards, L.60,000; Union Bank of Australia, L.120,000 to L.70,000; that is, L.560,000 reduced to L.250,000 in about three months, an improvement quite unprecedented, and which before its actual occurrence might have been deemed impossible."[3] Not the least important result of the gold discovery will be the effect of the intercolonial trade with Van Diemen's Land and South Australia in uniting more closely in social and political unity this whole group of colonies; especially New South Wales, Victoria, and South Australia. Hitherto the intercolonial traffic between their capitals was very limited, especially between Melbourne and Adelaide. Their origin having been contemporaneous, and their products similar, they had no variety of commodities to interchange, while their tariffs were formed on the old protection principle. Not only has the latter been modified to modern free-trade policy since the gold discovery, but the value of the gold transmitted by land and sea from Melbourne to Adelaide during the year ending 31st December 1852, amounted to L.2,215,167. The farm produce and bread stuffs alone shipped in return realized during that period L.250,000, or more than half the imports into Victoria under that head. Although a certain amount of jealousy still exists between New South Wales and her more fortunate younger sister, the traffic between the ports of Sydney and Melbourne has augmented in proportion with the prolific yield of the Victoria gold fields, thus materially cementing all interests. In allusion to this subject in a political point of view, we quote the liberal observations of Lieutenant-governor Young. "The year 1851 is memorable for the introduction of the elective principle of representation into the legislature, the free action of constitutional government, and for Her Majesty's gracious appointment of a governor-general of Australia, empowered to act as governor of each of its provinces when within the territory. This last-mentioned preliminary step towards a political confederation of the Australian colonies has proved very opportune and provident. The discoveries of rich deposits of gold, the more frequent intercourse thereby occasioned not only between Australia and

[1] *Thirteenth Report of the Colonial, Land, and Emigration Commissioners*, p. 38.
[2] *Reports of Her Majesty's Colonial Possessions, presented to Parliament* 1852, p. 221.
[3] Despatch of Sir H. E. F. Young, *Reports of the Colonies*, p. 228.

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Great Britain, but also between the different settlements themselves both by sea and land, and the certainty that the steam navigation of the River Murray will now at last be effected, are circumstances which must accelerate, and were perhaps providentially designed to produce, that social union of the provinces on this continent, of which a common origin, allegiance, language, and legislation have formed the natural foundation, constantly strengthened and extended as it is by increased migrations from the parent state."[1]

Western Australia. Geography.

IV. WESTERN AUSTRALIA.—A line drawn due N. and S. upon the maps of Australia from the middle of the Great Bight on the S. coast to the head of Cambridge Gulf on the N. coast, along the meridian of 129° E. Long., forms the eastern boundary of this colony; the coast line to the westward forming its N., W., and S. boundaries. Its extreme S. is West Cape Howe, in 35. 10., and its extreme N., Cape Londonderry, in 13. 45., both headlands being in S. Lat. Thus, the greatest length of Western Australia is 1457 British miles, by an average width of 700 miles, giving an approximate area of 1,019,900 square miles. One-half may be considered within the influence of tropical meteorology, the other half within the temperate zone. This territory includes the earliest discovered portions of Australia. The proclamation of such extensive boundaries for this colony was apparently intended for the purpose of excluding any other power from forming a settlement on the coast; as there was ample room at the S.W. angle known as Leeuwin Land for any settlement likely to take root in the country. As it is, there are not more than 3000 square miles of land around the Swan River settlement, and only a few hundred square miles in the vicinity of Albany, King George's Sound, occupied by the settlers as agricultural or pastoral lands in 1853. When we take into consideration that this colony has been established so far back as 1829, we cannot but conclude that it must either be naturally ill-adapted for a British settlement, or that something radically wrong in its management must have retarded its progress so far behind its contemporaries on the E. coast. As will be shown afterwards, both of these influences have checked the advancement of Western Australia.

General History. Swan River.

In August 1829 Captain Stirling, who had previously explored the coast, arrived at the proposed site of the new settlement on the Swan River, to which he was appointed lieutenant-governor. He found that several ships had arrived from Britain in the previous months of June and July with numbers of anxious settlers; who, at the very outset, were discouraged by the appearance of the land on the banks of the Swan and Canning Rivers, besides encountering the inclemency of the weather (for it was winter in Australia) without any other shelter than the tents they had brought with them. By the end of the year there were 1290 persons in the colony including non-residents; and others were gradually flocking in without any previous preparation having been made for the accommodation of their wives and families. In fact so little care had been taken to plan out the proceedings of the government and the situation of the colony, that there was not an acre of ground surveyed until several months after the first arrivals. All that was known of the proposed settlement existed only on the map—where counties and towns were liberally scattered over the supposed surface of the land. This, coupled with the fact that the majority of the newly-arrived settlers were townspeople or small capitalists, unaccustomed to manual labour, and unfit under any circumstances to struggle with great difficulties, soon produced a state of general suffering and distress. The governor did all he could to alleviate the hardships and disappointments of the settlers; but his own circumstances were hardly better than those of the rest, both he and his officials having undertaken their duties on the stipulation of payment in land. Instead of a thousand or fifteen hundred pounds a-year, he was to obtain a grant of 100,000 acres of land, and his subordinates 20,000 acres, down to 2000 and 3000 acres in proportion. In like manner, if a settler brought wealth, in the shape of agricultural implements, live stock, or labourers, he was to receive an equivalent for the benefit he thereby bestowed on the colony, by a grant of land. If a builder erected government works, or a surveyor parcelled out the land, they were both to receive a portion of their remuneration in land. In fact so much had been left to this system of barter, that the government and the colonists had entirely overlooked the necessity of a sufficient metallic currency to negotiate ordinary transactions. Hence they were often unable to purchase the necessaries of life from the neighbouring colonies. Meantime, so utterly paralyzed were the authorities, that they even neglected to survey the land which they considered the pabulum of their existence. Persons settled down where and how they liked on the banks of the Swan and Canning Rivers. The land they had expected to be surveyed, and the towns they had expected to be built, were nowhere to be found. Upwards of fifty ships had arrived by March 1830, and nearly 2000 immigrants with property to the amount of L.100,000, while scarcely twenty houses had been erected for their accommodation. At last a township was marked out on the Swan River, called Perth, and some degree of order began to appear out of the chaos by the close of the year, as the governor took up his quarters at this future capital; not, however, before many of the most energetic emigrants had either left for the neighbouring colonies, or returned home to warn their fellow-countrymen from proceeding to this Utopian colony.

Australia. Western Australia.

The history of New South Wales recorded the sufferings and privations experienced by the pioneers of that colony, although they were selected from a proper class for the purpose. Much more, therefore, was it to be expected that such hardships should fall to the lot of the first settlers at Swan River, who were totally unfitted for the laborious enterprize of founding a colony. The *ladies* and *gentlemen* who formed the *pioneer corps* of settlers were landed upon the shores of a naturally sterile region without any greater preparation for the grave and difficult undertaking of founding a new British province, than if they had gone out upon a holiday excursion in the woods. There is no greater fallacy entertained by theoretical colonizers, than this romantic method of forming new colonies. Colonization is a work of the most profound and serious nature, and does not bear to be handled by quacks and empirics in political economy. It is a matter for the grave deliberation of the state, which ought to protect the people from the cruelty of those who receive their money for lands which have no value imparted to them by labour. The agrarian system of colonization attempted in this instance proved a total failure, and to this day not one tithe of the lands granted has ever been properly surveyed.

For twenty years after the disembarkation of the first colonists, the Swan River settlement has struggled through a feeble existence. Governor Stirling was succeeded by Governor Hutt, who tried manfully to restore confidence to the colonists, and induce new settlers to come out. He in turn was succeeded by Governor Fitzgerald, the present ruler. In vain have they attempted, with the assistance of the colonists, to raise the colony on a par with her sister provinces in South-eastern Australia and Van Diemen's Land. So late as the year 1848, things had reached such a state of general depression, that the inhabitants had taken it seriously into consideration whether it would not be advisable to abandon the settlement altogether. About this time there was a demonstration on the part of the neighbouring colonists—which we have noticed elsewhere—against the land-

[1] Despatch of his Excellency Lieutenant-governor Young. *Reports*, p. 228.

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ing of convicts on the eastern shores of Australia. It occurred to this remote community to petition for what their more successful neighbours refused. Consequently in 1849, exactly twenty years after the first settlement, a band of convicts arrived from the parent state, and at once gave new life and vigour to this languishing colony. A correspondent of the *Times* at Perth, writing in January 1853, says, "The advent of convicts, after three years' experience, has been found to contribute more to the well-doing of the pockets of the settlers than detriment to their morals." The most satisfactory results have been received of the progress of the colony under these circumstances to the 8th June 1853. The inhabitants at Perth had held public meetings expressing a desire for the importation of 1000 convicts annually. Up to that date 2000 had arrived; and a less severe system had been adopted towards them than that which had prevailed in Van Diemen's Land and New South Wales, and with the most beneficial results. If this class of labourers had been sent out to clear the wilderness, and construct roads, prior to the arrival of Governor Stirling, and the well-meaning non-labouring colonists who accompanied him, how different a position might Swan River now have held among the flourishing provinces of Australia!

King George's Sound.

The settlement at King George's Sound was formed much earlier than that at Swan River, in anticipation of a projected scheme of colonization by the French government. It was effected in 1826 by the government of New South Wales, who despatched a detachment of the 39th regiment under Major Lockyer for this purpose. After four years' occupation as a military post, the settlement was ordered by the home government in 1830 to be transferred to the government at Swan River, both being within the new colony of Western Australia. During the next twenty years of its existence it survived actual desertion, in consequence of its excellent harbour being frequented by whaling ships, which found abundance of whales off the coast. Since the establishment of steam communication between England and Australia, it has come into notice as the first coaling station for the steamers on their outward voyage, *via* the Cape, to South Australia, Victoria, and New South Wales; and there is every likelihood of the little township of Albany becoming a thriving seaport. "The Sound is a magnificent roadstead, with from 7 to 15 and 20 fathoms water, completely sheltered from S.W. to E., and partially by two islands to the S.E. It is only open to southerly winds, which in this locality bring fair weather. On the W. the Sound is separated by a long tongue of land, terminated at its northern extremity by Point Possession, from the Princess-Royal Harbour. The entrance to this nearly circular bay is between Point Possession and Mount Clarence; being not more than 200 yards across, with a depth of 4½ fathoms water. Princess-Royal Harbour is capable of containing many hundred vessels: it is the finest harbour known to exist in Australia to the W. of Spencer's Gulf. It enjoys an equable climate, the thermometer, during nineteen months' observations, ranging from 40° to 76° Fahr. Vegetables also grow luxuriantly."[1]

Topography.

At the outset of the colony there were fifteen counties laid out on the map, arranged in apparently compact sections of about forty miles square, along the coast from Cape Leschenault to Point Hood, namely, Twiss, Perth, Murray, Wellington, Nelson, Sussex, Lanark, York, Grantham, Wicklow, Goderich, Stirling, Hay, Plantagenet, Kent. Subsequently eleven were added to these along the territory to the N., which was named generally Australind; and from recent explorations promises to furnish good pasture land for sheep and cattle. These counties are, Melbourne, Glenelg, Grey, Carnarvon, Victoria, Durham, Lansdowne, Hawick, Beaufort, Minto, Peel. The principal places claiming the title of towns are Freemantle, Perth, and Guildford, on the Swan River; Kelmscott on the Canning, and Albany at Princess-Royal Harbour. Australia. Western Australia.

General view of the country.

The general aspect of the forest scenery, mountains, rivers, and coasts, is the same as on the E. coast, which has been already described; with this difference, that the mountains and rivers are upon a less extensive scale. In comparison, the former seldom attain half the height and extent of range; while we have no evidence as yet of any stream approaching to the Murray in its ramifications. Much however remains to be explored in this quarter. "The highest mountain known is Koikeunneruf near King George's Sound, which attains the altitude of 3500 feet. The principal range of hills extends in a northerly direction from the S. coast, near Cape Chatham, for at least 300 miles."[2] This range no doubt is continued more or less parallel with the N.W. coast, about the same distance inland, judging by analogy, as its greater counterpart on the eastern coast; the great Australian desert between forming a barrier to any internal communication from the one coast to the other.

Plants.

Although the botany of these two great meridian ranges, trending in a general course N. and S. from the middle of the S. temperate zone, to the middle of the Tropic of Capricorn, is generically the same, yet the majority of the plants are specifically different. Probably from the lesser heights of the mountain ranges failing to absorb the same amount of moisture as those in the higher altitudes of the Australian Alps, the vegetation of the temperate regions of Western Australia is of a more arid nature than that in the S.E. latitudes. Here succulent plants are not only rarer, but the native grasses are scantier; and the extent of pasture land within the known boundaries is of a very limited description. To give some idea of this limit, we shall quote the latest returns of live stock.

Pasture land.

	1850.	1851.	Increase.
Horses	2,635	2,978	343
Horned cattle	13,074	15,315	2,241
Sheep	128,111	141,413	13,302

Wool.

The value of the wool, which is considered the staple export of the colony, amounted in 1850 to L.15,482, and in 1851 to L.17,883. Governor Fitzgerald remarks upon this head, in a despatch dated Government House, Perth, April 12. 1852, "I fear that unless new grasses spring up, or are introduced into our pastures, we shall never be able to rival in this respect the production of the eastern colonies. Our lands fit for sheep are so small in extent in proportion to the rest of the colony, that a limit will soon be arrived at unless better pastures be discovered. Should such exist, they probably lie far to the N.E." This is conclusive, without even referring the reader to the statistics of the eastern colonies already given, to satisfy the most sceptical mind of the inferiority of its pasture lands compared with the verdant plains and valleys of Eastern Australia. There are single settlers in New South Wales who possess as much stock as the colony altogether; and this after a growth of 22 years. These facts will show that natural disadvantages have retarded the progress of the colony as well as original mismanagement; for although the colonists could raise enough of vegetable produce and animal food for their subsistence, they lacked a sufficiency of the pastoral exports of wool, tallow, and hides, to constitute them a successful producing community.

Agriculture.

This poverty of production is also apparent in the agricultural records of the colony. Up to 1851, the colonists were dependent upon shipments of agricultural produce from the eastern colonies. The number of acres in crop

[1] MS. Notes of Assistant Commissary-general Kent, late of King George's Sound.
[2] Well's *Australian Geography*. Sydney, 1848.

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that year was 7297¼, showing a decrease for the year of 121¾ acres. "This is attributable to many causes, the high price of labour, and the distressed state from which the colonists were only just emerging. Many of the agriculturists, however, have now freed themselves from their great difficulties, and there is every reason to hope that a very large breadth of wheat will be laid down this year."[1] There is no doubt that when the colonists obtain that cheap labour of which they are in want, much will be done to render them independent of foreign supplies of provisions. This, however, sufficiently testifies the poverty of the land, and corroborates the statement of disinterested parties, that the soil is not remarkable for that richness of loam and decayed vegetation which distinguishes the soils of Van Diemen's Land and South-eastern Australia, which yield averages of 40 and 45 bushels of wheat to the acre. At the same time there is abundance of land for all ordinary farm purposes around both settlements, on Swan River, and at King George's Sound, suitable for the growth of all esculent roots and fruits required by the colonists. There is no doubt also that the extreme dryness of the climate, and the devastating summer conflagrations throughout the forest lands, prevent that accumulation of mould from decayed vegetation which characterizes the virgin soils of all lands throughout the world. This arid climate, however, is even more conducive to the health of Europeans, than that of the eastern colonies. Endemic or epidemic diseases are unknown, and "the country maintains its character of being perhaps the most healthy on the globe; there having been only 37 deaths recorded during 1851, in a population of 7096 souls."[2] This average, however, is taken after the introduction of convicts in the previous year, which augmented the white population by nearly 1000 persons. In 1850 the population was 5293, which increased to 7096 in 1851. Of these 4523 were males, and only 2444 females, or nearly two of the male sex to one of the female. This disparity of the sexes has called forth a petition from the colonists to equalize the numbers, by requesting the government to forward females from the pauper institutions in England. The government have not acceded to this; but the Colonial Land and Emigration Commissioners report, "That under instructions from Sir John Pakington, they have endeavoured partially to remove this disparity, by sending out at the expense of the parliamentary vote, an additional number of women. Thus, since October (1852), we have despatched three vessels, carrying about 760 souls, of whom 26 were convict families, 36 were single men, while as many as 278 were single females; and the desire to emigrate to any part of Australia is now so strong, that we experience no difficulty in selecting for this colony very eligible females, without having recourse to the workhouses."[3]

Climate. Population. Female emigration.

Religion and education are less zealously nurtured in this small community, than in the eastern colonies. Governor Fitzgerald, in the able despatch we have already quoted, remarks, "I regret to state, that the schools at the Vasse and Murray have been discontinued for want of scholars; and it appears to me, that if a superior description of masters be not furnished for our colonial schools, education generally throughout the colony will be regarded as of so little importance, that great difficulties will hereafter arise against any endeavours that may be made to establish a regular system of superior instruction."

Religion and education.

The revenue for the financial year ending April 1851, amounted to L.25,167, being an increase over the year 1850 of L.6029, which was mainly attributed to the increase in the customs caused by a greater amount of duties paid on spirits and wine in bond. The expenditure for 1851 was L.23,926, being an excess of L.7252 over 1850. This is to be attributed chiefly to the exigencies of the service consequent on the introduction of the convict system; and to the high price of food, a result no doubt of the gold discovery in the east, rendering necessary an increase of the salary to the government officers. The colony is now free from all debt bearing interest, which it was found necessary to incur during the distressed period of its existence. The imports during the year 1850 were L.52,351, and in 1851, L.56,958, the latter giving an average of L.8 per head of population. The exports, during the same years, were respectively L.22,195, and L.26,870, or less than L.4 per head of population for 1851; showing a balance of trade against the colony of more than 100 per cent. This is not a very encouraging balance-sheet; but we presume the anticipation of a large government expenditure has been the cause. The shipping has doubled itself within two years. In 1849 7952 tons arrived in the ports, which had increased in 1851, in consequence of the arrival of the convict-ships, to a gross tonnage of 16,540. These figures give no very high idea of the commercial state of this colony; but the future is not without hope. No rich gold field has as yet been discovered, but copper and lead ore, and other metalliferous minerals, have been ascertained to exist in large quantities, indicating the proximity of valuable mines. The Geraldine lead mine is now in operation; and the company who work it have smelting works on the spot. It is satisfactory to find, that one of the most sanguine men in the community is the governor, whose despatch in 1851 ends as follows: "In conclusion, I have to remark, that such are the inducements to remain in the colony, from the government expenditure, the high rate of wages, and from the circumstance that most persons who have been any time resident in the colony have some interest therein, comparatively few persons as yet have left us either for Melbourne or Sydney; all classes appear prosperous and contented; and should the present system of the introduction of convicts continue, I have little doubt but this will become one of the most important dependencies of Her Majesty's dominions."

Australia. Western Australia. Commerce. Minerals.

Besides these successful colonies, situated within the great southern or temperate division of Australia, there have been several attempts on the part of the British government to establish settlements on the north and eastern shores of tropical Australia, which require a brief notice. The first attempt was made by Captain Bremer, in H.M.S. Tamar, who, in company with two store ships and a party of military and convicts, established the stockade of Fort Dundas at Melville Island, in Lat. 11. 28. S. Long. 130. 30. E., in Apsley Strait. "This settlement, however, after an existence of four years, was abandoned on 31st March 1829, in consequence of the continued unfavourable accounts transmitted to the home government."[4] "The settlement of Fort Wellington was formed by Captain Stirling in H.M.S. Success, on the 17th June 1827, on the N.E. side of Raffles Bay, in Lat. 11. 14. S. Long. 132. 24. E., for the purpose of carrying on a traffic with the Malays, from Maccassar in the Celebes, who frequent the coast of Northern Australia in quest of the *Trepang* or sea-slug. This settlement was abandoned on the 29th August 1829, at a time when the objects for which it was formed were about to be realized."[5] On the 27th October 1837, a military post, with H.M.S. Britomart as tender, was established at Port Essington, "for the double purpose of affording shelter to the crews of ves-

Abandoned settlements. Fort Dundas. Fort Wellington. Port Essington.

[1] Despatch of Lieutenant-governor Fitzgerald. *Reports of the Colonies*, 1852, p. 220.
[2] Despatch of Lieutenant-governor Fitzgerald, dated April 12, 1852.
[3] *Thirteenth Report of the Colonial Land and Emigration Commissioners*, p. 37.
[4] *Voyage of H.M.S. Rattlesnake.* By J. Macgillivray, vol. i. p. 140.
[5] MS. Notes of Assistant Commissary-general Kent.

Australia.

sels wrecked in Torres Strait, and of endeavouring to throw open to British enterprise the neighbouring islands of the Indian Archipelago." After having struggled unsuccessfully for twelve years to rear sufficient food for themselves, and having lost a number of their men through privations and hardships and the unhealthiness of the climate, the sappers and miners finally abandoned the settlement, named Victoria, on the 30th November 1849. In January 1847, the staff of a new penal colony to be called "North Australia," headed by Colonel Barney, R.E., settled on the shores of Port Curtis, on the E. coast of Australia beyond the Tropic of Capricorn. After five months' occupation, and an expenditure of upwards of L.15,000, the attempt was abandoned.

Retrospect.

Australia is the latest known portion of the habitable world. The coasts and countries that are now the most distinguished of its territory are also those that were the last added to its geography. Our contemporaries, who now enter their ninetieth anniversary, will serve to bridge for us, with the span of a single life, the interval that separates Cook's discovery of New South Wales from our time. Thus brief is the retrospect of Eastern Australia, whose shores for two thousand years, unknown to the civilized world, had reverberated only to the waves of the great Pacific. A mere handful of savages roamed heedless over a country of surpassing interest to science, and wonderful in results to the industry of its later occupants.

Progress.

Let us regard first the material elements. At the close of the year 1858 there were 1,099,926 colonists (exclusive of aboriginal population), consisting of 652,900 males and 447,026 females. The value of imports for the same year was L.27,000,000, and of exports L.21,250,000. Of the principal articles of export produce, gold, which is derived from Victoria, New South Wales, and New Zealand, amounted to L.11,211,250; copper, from South Australia, to L.373,382; wool, from all the colonies, to L.3,750,000; and agricultural produce, from all save Victoria and West Australia, to L.1,108,476. The annual public revenues, exclusive of loans, amounted to L.5,391,323, and the collective public debt, while we write (1859), is between eight and nine millions sterling. The banking statistics form an interesting comparison, from their relatively large figures, with those of this country. For the four chief colonies, New South Wales, Victoria, South Australia, and Tasmania, containing together a population of 1,028,500, the note circulation (L.1 and upwards, payable on demand), was L.3,209,796; the specie in the banks, L.4,758,995; the deposits, L.12,873,224; and the discounts and other advances of the banks, L.16,583,932. Our colonists have already erected large cities, and have ploughed and planted a thousand locations, while ten thousand ships annually enter and depart from their busy seaports. The electric telegraph now connects all South-eastern Australia and Tasmania, and 160 miles of railway are in operation, besides surveys, estimates, contracts, and an energetic progress towards nearly 500 miles more. All this is well.

Society and government,

Let us now take the higher subjects of society and government. These colonies now govern themselves, and they are practically as independent in their procedure as the imperial Parliament itself. The home government has given Australia free scope to create and re-arrange its own political institutions, and the colonists have promptly applied themselves to what is evidently a congenial duty.

decidedly democratic.

The Australian tendencies point to those democratic principles that give us essentially republican institutions, modified only by the loyalty everywhere prevalent to a great monarchic empire of our countrymen. Manhood suffrage, the ballot, no property qualifications, representation based on population, entire civil and religious equality before the state; these are the principles that seem, with remarkable facility and unanimity, to evolve from a society of our countrymen, thrown together upon a new scene, free from the traditions of place, and equalized together by the sense of one common object, namely, the attainment of independence and means by the medium of industry. A society may reasonably pride itself, that every independent and well-conducted member is a citizen, equal before the law in all political, civil, and religious rights. Such a status imparts everywhere a marked stimulus. Public questions become the common property of every rank. Constant discussion gives decision to individual and general views. Strong views and deep convictions comparatively disregard the inconvenience of change, and hence the restless aspect of the colonial picture. Democracy becomes the conservatism of colonies; and the interest in public affairs is not by any means to be measured by leisure from other pursuits or by the wealth or refinement of society.

Australia.

Second or upper chamber.

The new system is already developing these results, and that perhaps in somewhat strong relief, but they were not unforeseen. A second chamber of legislation, to secure a re-consideration to popular impatience, was provided by the foresight of each colony. If this colonial senate has been less conspicuous than was desirable, justice has scarcely been done it in the mode of constitution at the offset of self-government. Its case was decided on at a season of transition. At Sydney the constitution is by crown nomination, at Melbourne by election, under a most exclusive qualification of voters as well as members; neither plan having at all the effect of bestowing the maximum of influence with a colonial public.

The "constitutional system" at fault.

But in truth the "constitutional system" itself, although suitable to the quieter politics and particular case of the parent society, is in some striking points a disadvantage to the colonies. That slip-shod system of everlasting "change of ministry" has no really necessary existence, and its inconvenient and discrediting effects ought not to be chargeable on what are properly colonial institutions. It arises from the want of a real executive head, a position not permitted by free institutions to the governor, as he is an appointee of the crown without assent of the people. Hence an executive elective, but multiform and dominated by the popular assemblies; hence constant temptation to plotting and scrambling for office, with its open road through the fluctuating majorities. The question is a nice one, and the colonists may some day be desirous to consider it, namely, how to conjoin the popular assent with the royal nomination, and thus (if we may use the expression) normalize the democracy.

Federation question.

Another change may be even more important. Amongst the earlier questions of self-governed Australia was that of its future federation. Victoria led the way in this inquiry, and was at once seconded by New South Wales. Colonies, too, like individuals with flourishing incomes, must needs run into debt. Nearly nine millions sterling is already the public debt of these colonies. Railways and other works have irresistible attractions, and not less the facile practice of pledging posterity for their payment. Again, one administration will pledge everything to secure an economical triumph in financing for these outlays; but its successor will not perhaps hesitate an instant at the most radical changes in all the fiscal securities of the debt, whether of tariff or land laws. For the regulation of such interests, and as a check, gentle yet effective and recognised, to party extremes, class prejudices, and passing popular excitements, let us invoke federal Australia. The instincts of democracy and the genius of our countrymen are both, perhaps, equally understood. Any anxiety of the future is not for executive tyranny but executive weakness; and while we hail a federation, let it be an effective government over every question that has an intercolonial relationship, and especially a relationship to an external and observant world. (S. M.) (W—M W—H.)

AUSTRIA.

Austria.

THIS great empire is situated nearly in the centre of Europe, extending from the 44th to the 51st degree of N. Lat., and from the 8th to the 26th degree of E. Long. Its configuration is irregular, but its extent corresponds to that of Plate CII. an oblong of fully 600 miles in length from E. to W., and above 400 miles in breadth from N. to S. Compared with France, the Austrian dominions have a form nearly as compact, but their frontiers are by no means so strongly defined, nor so well guarded by physical barriers. France resembles a five-sided figure, having on three sides the sea, and on the other sides the Pyrenees, the Alps, and the Vosges; while in Austria the chief ranges of mountains are in the interior. In extent of surface, the Austrian dominions considerably exceed those of France, for they cover, including Cracow, incorporated into the Austrian empire in 1846, 256,958 English square miles. They comprise a remarkable diversity of tribes, and even nations, differing from each other in language, habits, religion, and comparative civilization.

The component parts of this great empire consist of six countries bearing each the name of kingdom, viz., Hungary, Bohemia, Galizia, Lombardy and Venice, Illyria, and Dalmatia; one archduchy, Austria; one principality, Transylvania; one duchy, Styria; one margraviate, Moravia; and one county, Tyrol. After the accession of the present emperor Francis Joseph, the various provinces of the empire received the title of *crown-lands*, twenty in number, and subdivided into minor districts. This new arrangement, however, must upon the whole be regarded as provisional, since the new constitution, in virtue of which Austria was to be transformed into one uniform empire, was, as will hereafter be seen, abrogated in the year 1851, two years after its promulgation.

We shall begin with an historical notice of this empire, showing, first, the means by which Austria, originally a small state, progressively rose into importance; second, the resources by which she withstood the reverses sustained in her long contest with revolutionary France; next, her condition and policy during the subsequent years of peace; and finally, the manner in which she came through the latest and most dangerous crisis in her history.

History.

The cradle of Austrian power was the fertile tract lying along the southern bank of the Danube to the eastward of the river Ens. It is said to have been overrun and partly colonized by Germans under Charlemagne; but be that as it may, after the empire of Germany was constituted in the ninth century, the district in question, afterwards called Lower Austria, was declared a military frontier for repelling the incursions of the Huns and other barbarous tribes to the eastward. It was called *Ost-reich*, the east country, from its position relatively to the rest of Germany; and its governor received from the head of the empire the title of margrave (in German *mark-graf*, or lord of the marches), which his descendants bore for centuries without anticipating the future greatness of their house. Towards the middle of the twelfth century their territory received an important accession in the province W. of the Ens, which, from its vicinity to the Alps, and the greater elevation of its surface, was called Upper Austria. The governors of this augmented domain were now raised by the emperors of Germany from the humble rank of margrave to that of duke; and it was one of their number, Duke Leopold, who, towards the end of the twelfth century, ungenerously detained our Richard I. in confinement on his return from the Holy Land. It was at this time also that the important province of Styria came to the dukes of Austria by bequest. Hitherto the ducal residence had been in a castle on the high ground of Kahlenberg, near Vienna; but it was now removed to that city. In 1246 the male branch of the ducal line, originally from Bamberg in Franconia, became extinct, and Austria underwent a long interregnum. The reigning emperor of Germany declared both that duchy and Styria to have lapsed to the imperial crown, and appointed a lieutenant (*statthalter*) to govern them on the part of the empire. But claims to the succession were brought forward by descendants of the female branch of the Bamberg line; and after various contests, Ottocar, son of the king of Bohemia, was, in 1262, duly invested with the government of Austria and Styria. Carinthia, Istria, with part of Friuli, soon after devolved on Ottocar by succession; but he forfeited all these advantages by his imprudence in refusing to acknowledge as emperor Rudolph of Hapsburg, who had been regularly elected to that high station. Hostilities ensued; the fortune of Rudolph prevailed; and, in 1276, Ottocar was obliged to renounce his title to Austria and its appendant states. Notwithstanding this renunciation, Ottocar re-entered Austria with an army, but soon after fell in battle. The ducal throne being then vacant, Rudolph vested the succession to it in his sons; and having obtained the sanction of the electors of the empire to that important act, the reign of the Hapsburg dynasty over Austria commenced in 1282.

Austria.

In the beginning of the following century the dukes of Austria lost a part of their Swiss territory by the insurrection of the cantons. This they never recovered; but in 1364 they acquired Tyrol; and Austria, hitherto known only as a remote province, little connected with the improved part of Germany, was soon after brought into contact with the general politics of the empire. The rank of emperor of Germany had been held successively by Saxon, Franconian, Suabian, and Bohemian princes, Austria having as yet supplied only one of the number (Albert I.); but, in 1438, another Albert, duke of Austria, was raised to that dignity, and, from close connection with Bohemia and Hungary, the power of Austria became so much greater than that of any other state in the empire, that from 1438 the imperial crown was regularly vested in the chief of the Austrian family. In the latter part of the century of which we are treating (the fifteenth), Maximilian I., an emperor of the Austrian line, made great additions to the power of his house by matrimonial connections, having himself espoused the heiress of the Netherlands, and afterwards married his son to the heiress of the crown of Spain. Of the latter marriage the issue was the well-known Charles V., who held the crown of Spain by inheritance, and the empire of Germany by election. In the third year of his reign (1522), Charles made over the German provinces to his brother Ferdinand I., who, in consequence of his marriage with Anne, sister of Louis II., king of Hungary and Bohemia, succeeded in gaining the crowns of these two countries. In 1555, Charles, whose ambition had appeared insatiable, all at once retired from his worldly career, leaving the German crown to his brother Ferdinand, and his other possessions to his son Philip II. Ferdinand, already king of Hungary and Bohemia, was elected emperor in 1556, and thus became the head of the Austrian Hapsburg line. The formidable power united in one dynasty, was thus split up by the very monarch who was its creator, though, even after its partition, both the Spanish and Austrian branch were still large enough to rank as first-rate powers. In Hungary, Ferdinand found a rival in Zapolya, elected king by the majority of the people; nor during his life could Ferdinand obtain possession of the whole country.

The general rule of the Hapsburgs, and especially the religious persecutions under the reigns of Rudolph II., Ferdinand II., and Leopold I., were productive of protracted and bloody wars, during which time the Turks made them-

Austria. selves masters of the greater part of Hungary, frequently assisting the malcontents against their Austrian masters. Ferdinand was succeeded by Maximilian II., his eldest son, whose successor was the dreamy and bigoted Rudolph II., subsequently compelled to resign his crown to Matthias II. In the year 1618, Ferdinand II., archduke of Styria, succeeded to the throne, after the death of his predecessor without issue. This emperor is well known by his sworn hatred against the so-called heretics, the Protestants, and scarcely had he commenced his reign when his cruelty against the Bohemians gave rise to the *Thirty Years' War*, one of the most remarkable events in modern history. On the one side were the Catholic princes of the empire, with Austria at their head; on the other, Saxony and the Protestant states, assisted at one time by Sweden, and subsequently by France. The most distinguished commanders were Gustavus Adolphus on the part of the Protestants, and, on that of the Catholics, Wallenstein, Duke of Friedland. Both were greatly superior to the age in which they lived, and evinced, at the battle of Lutzen, fought in 1632, talents not inferior to those displayed on the same fields in 1813. Wallenstein survived his illustrious opponent, but met a tragic end: having been suspected of treating with the Protestant princes for his own aggrandizement, a suspicion never afterwards verified, he, with some of the chief officers of his staff, was most cruelly assassinated by order of his imperial master. The war was at last ended by the peace of Westphalia, by which Austria was obliged to relinquish Lusatia to Saxony and Alsace to France.

The peace of Westphalia, like that of Utrecht in a subsequent age, restored tranquillity throughout Europe. It continued many years, and might have lasted much longer, had not the ambition of Louis XIV. alarmed the neighbouring states, and obliged them to look for safety in arms. Belgium, held at that time with a feeble hand by Spain, was the prize at stake; and the dread of that fertile and populous country falling into the power of France called forth the greatest efforts on the part both of Austria and of Holland, which, from the extent of its financial means, was at that time a power of great influence. Louis was surrounded by able generals and well-disciplined armies. Flattered with the prospect of success, he attempted the conquest of the Netherlands in no less than three wars, in two of which (those begun in 1672 and 1689) Austria bore a principal part. In the last she received the co-operation of England, which then, for the first time, came forward as a principal in continental coalitions, contributing largely both in troops and subsidies. The chief scenes of conflict were the Netherlands and the banks of the Rhine. The French, acting with all the advantage of unity, had frequently the superiority in action; but the allies, numerous and resolute, were never discouraged by defeat. At last, in 1697, came the peace of Ryswick, which left, as peace often does, the contending parties in nearly the same relative positions as at the outset of the contest. The allies had the satisfaction, however, of having compelled the aspiring Louis to stop short in his encroachments and schemes of aggrandizement.

But with so restless a prince at the head of a population of 20,000,000, peace could not be of long continuance; and, on the death of the king of Spain, Austria, England, and Holland, found it again necessary to take the field. The question now related not merely to the Netherlands, but to whether a French or an Austrian prince should succeed to the crown of Spain. Hence the name of War of the Succession, given to this long contest, which, beginning in 1701, lasted no less than twelve years. The superiority in military skill was now for the first time on the side of the allies. The Austrians and other Germans, assisted by Holland and England, were led to repeated victories by Eugene and Marlborough. France sent forth numerous armies, and showed, in Villars and Vendome, generals worthy of the better days of Louis; but in Italy and the Low Countries the allies were completely successful; and it was in Spain only that they failed. Such was the state of affairs in 1711, when the death of the reigning emperor unexpectedly took place, and the election to that dignity fell on his brother, who had been destined by the allies to the throne of Spain. The prospect of the union on one head of the crowns of Spain and Austria brought to recollection the ambitious projects of the Emperor Charles V., and inclined many who had supported the war from a dread of France, to consider the transfer of Spain to a grandson of Louis XIV. the less dangerous alternative of the two. This, joined to the change of ministry in England, the removal of Marlborough from the command, and the impatience of the Dutch under so long and burdensome a war, led to the peace of Utrecht, to which Austria, after urgent remonstrances with her allies, and fruitless efforts in the field, acceded, by a treaty concluded in the year after (1714) at Baden. Well might she give her assent to a treaty which transferred to her not only the Low Countries, but extensive possessions in both the north and south of Italy. Austria.

The emperor, anxious to confirm his authority in Hungary and Transylvania, now directed his troops against the Turks. The latter, who, during the space of 150 years, were in possession of the capital of Hungary, and of the greatest part of its territory, evinced considerable sympathy towards the Hungarians, whom they, on many occasions, proved ready to assist in their struggles against Austria. In fact the impotence of the Austrian rulers, as evidenced by their inability to expel the Turks from Hungary, and their readiness to appease the anger of the sultans by annual tributes, served only to keep alive in the Turks the ambition of rendering themselves masters of the Austrian capital. Accordingly, in 1683, the Mussulman host appeared before the walls of Vienna, and the capital was only saved by the appearance of the intrepid Polish king Sobieski, who would, no doubt, have found the Turks within its walls, but for the singular carelessness with which the vizier carried on the siege. This was the first serious check given to these confident barbarians. At a subsequent date Prince Eugene defeated them in several actions, and the peace concluded with them at Carlowitz, in 1699, by the intervention of England, secured to Austria a considerable accession of territory on the side of Hungary. Still that country continued divided and doubtful in its allegiance to Austria. Eugene led thither, in 1716, a part of the armies with which he had conquered in Italy and the Netherlands, and applied European tactics against the Turks with distinguished skill. The result was a series of splendid successes, and a treaty of peace highly favourable to Austria.

Such, however, was not the case in the last scene of the military career of Eugene, when, nearly twenty years after (in 1735), he headed the Austrian armies on the Rhine. The French had taken the field in support of the claims of Spain on the south of Italy. Austria was evidently overmatched in force; and England, guided by the pacific counsels of Walpole, declining to interfere, the result was a treaty, by which the emperor relinquished to Spain the contested territory in Italy.

In 1740 the death of the reigning emperor, Charles VI., brought to a close the male line of the house of Hapsburg, the succession devolving on Charles's daughter, Maria Theresa. The death of Charles became the signal for attack on his dominions by almost all the neighbouring powers; by Prussia, Bavaria, Saxony, and even by France. But England came forward to support the cause of Austria with a liberal subsidy, while the Hungarians, now united and loyal, recruited her armies. The aspect of affairs was soon altered the Bavarians were driven back; and the French, who had ventured to advance as far as Bohemia, were obliged to retire to the Rhine. Frederick II. of Prussia proved a more

Austria. obstinate opponent; and, as the interest of England and Holland called the Austrian forces to the Low Countries to maintain the great contest carrying on in that quarter against France, Maria Theresa was induced to subscribe, first in 1742, and afterwards in 1745, a separate treaty with Frederick, by which she ceded to him the chief part of Silesia. But the unprovoked attack of Frederick sunk deep in her mind; she watched an opportunity of revenge; and, in 1756, formed that coalition of powers against Prussia, which gave rise to a war of seven years, and to an extent of devastation such as Germany had not witnessed for more than a century. On one side was the whole Austrian force, aided by 80,000 French, and, at particular periods of the war, by the Russians and Swedes; on the other stood Prussia and England, numerically inferior to their antagonists, but managing their resources, and directing their military efforts, with all the ability that belonged to the character of Frederick and of Lord Chatham. On the side of the French there appeared no commander of eminence; but on that of the Austrians, Marshals Daun and Laudohn were generals worthy of being opposed to Frederick. After a number of battles and great alternations of success, both sides became tired of the waste of blood; and a contest, waged for a time with a rapidity of movement and an eagerness for conflict almost equal to those displayed in the French revolution, was marked towards its close by the cautious tactics of Turenne. At last, in 1763, a general peace was concluded, and the rival powers were left very nearly in the same position as at the beginning of the war.

From this time Germany enjoyed peace during thirty years. In 1778 the death of the Elector of Bavaria gave rise to pretensions on the part of Austria, which drew once more into the field the great Frederick, now grown gray in command. Austria opposed to him forces fully equal in number and scarcely inferior in discipline, but happily the campaign proved bloodless, each side anticipating a close of the dispute by negotiation. In that manner, accordingly, it ended; Austria being content with the cession by Bavaria of the frontier district, called the quarter of the Inn.

Maria Theresa had married Francis Duke of Lorraine, who was afterwards elected Emperor of Germany, but died in 1765. Their son, Joseph II., was then joined in the sovereign power with his mother; and, on her death in 1780, he became sole ruler. The princes of the house of Austria, disposed rather to follow than to lead, have seldom been the authors of political change; but the Emperor Joseph was imbued with all the ardour of a sanguine innovator. He gave a loose to this disposition after 1780, issuing a number of edicts, of which several were praiseworthy in their objects, but abrupt and premature in their operations, having besides set at defiance all the municipal and other authorities of the various provinces, under the pretence that he was the best judge of the wants of the country. He established general toleration in religion, abolished a number of monasteries and convents, dismantled various fortresses, and took steps for new-modelling the existing systems both of law and of national education. But his commercial legislation, based on the prohibition system, gave undoubted evidence of the narrowness of his views as a statesman. Had the public in his dominions been ripe, as in France, for a general political change, Joseph would have perhaps been hailed as a subverter of abuses, and as the author of general improvement; but the Austrians, attached to old usages, understood little of his plans, and merely received them with passive acquiescence, while the arbitrary manner in which his improvements were introduced could not fail to provoke hatred.. The actual effect was thus very limited, notwithstanding the example of new institutions in the United States of America, and soon after in France. But in Belgium the case was different: the contagion of the French revolution spread over the country, and produced a sudden rising against the Austrians. This unexpected revolt, and the chequered success of the war then carrying on against Turkey, are understood to have preyed on the sensitive mind of the emperor, and to have caused his death in 1790. Austria.

Leopold, the brother and successor of Joseph, had a very short reign, the crown devolving in 1792 on his son Francis II Francis had hardly succeeded to the throne when he found himself involved in a contest with France, the length and vicissitudes of which proved such as to cast into the shade all former wars between that country and Austria. The first important blow was struck in November 1792 at Jemappes, where the numbers and audacity of the French obtained a signal success. Next year the superior efficiency of the Austrian armies secured to them a temporary superiority; but, in 1794, the multitudes of Frenchmen brought forward by the energetic measures of the terrorists, and the talents of commanders such as Pichegru, Moreau, and Kleber, young in years, but full of enterprize and activity, led to the conquest of the Netherlands, and the retreat of the Austrians beyond the Rhine. France now offered to Austria a separate peace; but England engaging to furnish large subsidies, the emperor declined a treaty that would have involved the cession of Belgium. The French, determined to obtain this cession by force of arms, crossed the Rhine, in the autumn of 1795, with two formidable armies. Prussia had withdrawn from the contest, and allowed the whole weight of it to fall upon the emperor. It was then that the talents of Marshal Clairfayt, as yet known only to military men, became apparent to Europe at large. With numbers inferior to the two French armies collectively, he found means, by rapid movements, to concentrate a force superior to either singly, and drove them across the Rhine with great loss. Next year, however, the French, undismayed by failure, resumed the offensive, and crossed the Rhine again with two armies; one of which penetrated into the heart of Franconia, whilst the other overran Suabia and part of Bavaria. But these armies had not the means of affording each other ready support; they were separated by the Danube, while the Austrians were in possession of the bridges on that river, and could move within a smaller circle. They were thus enabled to repeat their manœuvre of the preceding year, by detaching a superior force against the French army in Franconia, and thus obliging it not only to evacuate the country it had overrun, but to seek safety beyond the Rhine. Such was also the case with the southern army of the French, although the retreat conducted by Moreau was the subject of general commendation.

But whilst in Germany success inclined to the side of Austria, the case was very different in Piedmont and Lombardy. In Piedmont, indeed, the war had long been carried on between the French and the allies without decisive success on either side. The opposing forces were nearly equal, and the mountainous nature of the country afforded so many strong positions, that there seemed no means of bringing the contest to a speedy termination. But all this was suddenly changed by the genius of one man. Buonaparte appeared on the scene, and in less than a month after receiving the command, defeated the allies in three engagements; obliged the court of Turin to make a separate peace; and, pouring his forces into Lombardy, drove the Austrians from every position in that country except Mantua. The strength of the latter place, however, bade defiance to the attacks of the French, and enabled the emperor to make repeated attempts for the recovery of Lombardy. No part of the war is more deserving of attention than this campaign; for none displayed in a more striking light the extensive resources of Austria, or the inventive genius of Buonaparte. Threatened in the end of July by an Austrian army of great strength, but which was imprudently

Austria. advancing in two bodies, he hesitated not a moment in sacrificing his artillery, that by sudden marches he might assail his opponents before they effected a junction. In this he succeeded; but his loss was heavy, and the Austrians were rather repulsed than defeated. Six weeks after, a repetition by Buonaparte of these daring movements was attended with decisive success. When apparently marching against the Austrian troops in Trent, he turned suddenly to the right, and advancing by a valley, reached the headquarters of their army before they were prepared. The result was a series of actions, which cut off the retreat of their main body, and obliged it to fly for refuge to Mantua. But ere two months had passed, the Austrians prepared another army, which Buonaparte marched to encounter as it advanced towards Verona, using in his despatch to Paris these remarkable words: *Il faut frapper l'ennemi comme la foudre, et le balayer dès son premier pas.* On this occasion, however, fortune was not favourable to him. He was worsted twice in action (on the 6th and 12th November); yet, far from being discouraged, he conceived the extraordinary plan of quitting his camp at night, and gaining the rear of that army which had twice repulsed him. He reckoned on the effect of a surprise; but his hopes were disappointed by the time unavoidably lost in attacks on the village of Arcole, which stood in his way. The main body of the Austrians had time to advance, and the result was a series of conflicts, attended with great loss on both sides.

Thus ended the campaign of 1796, sanguinary beyond example even in those days of blood, and not altogether conclusive in its results. Next year, however, the chances of war were no longer doubtful. The Austrians having reinforced their army, made a final effort to relieve Mantua; but Buonaparte having intercepted a despatch with their intended plan of operations, was enabled to make such a disposition of his troops as to ensure success; and the results were, the victory of Rivoli, the surrender of the force destined to relieve Mantua, and the complete expulsion of the Austrians from Italy. The French now crossed the mountain barrier, and advanced toward the heart of Austria. This, joined to the approach of their armies from the Rhine, obliged the emperor to conclude preliminaries of peace at Leoben, and afterwards a treaty proceeding on these as a basis at Campo Formio. This treaty involved the cession by Austria of Belgium and Lombardy, but gave her, in return, Venice and its dependent provinces, making an absolute loss in population of 1,500,000 souls.

This peace, however, proved only a truce. The absence of a portion of the French armies in Egypt, and the evident misgovernment of the directory, induced England to form a new coalition, and renew the continental contest early in 1799. The Austrian troops took the field, powerful equally in numbers and in discipline; and the French, commanded for the first time by inferior leaders, were driven back both in Germany and Italy. The arrival of Russian auxiliaries, and the talents of Suwaroff, bore forward the tide of success, until the autumn of the year, when increased levies on the part of the French, and a better choice of generals, began to turn the scale in their favour. The capricious Paul now withdrew from the coalition, and the Austrians entered on the campaign of 1800 with their own forces only. These proved, as formerly, insufficient to withstand the French, especially when the latter were commanded in Germany by Moreau, in Italy by Buonaparte. Battles, unfortunately too decisive, took place; the victories of Hohenlinden and Marengo led to the treaty of Luneville, and to the cession by Austria of almost all her Venetian acquisitions.

This peace, though not so short as the preceding, lasted only four years. In 1805 Austria and Russia, provoked by Buonaparte's aggressions, and stimulated by English subsidies, took the field with numerous armies; but the successive overthrows at Ulm and Austerlitz rendered peace again indispensable to Austria. It was obtained (6th August 1806) by the surrender of the remainder of the Venetian territory, of the Tyrol, and of various districts, comprising a sacrifice in all of three millions of subjects. Soon after these reverses, Francis II. renounced the title and authority of Emperor of Germany, and assumed the title of Emperor of Austria. Taught by repeated disasters, he remained passive in the great contest in 1806 and 1807 between France, Prussia, and Russia; but in 1809 the war in Spain having withdrawn a very large portion of the French force, he ventured once more to try his fortune in the field. The Austrian armies were numerous; but Buonaparte had still a powerful French force at command, and was aided by all the troops of the confederation of the Rhine. The Austrians, worsted in Bavaria, retreated to Vienna; and although temporary hopes were excited by their success at Aspern (21st and 22d May), they were blasted by the disastrous day of Wagram, and peace was again purchased by a sacrifice of territory containing more than three millions of inhabitants. Austria, now reduced to a population of twenty millions, remained in peace during the years 1810, 1811, and 1812; but when the disasters of the French in Russia once more raised the hopes of Germany, and brought friendly standards into Saxony, Austria took part with the grand alliance, and her troops bore a conspicuous part in the battle of Leipsic and the invasion of France. The definitive treaties of 1814 and 1815 reinstated her in all her former territories, except Belgium, and gave her substantial additions on the side of Italy. It must, however, be observed, that according to the new territorial division, as determined by the Congress of Vienna, the extent of the Austrian Empire was diminished by 400 German square miles. The public debt, as reduced in consequence of the state-bankruptcy of 1811, amounted to something above 500,000,000 florins (or L.50,000,000 sterling).

The subsequent history of Austria may be divided into two distinct periods. The first of these, beginning with the year 1816, after the definitive settlement of the negotiations of Vienna, and terminating with 1848, was, so to speak, one of comparative peace, especially with regard to foreign powers; the other commenced with intestine commotions and wars, resulting in the complete subversion of the Austrian states-machine, and has left the whole empire in a provisional and unsettled condition up to the present day These two periods we shall treat separately in their order

AUSTRIA FROM 1816 TO THE WAR OF 1848.

Prince Metternich, one of the most conspicuous personages among the diplomatists assembled at the Congress of Vienna, became, from this time, the uncontrolled director of the helm of the state. His policy, in which he persevered until the hour when he was hurled from his post by the movement of 1848, was based on the principles of legitimacy and strict conservatism. In conformity with the former, Austria ever proved ready to assist any acknowledged or legitimate prince against revolutionary movements, while her conservative policy rendered her averse to anything like progress or innovation. "The transition from an old state of things to a new is as dangerous as that from a new state to one which no longer exists. Both are productive of disturbances which must be avoided at any price." Such was the doctrine which Metternich proclaimed after the restoration of peace, and which became ever after the basis of the Austrian policy. To follow up this system in all its consequences, the Austrian government established a strict censorship, whose office was to watch over the home press and literature, and to survey the importation of foreign literary productions. The secret police, which received a thorough organization since the year 1820, had to perform the office of censor in the department of social conversation; its reports

Austria. serving to the government as a means of estimating the sentiments of the people. It is needless to observe, that this was not the best method for furnishing the cabinet with correct information as to the state of the public mind; for the people, knowing the system of espionage by which they were surrounded, either avoided conversing on political topics altogether, or, if at all adverting to such subjects, purposely expressed sentiments totally at variance with their real convictions.

At the new territorial division of Europe after the fall of Napoleon, Austria renounced her pretensions to Belgium for the acquisition of the Italian provinces, which she deemed more secure. A few years, however, sufficed to prove the fallacy of this policy. In 1822, when a rebellion broke out in Naples and Sardinia, the movement soon spread to Lombardo-Venetia; and the Austrian government, after having quelled the disturbances in her own provinces, deemed it necessary for her own security to put down, by force of arms, the risings in the other states of the Italian provinces. Ten years later Parma and Modena suddenly rose in rebellion, when, guided by like principles, Austria sent her troops to restore peace in the Romagna. In short, the Italian possessions have proved one of the most vulnerable points of the Austrian Empire.

The French revolution of July 1830, however, was the first external event after the Napoleonic era which deeply affected and embarrassed the commanding attitude of the court of Vienna. The very accession of Louis Philippe to the Bourbon throne was a sort of declaration of war against the principles of legitimacy; and though the recognition of the Orleans king by Great Britain led Austria to acquiesce in the event, and to follow the example of the court of St James, she had soon after to encounter various difficulties directly arising from this French revolution. Her first task was in Poland. Tired of Russian rule, the Poles, hoping to be supported by France, took arms to regain their independence, when Austria aided the Czar in crushing them. The second manœuvre was in Germany, to which the revolutionary impulse had been communicated from France. Here Austria acted in concert with Prussia in establishing some new restrictive laws with reference to the German Confederacy. But more important was the desire for reform simultaneously manifested in several of her own provinces, which, with the exception of Hungary, had been stript of all their ancient institutions and ruled by edicts from Vienna. As all the means of expressing public opinion were wanting, the government persevered with seeming confidence in its old policy, without encountering many obstacles; though in Hungary matters looked somewhat different. Deprived, equally with the other provinces, of the liberty of the press, Hungary retained its diets and county assemblies, institutions which gave ample opportunity for the expression of free opinion, and which, at the same time, operated as a check on the grasping power of the crown. The diet of 1832 loudly demanded the redress of old grievances, the states intimating their determination not to vote supplies till their wrongs were removed, and asking, moreover, the introduction of the Hungarian language into the courts of administration and justice instead of the dead Latin. Meanwhile the spirit of nationality awoke in Bohemia, the Czechs or Sclavonian party attempting to defend their nationality against the absorbing superiority accorded to the German element by the government.

In 1835 the Emperor Francis died, leaving the throne to his son Ferdinand. The mental weakness of this good-natured monarch, far from contributing to any change in the maxims of the state policy, served only to allow free scope to the omnipotent prime minister. "On the accession of the Emperor Ferdinand," says Baron Pillersdorf (the successor of Metternich), "the monarchy was not menaced by external dangers. Circumstances permitted an uninterrupted enjoyment of peace, but the necessity for internal ameliorations became, by so long a delay, more urgent, the demand for them more sensible; whilst, owing to the procrastinations of the government, faith and confidence were diminished. It is true that the prosperity of the provinces generally did not decline; on the contrary, many branches of commerce manifested an increase in their development; but in spite of this the situation of the whole empire inspired, in different respects, serious apprehensions, arising from the disordered state of the economy of finance, the yearly augmentation of the public debt, the inefficiency of the measures adopted, and still more from the oppressed disposition of mind of the clear-sighted and intelligent classes of the population. The Austrian Empire was partly surrounded by, and was thrown into manifold relations with, countries in which the constitutional form had developed itself in place of that which had previously existed; and as the defects of our own system had been publicly scrutinized and discussed, the spirit of constitutional freedom was transferred from without to the sentiments of all strata of the people. Contemporaneously with this arose a contrast, the more striking in the empire of Austria (the author here alludes to Hungary), where one-half of the people enjoyed thoroughly, during many centuries, a constitution, and consequently a right to participate in legislation."[1] These few remarks may suffice to show the state of Austria before the troubles of 1848. Under such circumstances the state of Austria necessarily became perplexed. In Germany she saw the rising influence of Prussia, whose free institutions and superiority in culture and science were gradually raising her to be the leading power of the German Confederacy; which very circumstance induced her to support the German element in her own dominions at the expense of the other nationalities. The non-German population were thus discontented with the court of Vienna for its Germanizing measures, while the Germans knew well that it was not Vienna which represented German learning and civilization. It may be remarked that the aversion of Austria to foster the development of the Sclavonic element in particular, was greatly owing to the apprehensions that it might lead to the ultimate advantage of Russia, which was continually endeavouring to attach to itself all the Sclavonic tribes. No Austrian statesman, in fact, was more alive to the encroaching power of Russia than Metternich. In 1830 Austria accordingly refused to join the rest of the European powers in the protocol which declared the independence of Greece; while ten years later, when Turkey was threatened by Mahommed Ali the pacha of Egypt, whose interests were loudly advocated by France, the court of Vienna readily joined England as an ally of the Porte. Both these instances prove of how much importance the integrity of Turkey appeared to Austrian statesmen with reference to the menacing attitude of Russia.

In 1846 the court of Vienna was again frightened from its sense of security by the Poles. Having suppressed this revolution, Austria, in concert with the other two powers which dismembered Poland, determined to blot out Cracow, the last remnant of Polish independence, from the map of Europe. This step, being contrary to the treaties of Vienna, was of course discountenanced by England, and more strongly remonstrated against by France. This disapproval, however, did not prevent the incorportion of that small republican territory with the Austrian empire; but it may safely be assumed that, if the question of the *Spanish marriage* had not for the time being occasioned a rupture between

[1] *The Political Movement in Austria during the year* 1848-9. By Baron Pillersdorf. London, 1850.

Austria. the cabinets of London and Paris, their conjoint interposition would not have been so utterly disregarded by the northern powers. Not satisfied with the advantages gained in Poland, Metternich thought fit to meddle with the internal affairs of Switzerland, which engaged his special attention from the circumstance of its vicinity to the Italian provinces of Austria. This country was at that time agitated by two contending parties, the Sonderbund, a Jesuitical party, and the Liberals. Metternich, who advocated the cause of the Sonderbund, succeeded in gaining over France to his side, coming into direct opposition to England, which gave its support to the party of progress.

THE REVOLUTION OF 1848, AND SUBSEQUENT EVENTS.

The French revolution of 24th February, which convulsed almost the whole of continental Europe, caused the Austrian empire to totter to its very centre. Scarcely had the intelligence of the fall of Louis Philippe reached Vienna, when that capital, proverbial for its carelessness about politics, presented all at once a counterpart on a smaller scale of Paris in the last days of Louis XVI. On the 13th of March the whole city was in a state of open rebellion; the populace, forcing the magistracy along with them, broke their way into the imperial palace, and loudly demanded from the Emperor Ferdinand the dismissal of his old counsellors and the immediate grant of a new charter. Three days afterwards an imperial proclamation was issued declaring the abolition of the censorship, the establishment of a national guard, and the convocation of a national assembly.

These measures, however, as well as the nomination of a new ministry, headed provisionally by Count Colowrath, and afterwards by Pillersdorf, (in place of Prince Metternich, who by this time was in full flight towards London,) were far from sufficing to arrest the popular movement, encouraged and led on by the students and other members of the university. The national guard just called into being, along with the academic legion, formed themselves into a permanent committee, and dictated laws to the government. The ministry, unable to resist, promised the convocation of a constituent assembly, while the emperor and the court fled from the capital and retired to Innspruck (May 17). The old system lay thus in ruins, its supporters or rather creators turned fugitives, while the prospects of a new organization were continually defeated more and more by the condition of the rest of the provinces. The Lombards and Venetians, already half in arms before the Parisian revolution broke out, were afterwards all the more determined to fight out their independence; and after having expelled the Austrian troops from Milan, they found an ally in Charles Albert, king of Sardinia, before whose arms the Austrian force under Radetzky was compelled to retreat. Meanwhile the movement propagated itself into Bohemia, where the Czechs, or Sclavonic party, determined to obtain redress against the Germanizing measures of the government. In a petition forwarded to the emperor, they demanded a united and independent national assembly for Bohemia and Moravia, independent municipal institutions, and in the distribution of public offices an equal selection from among the Sclavonians and German part of the population. Shortly afterwards the Sclavonian party in Prague, already in open collision with their German fellow-citizens, organized a club under the title of *Slowanska Lipa*, with the object of concerting common measures in the interest of all the Sclavonian inhabitants of the Austrian empire. A general summons was accordingly issued to the Sclavonians of the different provinces, calling upon them to send representatives to the Sclavonic congress to be held in the Bohemian capital. Delegates accordingly arrived, and the congress was opened in the beginning of June.

The people, who hated the Austrian commander, Prince Windischgratz, petitioned the emperor for his removal; meanwhile, however, a collision ensued between the Sclavonic militia and the regular troops, the result of which was the bombardment of the town and the final dispersion and imprisonment of the leaders of the Sclavonic party. Nor did matters wear a more peaceable aspect in Hungary. Here the national diet succeeded in carrying a measure for the abolition of feudality, as well as the appointment of a responsible and independent Hungarian ministry. These reforms soon gave rise to a civil war, commenced by the Sclavonians of Hungary, and, to say the least, encouraged by the Austrian government, which disliked to see an independent Hungarian ministry by its side. The imperial dynasty was thus menaced on every side. Austria.

In addition to this distracted and threatening state of affairs within the bosom of the empire itself, may be added the terrible blow inflicted upon Austrian influence on the side of Germany. The national assembly which met at Frankfort determined on the reorganization of Germany into one integral empire, excluding the German possessions of Austria from the confederacy, and offering, besides, the imperial crown to the king of Prussia. It was under these circumstances that the constituent assembly, composed of representatives from all the provinces of Austria except Hungary and Lombard-Venetia, was opened at Vienna by the Archduke John (July 22). It may easily be imagined that the Sclavonian element, largely preponderating over the German in these provinces, also greatly preponderated in that assembly; a circumstance the more distasteful to the government, in that its influence in Germany had already received so severe a blow, as already related. Notwithstanding, the aspect of affairs in Italy and Hungary, and the desire to flatter the Sclavonian population for the sake of its support, induced the government to allow free scope to this assembly in its schemes for the re-organization of the empire. But even whilst the assembly held its sittings, the committee of safety and the academic legion exercised, in many respects, the chief authority in the capital, which was the scene of repeated tumults until the month of October. At this period the people became incensed by the appearance before the walls of Vienna of a Croatian army, led on by the Ban Jellachich, who had previously been foiled in his attempts to advance upon Pesth. The popular fury became concentrated on Latour, the minister of war, who was known to have supplied the Ban with arms and ammunition for the invasion of Hungary. The war office was stormed by the people, after a severe conflict with the troops, when Latour was taken and cruelly murdered, his body stript of its clothes, and suspended to a lamp-post. After this event Windischgratz began to collect a large army, and soon after appeared before Vienna. The defence was carried on under the command of General Bem, a Polish officer, subsequently so distinguished in the Hungarian war. Windischgratz, however, conjointly with Jellachich, succeeded in storming the town (October 30). Among those who suffered death at the instance of Windischgratz was Robert Blum, member of the parliament of Frankfort, who was accused of having incited the people to rebellion. While Prague and Vienna were thus subjected by military power, the fortune of war began also to turn in favour of the Austrians in Italy. The Austrian government, which had been ready a few weeks before to relinquish its claims on Lombardy, and which implored the British cabinet to mediate a peace on the condition of its retaining only Venice, now saw Radetzky repel the Sardinian troops and re-enter Milan (August 1848). See LOMBARDY and SARDINIA. In Hungary, however, matters had now begun to assume a threatening aspect. By an imperial edict the diet met at Pesth (July 2), with the special purpose of providing for the safety of the country, when, on the other hand, it became notorious that the invasion of Hungary by the Croats, under Jellachich, was determined on by the Austrian government. This diet, therefore, after the

Austria. resignation of the Hungarian ministry in consequence of the double dealings of the court, appointed a committee of public safety, having previously voted a national army of 200,000 men. Meanwhile the court, then sitting in Olmütz, determined upon persuading the weak-minded Ferdinand to abdicate his throne in favour of Francis Joseph, son of the Archduke Francis Charles, Ferdinand's brother, and heir-presumptive to the throne. In a manifesto dated December 2. 1848, Francis Joseph announced his accession to the throne, promising to rule on the basis of true liberty, of the equality of the rights of the different populations comprising his empire, and indicating, moreover, his determination to suppress the rebellions then raging throughout his dominions. This announcement, as may be imagined, had the effect of still more powerfully rousing both Lombard-Venetia and Hungary. The former was henceforth the more determined to regain its complete independence, while the latter regarded the abdication of Ferdinand and the accession of his successor as unconstitutional, illegal, and null, inasmuch as it did not take place with the knowledge and consent of the diet. After a levy of recruits had been effected, the new emperor intrusted Windischgratz with the subjugation of Hungary, of which he was nominated civil and military governor. Joined by the Ban, Windischgratz broke into Hungary, and in a few days possessed himself of Buda-Pesth, the capital (January 1. 1849); the Hungarian diet meanwhile transferring its seat to Debreczin in Lower Hungary. After a short respite allowed to his troops, the Austrian general marched on towards the new seat of the Hungarian diet, but after the first battle, fought about the end of February, at Kapolna, Windischgratz, instead of advancing, was compelled to prepare for a retreat. The emperor, probably relying too hastily on the success of his arms in Hungary, dissolved the constituent assembly of Vienna which had been transferred to Kremsir, and, rejecting the constitution they were preparing, issued a self-granted (*octroyé*) so-called constitution (March 4. 1849).

This charter, meant to sweep away all the ancient institutions of the various provinces, proclaimed constitutional liberty, the responsibility of ministers, the liberty of the press, and other safeguards common in constitutional governments, as its groundwork. The establishment of a general diet in Vienna, and of provincial assemblies, and also of courts of central administration in the capital, were likewise among its more prominent provisions.

That Hungary could only see in this charter the abolition of its independent parliaments, and the subversion of all its ancient institutions, will be readily manifest; nor was Lombard-Venetia likely to be reconciled to Austrian rule by the proclamation of such a charter. In Italy, accordingly, the war continued, but very visibly in favour of the Austrian arms; and on the 23d of March 1849 the cause of Italian independence was crushed on the disastrous field of Novara, where the Sardinian forces were completely routed by Radetzky. But although Austria obtained so unexpected and speedy a triumph in Italy, its cause looked sufficiently desperate in Hungary in the spring of 1849. The Austrian army suffered one defeat after another in rapid succession, and were driven back, broken and dispirited, up to the vicinity of Presburg. Emboldened by the successes of its army, the Hungarian diet proclaimed the dethronement of the house of Hapsburg, and nominated Kossuth provisional governor of Hungary (April 24). In this emergency Francis Joseph applied for assistance to the Czar, which the Russian emperor readily granted, and the more so that his interference was objected to neither by France nor England. The Russian army, under the command of Paskiewics, was not long in penetrating into Hungary, and the whole war was at once extinguished by the disgraceful surrender of the Hungarian general Georgei to the Russian commander (August 13). See HUNGARY. Thus did the Hapsburg dynasty pass through a crisis more formidable than it Austria. had ever before experienced; owing its final preservation to the timely assistance of Russia, a power the increasing influence of which Prince Metternich, during his long administration, kept steadily in view and endeavoured to obstruct, but which, from the services it rendered, naturally assumed forthwith towards Austria the attitude of a protector.

To complete the summary of the events resulting from the movement of 1848, a few words must be said on the relation of Austria to Germany, subsequent to the war we have narrated.

Though the king of Prussia declined accepting the imperial dignity, tendered to him in 1848 by the diet of Frankfort, he concluded a treaty with the kings of Saxony and Hanover (May 1849), with the view of forming a *strict union* with the different states of the German Confederacy, to the exclusion of Austria. To this treaty, which is known by the appellation of the "Treaty of the Three Kings," the majority of the lesser states soon acceded, Prussia proposing, besides, to convene a diet at Erfurth under its own presidency, for the final settlement of the reorganization of Germany. This assembly was accordingly opened (March 1850), and obviously tended materially to raise the influence of Prussia at the expense of Austria, hitherto the leading power in the German Confederacy. But Austria, having now established her authority in her own provinces, began vigorously to counteract the efforts of her rival, and, on her part, invited the different states to send their representatives to Frankfort, where she assumed the lead. The legality of this assembly was at once acknowledged by Bavaria, always jealous of Prussian influence, as well as by Saxony and Hanover, which were subsequently gained over by Austria.

While these two parliaments were thus playing at cross purposes, disturbances arose in Hesse-Cassel. The margrave invoked the assistance of Austria, while the population, on the other hand, looked to Prussia for support. In accordance with the decision of the diet at Frankfort, Austria determined to march its armies into Hessia, a course of action opposed by Prussia and threatening immediate war between these two powers. (See articles GERMANY and PRUSSIA.) This conflict, which seemed unavoidable, was however averted by the conferences of Olmütz, Austria being represented by the prime minister Prince Schwartzenberg, and Prussia by Manteuffel. These deliberations ended in the entire humiliation of Prussia, which acknowledged the right of Austria to march its troops into Hessia, and even Schleswig-Holstein; a circumstance attributed, not without reason, to the influence of the Czar, with whom the Emperor of Austria and the Prince of Prussia held a conference at Warsaw (October 25. 1850), and who, as may be easily imagined, from his aversion to every species of innovation, pronounced in favour of the policy of Austria to re-establish the old *status quo* in Germany. About the close of the year 1850, Austria and Prussia convoked a congress of all the German states at Dresden, when the influence of the former so far preponderated, that Prussia, bent all the while on the reorganization of Germany, was fain to propose that the final solution of the affairs of the confederacy should be submitted to the decision of the old Frankfort diet. Having thus achieved so many triumphs over her rival, Austria now proposed to the diet of Frankfort the incorporation into the German Confederacy of all her provinces, including Hungary and Lombard-Venetia. This bold proposal, materially threatening the balance of power in Europe, was met by the remonstrances of the governments of France and England, though its failure may be more directly traced to the policy of Russia, which could not be supposed to look with indifference on the increase of power to the Austrian empire by the success of such a scheme of ambition.

Austria. *Population of the Austrian Empire according to the census of* 1846: *the Provinces classed by the comparative density of the Population.*

Provinces.	Population.	Inhabitants per German square mile.
Lombardy	2,670,833	7120
Venice	2,257,200	5439
Bohemia	4,347,962	4809
Moravia and Silesia	2,250,594	4731
Lower Austria	1,494,399	4322
Istria, Görtz, and Trieste	500,101	3616
Galizia and Bukowina	5,105,558	3339
Hungary	11,000,000	2776
Upper Austria	856,694	2573
Styria	1,003,074	2566
Transylvania	2,182,700	2286
Carinthia and Carniola	784,786	2222
Dalmatia	410,988	1849
Military frontiers	1,226,408	1796
Tyrol	859,250	1746
The army	492,486	...
Total	37,443,033	

The increase of the population of the Austrian empire, since 1816, thus amounts to 10 millions. The approximate estimate of the population in 1852 is given by Hain in his last statistical work at 38 millions.

Such is the respective population of the different provinces of the empire. These differ so widely in climate, soil, language, and customs, that any general description cannot apply to the whole; we shall therefore describe the chief characteristics of those which form a part of the German Confederacy; for HUNGARY, LOMBARDY, and VENICE, the reader is referred to the respective heads of each, while Galizia will be found under that of POLAND.

AUSTRIA, THE ARCHDUCHY.

The archduchy of Austria consists of two nearly equal parts, viz., Upper and Lower Austria. The river Ens, flowing northward from the Alps to the Danube, intersects the archducal territory nearly in the middle; the country to the E. of the river being Lower, and that to the W., Upper Austria. Lower Austria, in particular the fertile tract adjoining the Danube above and below Vienna, formed originally the *nucleus* of that union of states which now constitutes the Austrian empire. That district is the seat both of the capital and of extensive manufactures, and is, in this respect, after the Italian provinces and Bohemia, the most important. Vienna itself, with its environs, produces silk, the manufacture of which is carried to a degree of considerable perfection, amounting in annual value to more than 12,000,000 florins. The other branches of industry consist principally of woollen, cotton, and hardware manufactures, the yearly value of which, added to the lesser fabrics of hardware, leather, glass, hats, and paper, is computed at three or four millions sterling. In the mountainous part of the province are mines of iron, coal, and rock-salt; but the wealth derived from these is slight compared with that resulting from the agricultural products of the more level part of the country. These consist of wheat, barley, oats, and other corns raised in England; and in the warmer situations of maize and vines. Advantage is taken here, as in Lombardy, of the numerous streams which flow from the mountains in the S. towards the Danube. They are used for irrigation, the great *desideratum* of the agriculturist in a warm locality. The produce of the land along the Danube, from Vienna to the Bavarian frontier, has been greatly increased likewise within the last half century by the use of marl. The traveller, in pursuing this track, sees in all directions a quantity of marl-pits, wrought with great activity; but still the crops raised are much smaller than they would be under a system like that of our improved lands.

Upper Austria, or the country W. of the Ens, was added to the sister province in the twelfth century; it is called Upper from its comparative vicinity to the Alps, and its greater elevation of surface. Its wealth consists not in manufactures, but in agricultural produce. It is too cold for the culture of the vine; but the low grounds are productive in corn, while the pasturages are extensive, both in the hills and the valleys. The sides of the mountains are covered with forests, the timber of which finds to a certain extent an outlet by navigable rivers, of which the chief are the Ens, the Salzach, the Traun, and the Trasen. One of the principal sources of employment to the lower orders in the forest-lands consists in felling their timber and conveying it to these rivers, whence it is floated to the towns along their banks, or to the Danube, the great channel for the transport of bulky commodities. Upper Austria, since the acquisition of Salzburg, has an extent (about 7500 square miles) nearly equal to that of Lower Austria; but in population it is far inferior, containing only 856,694 inhabitants, while the lower province reckons 1,494,399. Austria.

Population of the Chief Towns.

Lower Austria.		Upper Austria.	
Vienna	431,147	Lintz	26,618
Neustadt	12,862	Salzburg	17,009
Krems	8,700	Steyer	10,380

The early inhabitants of Austria are understood to have come partly from among the Germans in the W., partly from the Sclavonian tribes in the N. and E. German is now almost the sole language of the inhabitants, but it differs considerably from the German spoken in Saxony. As to religion, almost all the inhabitants are Catholics. Situated to the S.E. of Germany, and comparatively backward in civilization, Austria is considered as rather an outwork than an integral part of the empire; it was not until 1438 that the election to the imperial crown fell almost invariably on the head of the house of Hapsburg.

BOHEMIA.

Situation and extent. Bohemia, which ranks immediately after Hungary among the great members of the Austrian union, bears the title of kingdom, and is amply entitled to it by its extent, its population, and its progressive improvement. Backward as it still is, its resources, as the imperial government is well aware, are of a nature very different from those afforded by the mountainous provinces of the Alps, or the half-civilized districts on the side of Turkey. It is situated between the 48th and 51st degrees of N. Lat.; its form is an irregular square; its area, not yet accurately ascertained, is computed at fully 20,000 square miles, or three-fourths of the extent of Scotland. It is separated from the surrounding countries by ranges of mountains which encircle it on every side. From this, and from the general appearance of the interior, there seems little doubt that in an early age the chief part of Bohemia was covered with water, and that such continued the case until an outlet was opened at the northern and least-elevated part of the chain, in the direction by which the Elbe still flows, carrying with it the waters of tributary streams from almost every part of the kingdom.

This separation from the adjacent countries, particularly from the comparatively improved states of Saxony on the N. and Franconia on the W., necessarily operated to the disadvantage of Bohemia, and retarded its advance in civilization. German settlers resorted to it from time to time, but individually or in small parties, never in numerous bodies, or in such a manner as to disseminate extensively the improvements of their respective countries.

History. Of the aboriginal inhabitants of Bohemia there are no distinct accounts; but the name of the country confirms the current tradition that they were the Boii, a well-known Celtic tribe. Christianity appears to have been introduced

Austria. among them only towards the close of the ninth century, the era of the commencement of their historical records. The ruler or governor then bore the name of Grand Duke; and the succession under that, as under the subsequent title of King, was for a long time elective. In the thirteenth century Ottocar I., a prince of ability, passed laws similar to those which were enacted in England about the same time by Edward I., exempting the inhabitants of villages from dependence on the neighbouring barons, and enabling them to possess their little properties in security. His son and successor, Ottocar II., followed a similar course; a system of laws was compiled and reduced to writing in German; and Prague, the capital, became a town of importance. Bohemia was, as is well known, the country of the martyr reformers, John Huss and Jerome of Prague, who, at a date as yet too early, exposed the errors of the Church of Rome; for the public, not then enlightened by the art of printing, and the circulation of sound doctrines, misunderstood their views: a civil war burst out, and the result tended to perpetuate the abuses which these well-meaning men had laboured to remove.

The crown of Bohemia, like that of Hungary, had at different intervals been held from marriage connection by princes of the house of Austria; but in 1526 both crowns devolved on the head of that house, and have ever since been held by it in hereditary succession.

Climate and soil. The climate of Bohemia varies greatly, according to the elevation of the ground; the plains and valleys being warm, while the mountains, both in the S. and N., are cold and bleak. The annual fall of rain differs in like manner, according to situation; but 20 inches a-year is said to be a frequent average. The soil of Bohemia is in general good, but the agriculture is extremely backward. The chief products, as in a similar latitude in England, are wheat, barley, rye, oats, potatoes; also hemp, flax, and hops. In some warm situations, vines are cultivated, but as yet on a small scale. The pastures, on the other hand, are extensive, and in many parts as good as those of Saxony and Silesia; but the inhabitants are far behind their neighbours in the management of their flocks and the quality of their wool. In the rearing and training of horses considerable improvement has been made; studs having been established in different parts of the country by the Austrian government, which draws a large proportion of its cavalry from this quarter.

Forests, rivers. The forests of Bohemia are of great extent; and large quantities of timber are annually cut down and shipped in the parts adjoining a navigable river. The Elbe and Moldau are of great use for the conveyance of these as well as of other bulky commodities. The Elbe rises in the E. of the kingdom; but the Moldau, which at their junction is the larger river, rises in the southern extremity of Bohemia, and has a course of above 150 miles, nearly the whole width of the kingdom. The Eger, the river next in size, rises in the W., and has a course of about 100 miles, with a less rapid current than the Moldau.

Bohemia is divided into sixteen circles or counties, varying of course in extent and population, but containing on an average nearly 1300 square miles, and 270,000 inhabitants.

Population of the Chief Towns.

Prague	118,405	Pilsen	11,486
Eger	11,170	Budweis	12,311
Reichenberg	13,184	Konig-groetz	7,000

Besides these there are about fifteen petty places with 2000, 3000, or 4000 inhabitants each; but altogether, the town population, with the exception of the capital, is insignificant. That of the country is very different; it approaches in density to that of Ireland,—the farms being small, and the cultivation being carried on almost wholly by manual labour.

Austria. The manufactures of Bohemia have made considerable progress in the last and present age: they consist chiefly of woollens,—which are mainly produced in the town of Reichenberg and its environs,—of linen and leather; but they comprise also cottons, hardware, and glass. The glass-manufactories are principally situated in the mountainous parts of the province, and the largest emporia of these branches of industry are in the towns of Neuwelt, Silberberg, and Georgenthal. Besides the above, Bohemia is remarkable for the large number of its breweries, furnishing, it is said, the third part of all the beer produced in the empire. The annual value of the total industry of Bohemia is computed at 150,000,000 of florins. Great part of the woollen and linen is woven, as in the last age in England, in cottages. The mountains contain ores of iron, lead, tin, cobalt, and silver; but iron alone is extracted on a large scale. The foreign trade of Bohemia with Saxony and the north of Germany is carried on by the Elbe, on which, during the last few years, regular steam communication has been established; and the intercourse with the other Austrian provinces has been greatly extended by means of the different lines of railway recently established in the various parts of the empire. Austria. Manufactures.

The population of Bohemia has greatly increased in the last and present age. In 1791 it was considerably below 3,000,000. At present it amounts to 4,847,962. Of these about a third part are of German extraction, the other two-thirds being descended from the aboriginal stock. The ancestors of the Germans settled here from time to time, as mechanics, miners, and traders; employments which the uninstructed natives, like the cottagers of Ireland, were not capable of exercising. At present, even, it is by the German part of the population that whatever relates to public business or to foreign trade is conducted; the Bohemians generally confining themselves to husbandry in the country, or to common labour in towns. The middle classes, in general, speak both German and Bohemian; but the latter, a Sclavonic idiom, and quite different from German, is the only language of the lower orders, particularly in remote districts. The power of the sovereigns is as absolute in Bohemia as in any part of the Austrian dominions. The parliament or states consists of four classes of members; the clergy, the great nobility, the nobility of the second class, and the representatives of the chief towns. But their duties are little more than nominal; and the sphere of their vocation and authority does not extend much beyond executing the orders of the chief court of Vienna, and is almost confined to the collection of the taxes imposed upon them by the central government. They deliberate on the measures proposed to them by the royal commissioner, but they have no power to originate a bill. As to public revenue, Bohemia contributes fully two millions to the imperial treasury, and maintains a force in regulars and militia of 50,000 men. A few years before the war of 1848, the feeling of Sclavonian nationality began to manifest itself in this province in loud discontent against the Germanizing policy, and the bureaucratic system of the government. These manifestations exhibited themselves without restraint during the year 1848; and, as the government was in open war with Lombardo-Venetia and Hungary, were at first left unchecked, though, as the reader will find from the general history of the late war, the idea of Sclavonic nationality and independence was speedily silenced by martial law.

Moravia. Moravia, and Austrian Silesia, which is now annexed to it, contain an area of 11,000 square miles, with a population of 2,250,594, a degree of density approaching to that of England, and nearly double the average population of Germany. This is owing chiefly to the fertility of the soil; for although chains of mountains cross the country in several directions, the plains and valleys are extensive, yielding in abundance wheat, rye, oats, barley, and, in the warmer situ-

Austria. ations, vines. The pastures also are good, and a number of horses and horned cattle are exported annually. Here, as in Bohemia, the majority of the inhabitants are of Sclavonian descent; and the language of the lower orders is not German, but a dialect of the Sclavonic. Moravia resembles Bohemia in other respects,—in the religion of its inhabitants, who are chiefly Catholics; and in the limited power of its states or parliament, who deliberate on such subjects only as are proposed to them by the executive government. But it surpasses Bohemia, and every part of the Austrian dominions, except the Vienna district, in the extent of its manufactures and the use of machinery. Woollens, linen, and, since the beginning of the present century, cottons, are here made in large quantities, both for home consumption and export. The chief seats of the manufacture of cloths and other woollen goods are Brünn and Iglau. The manufacture of linen fabrics is carried on in Schönberg, Tribau, Sternberg, and Brünn. An article of recent production, and promising much success, is the manufacture of beet-root sugar.

Austrian Silesia has an area of 1900 square miles, with a population of 467,420. It consists of two circles or counties, called, from their respective chief towns, Troppau and Teschen; but, for the administration of justice and other public purposes, Austrian Silesia is considered as united with Moravia. It resembles that country, too, in the activity of its productive industry. The density of its population is owing less to an advanced state of tillage than to extensive manufactures of linen and woollens; the former, as well as the manufacture of thread, obtaining much celebrity. Of no less importance are the iron trade and the manufacture of hardware. The pastures of this country are in general rich, and the export of wool, already considerable, is likely to increase.

THE ALPINE PROVINCES.

Styria. The duchy of Styria, one of the earliest acquisitions of the Austrian family, has an extent of nearly 9000 square miles, with a population of 1,023,153, of whom more than half are of German descent, while the remainder are Wends or Sclavonians. The inhabitants differ in language, but are agreed in religion, being almost all Catholics. Styria bears a resemblance to the adjoining province of Carinthia, both in soil and climate; Upper Styria being very mountainous, while in Lower Styria the ground has less elevation as it recedes from the Alps. Hence a corresponding difference in temperature and products; the mountainous part being covered with forests, and fit only for pasture, while the plains and valleys produce wheat, barley, oats, rye, and, in the warmer situations, maize. The culture of potatoes, though introduced less than a century ago, has now become general, and has been the means of adding largely to the population. The mines are extensive, particularly those of coal and iron; the steel of Styria is as noted in Germany as the Swedish steel in the north of Europe. Salt also is obtained here in great abundance. Styria produces many articles of iron manufacture, among which may be chiefly noticed its excellent scythes and reaping-hooks; and the government founderies at Maria Zell and St Stephen are deserving of particular mention.

Tyrol and Voralberg. Tyrol bears in official papers no higher name than that of county (in German *Graf-schaft*); but it is by far the largest county in Europe, having an extent of above 15,000 square miles, with a population of 866,078. It is traversed in every direction by mountains, many of them of great height; while the low grounds consist, not of plains of any extent, but of a succession of long valleys to the number of more than twenty. In these the climate is comparatively warm, and the soil in many parts fertile, producing corn in considerable quantity, and, in favourable situations, vines. The ploughs and agricultural implements used in this country are extremely rude; but the inhabitants show both ingenuity and industry in cultivating slopes and summits, wherever there is enough of soil to reward their labour. In this mountainous region waterfalls are frequent, and many of them are made available for the movement of mills and other machinery. Mineral ores are found in Tyrol to an extent that justifies the expectation that they may eventually be made to afford considerable employment and income to the inhabitants; but in a country so rugged in its surface, and so deficient in machinery, little progress has as yet been made in working mines. Manufactures are equally backward; the work required for them, whether spinning, knitting, or weaving, being almost all performed by the hand. Southern Tyrol partakes more of the character of the Italian provinces, and has recently made great progress in the manufacture of silk goods, as also of leather. Austria.

The domestic animals in Tyrol are, in general, of a diminutive size. The forests contain wolves, bears, goats, and many other animals in a wild state; hence the number of the Tyrolese *chasseurs* or sportsmen, and their dexterity as sharp-shooters, so frequently evinced in the late wars. The Tyrolese, though of a warlike character, and strongly attached to the house of Austria, dislike the restraints of discipline. They perform, however, militia duty, and are called out for training during several weeks in the year.

The language of the Tyrol is German. Like the other provinces of the Austrian empire, it had its states or parliament, composed of deputies from the clergy and nobility, to whom there have been added, for some time past, deputies from the peasantry. It is needless, however, to observe that the functions of these states have always been much more nominal than real.

Carinthia. Carinthia adjoins Tyrol, and, like it, consists of a succession of mountains separated by narrow valleys. It contains a number of lakes, formed, as in the highlands of Scotland and other mountainous countries, by water collecting in hollows, and finding no outlet, except at a considerable height. Tillage is here on a very limited scale; but the pastures are more extensive, and the forests which cover the sides of the mountains would be very valuable, were it practicable to convey the trees to a navigable river. The mines of this province are extensive, particularly those of iron, lead, and quicksilver. The extent of Carinthia is 4000 square miles; its population 316,224. The chief towns are Clagenfurth and Villach. As in the case of Styria, the manufactures of Carinthia consist chiefly of hardware. The most profitable branch of industry, however, is that of sugar-refining, which flourishes most at Laibach.

Carniola. Carniola, the adjacent province, is more populous than Carinthia; because, though mountainous in the north, it has in the south extensive valleys and fertile plains. Here are also a number of mines of iron, lead, and quicksilver. The agricultural products are not merely wheat, rye, and barley, as in Carinthia, but maize and vines, the sure indication of a warmer sun. Of a population of half a million, only a tenth part are of German descent; the rest are Sclavonians. Carinthia, Carniola, Istria, and part of Friuli, form the present kingdom of Illyria.

Dalmatia. Dalmatia, though dignified with the title of kingdom, is a long, narrow, and, as yet, thinly peopled tract, extending along the east shore of the Adriatic, from Lat. 42° to 45°. It comprises the whole of what was formerly Venetian Dalmatia, along with the smaller territories of Ragusa and Cattaro. Its extent is about 6000 square miles; its population, 418,063. One of the chief occupations of the working population is ship-building. Its agricultural products, maize, vines, olives, and silk, give proof of a climate considerably warmer than in any of the above-mentioned provinces. Here, as in those provinces, the ranges of mountains are extensive; but there are also beautiful and fertile valleys. The iron mines and the marble quarries of Dalmatia are both of great

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extent; but as yet they are little wrought, on account chiefly of the thinness of the population. Such parts of the forests as adjoin navigable rivers, or have ready means of conveyance to the coast, are made available for ship-building; the Austrian government adopting the views of Buonaparte in considering Dalmatia of great importance towards forming a navy. No part of Europe abounds more with good harbours than the mainland of Dalmatia, and the numerous islands along the coast.

Physical Aspect, Soil, and Climate.

Rivers.

Of the rivers in the Austrian territory, by far the most interesting is the Danube. Before entering the imperial dominions, it receives a number of rivers flowing northward from the Alps, of which the principal are the Inn, the Iser, the Iller, and the Leck. It next receives the Ens, and flows eastward with a full stream, varying in breadth from a quarter to half a mile. It is bordered throughout this part of its course by high grounds or ridges of mountains, the distance of which from the water is generally greater on the south than on the north side. It is of sufficient depth to bear barges and large boats throughout the whole Austrian territory, and in Hungary it admits vessels of considerable size. Its navigation, however, is not easy, its banks being in various parts steep and rocky; while in the level countries, in which its waters are more widely spread, its bed is often encumbered with shoals. In the year 1830 a Danubian Steam-Navigation Company was established, which in 1848, possessed already more than thirty steam-vessels, which gave an unusual stimulus to commerce. The Danube, as connecting Austria with Turkey and the East, countries which produce no manufactures of their own, might undoubtedly be the means of greatly increasing the foreign trade of Austria, were it not for its restrictive and prohibitive commercial system.

The other great rivers in the Austrian dominions are the Save, the Drave, and the Muhr, which convey to the Danube the waters from the eastern face of the Alps. The Marsch or Morawa brings to it the tribute of Moravia, while the still larger streams of the Theiss and Maros collect all that flow from the southern side of the Carpathians. All these rivers abound with fish, and are of sufficient depth to be navigable; but flowing through poor and thinly-peopled countries, they have as yet been of little use in a commercial sense. A few years ago the Theiss was in part rendered navigable for steamers, an improvement for which Hungary is mainly indebted to Count Széchenyi.

Lakes and marshes.

Lakes and marshes are both numerous and extensive in the Austrian dominions. In Styria, Tyrol, and other mountainous tracts, they are formed, as in the highlands of Scotland, by water collected in valleys which, from the structure of the ground, are pent up in all directions. In Hungary, Galizia, and other level countries, their origin is different: they are a consequence of neglect of drainage, and of that backward cultivation which prevails in almost all countries until population and agricultural improvement attain a certain height. It was thus that marshes, heaths, and forests covered the surface of England in former ages, and that large tracts are at present lost to every useful purpose along the banks of the Danube, the Theiss, the Drave, the Save, and other rivers in Hungary, which inundate the country, when swelled by heavy rains or the melting of the snow. To drain these low-lying tracts would require skill, capital, and machinery, and, above all, the countenance of the central government at Vienna; all of which, however, have been hitherto wanting in these poor and backward countries.

Mountains.

The other striking physical features of the Austrian territory are successive chains of mountains, viz. the Alps in the S.W., and the Carpathians in the N.E. of the empire, all of great height and extent. In the bleak climate of Norway the higher parts of mountains present little else than continued sterility; but in the central and southern parts of Europe vegetation is seen to rise to a great height. The base of a mountain is often covered with vines and maize; the ascent with green pastures, or with wheat, barley, and similar kinds of corn. The trees in the lower and middle region are often the oak, the elm, or the ash; while, in the approach towards the summit, the yew and the fir are chiefly seen to brave the fury of the tempest. Many parts of Tyrol, Styria, Carinthia, and Carniola, abound with picturesque views, and recal to the traveller the scenery of Switzerland. Styria, in particular, has, like that country, its cascades, its glaciers, its perpetual snows, and its tremendous avalanches.

Austria.

Climate.

German writers are in the habit of dividing the climate of the Austrian empire into three regions or zones, viz. the northern, situate between the 49th and 51st degrees of N. Lat., and comprising nearly the whole of Bohemia, with the high-lying parts of Hungary, Moravia, Galizia, and the Buckowine; the whole extending over a surface of 70,000 square miles. The weather in these countries, though colder in winter and warmer in summer than in England, bears, in its average temperature, a considerable resemblance both to our climate and to that of the north of France. In products also there is a remarkable correspondence; wheat, barley, oats, and rye, forming the great bulk of the yearly crops. The middle region of the Austrian dominions is considerably more extensive; containing the whole of Lower Austria, with the chief part of Upper Austria, Moravia, Hungary, Transylvania, and Galizia. It extends along the entire length of the empire, and has a surface of fully 150,000 square miles. This vast tract lies beween Lat. 46° and 49°. The summer and autumn heats are here much greater than in England; and, in addition to wheat and other products mentioned above, vines and maize are cultivated in favourable situations, as in the middle part of France. Lastly, comes the southern region, extending from Lat. 46° to 42°, and comprising Lombardy, the Venetian States, the coasts of Croatia and Dalmatia, with the southern line of Sclavonia, and the Bannat of Temesvar. In these different countries the winter lasts during two or three months only, and the cold seldom exceeds that of our month of March. Here are raised not only maize and vines, but olives, myrtles, and other southern products, as in the south of France. This temperature extends over a surface of from 30,000 to 40,000 square miles.

We have stated these distinctions of climate according to latitude; but it is proper to add, that in no country does there exist greater difference of temperature in the same latitude, in consequence of the very marked differences in the elevation of the soil; one line presenting a succession of mountains, and another of plains and valleys. Thus, the Alpine Provinces, with the extensive tracts adjoining the Carpathian range, and the lofty barrier between Bohemia and Moravia, partake of all the rigour of the north, though situated to the S. of Lat. 49°; while Galizia and the interior of Bohemia, though to the N. of that line, are considerably warmer, because their surface is in general even, and little elevated above the level of the sea.

The average fall of rain is considerably greater in the mountains than in the plains. In Vienna, and the low-lying tracts generally, 28 inches are a frequent average for the year; but in the mountains it often amounts to 40 inches and upwards.

From its geographical position, the summer heats in Austria are considerably greater than in the same latitude in England, while the cold of winter is often more intense. In this country, and still more in Ireland, the vicinity of the ocean induces a frequency of rain, with a medium degree of heat and cold in the prevailing winds, which by no means exist in Poland, Austria, or any country in the interior of the continent. But the transitions from heat to cold, and *vice versa*, are in many parts of Austria as frequent and as remarkable in degree as in this country.

Products, Manufactures, and Trade.

Mines and minerals. In a country covered in so many parts by mountains, the extent of mineral produce can hardly fail to be large. Iron ore is abundant in many parts of Bohemia, Upper Austria, Styria, and Carinthia; and if the quantities of tin or copper hitherto wrought in these provinces be comparatively small, it is owing to the fact, that most of the mountain districts are as yet imperfectly explored. The mines already wrought in Bohemia afford good tin, and those of Hungary excellent copper. In the latter country, particularly at Schemnitz and Kremnitz, are rich mines of gold and silver, partly the property of government and in part of private individuals. The aggregate value of the mines and minerals belonging to government amounts to 4,457,135 florins, and of those which are private property to more than 13,000,000. In this computation Hungary and Transylvania are not included. The respective quantity of the more important metals and minerals belonging to the government, as obtained in 1847, was as follows:—Copper, 2753 cwt.; lead, 1418 cwt.; zinc, 3360 cwt.; raw iron, 494,089 cwt.; cast iron, 58,043 cwt.; iron vitriol, 12,136 cwt.; cobalt, 300 cwt.; sulphur, 13,238 cwt.

Coal mines. A far more important mineral than silver ore, namely coal, has been found in many parts of the Austrian dominions,—in Bohemia, Moravia, Austria Proper, Hungary, and Styria; but the quantity raised is large only in situations contiguous to a navigable river. One of the main sources of the superiority of England to other countries, has been the ease of conveying coal in former ages by sea, and latterly also by canals and railways, to situations where fuel is of importance for manufactures. But in a country like Austria, which has no coast, where canals are almost unknown, and railways have been heard of only of late, the opportunities of such conveyance are as yet very rare. This, joined to the abundance of wood fuel, has prevented the working of many coal mines; but they bid fair to be a source of general employment to the lower classes, and of advantage to those who manage them, when manufactures shall be conducted on a larger scale, and the communications assimilated to those of England or the Netherlands. The whole amount of coal belonging to government was, according to the official computation of 1847, 158,219 cwt., and that belonging to private individuals exceeded 14,000,000. It may be stated that in Hungary the produce of the government coal pits is nearly fourfold that of all the rest of the empire as above given.

Salt mines. Similar observations apply to the raising and distributing of rock salt, mines of which are found in various parts of the empire. Those of Bochnia and Wieliecka in Galizia are known to be the greatest in Europe. A number of others are found along each side of the great Carpathian range, and may be said to extend with greater or less intervals all the way from Moldavia to Suabia. This very extensive tract comprehends the salt mines of Wallachia, Transylvania, Galizia, Upper Hungary, Upper Austria, Styria, Salzburg, and finally of Tyrol. They are found either at the base or on the ascent of great mountains, the salt extending in horizontal or undulating strata, and alternating with strata of clay. The total produce of salt was in 1847 as follows:—Rock salt, 3,060,850 cwt.; boiled salt, 2,050,362 cwt.; sea salt, 522,726 cwt.; total, 5,633,938 cwt.

Agriculture. Austrian agriculture has made, so to speak, no progress whatever during the last thirty years, and continues in a very backward state in all parts of the empire, with the exception of the Italian provinces and the archduchy of Austria itself. The reasons of this backwardness are very obvious. While France, likewise an agricultural country, issued from the great Napoleonic war with a free population, feudality continued in Austria down to the year 1848; a circumstance in itself sufficient to cripple the agricultural produce of the country, and still further enhanced by the protective policy of the government towards manufactures; a policy which, while it tended on the one hand to turn all the capital of the country into the channel of the manufacturing interest, compelled the agriculturist, on the other hand, to purchase home-made implements that might have been procured abroad at a cheaper rate and of a better quality. To these two causes may be added the existence of a large standing army, and the long period of military service customary in Austria, which bereft the rural population of the stoutest of its labourers. Farther, the absence of personal liberty and the right of free discussion, elements the most important towards the increase of national wealth, have also unavoidably contributed to the same result. In addition, it may be stated that the Austrian population have hitherto remained in complete ignorance of the modern scientific and practical improvements in agriculture, adopted by the other nations of Europe. Nowhere, however, is there a fairer field for improved husbandry, for no part of Europe presents a greater extent of good soil. Lower Austria has, like Lombardy, the advantage of extensive plains watered by streams flowing from a range of mountains which form the background of the prospect contemplated by those who travel along the banks of the Danube. Moravia has a similar climate, and almost equal advantages of soil and position. Galizia is likewise fertile, the most so perhaps of any of the Polish provinces; while in the S. and E. of the empire, many of the plains of Hungary and Transylvania might be rendered productive were the population more dense, and acquainted with the method of draining, irrigating, and properly tilling the ground. The land of second-rate fertility is in the Alpine provinces. The slopes of the mountains, up to a certain height, are favourable to pasture, and the raising of oats and other like grain; but in many parts the height is so great as to outweigh the advantage of latitude, and to confine the inhabitants to a scanty return for their labour.

Comparative culture of Great Britain, France, and Austria, exhibited in proportions of 100.

	Great Britain and Ireland.	France.	The Austrian Empire.
Land under tillage	34	44	34
Vines, orchards, gardens	1	5	3
Land in grass, whether natural or sown	40	14	17
Forests, plantations, copses	5	17	26
Poor land, as heath, marshes, commons; also land totally unproductive, as rocks, summits of mountains, lakes, beds of rivers, roads	20	20	20
	100	100	100
Comparative population. Inhabitants per square mile	220	165	130

This table suggests several conclusions of importance. First, the proportion of land altogether uncultivated is nearly equal in the three countries; the mountains of Scotland, the bogs of Ireland, and the commons of England, containing a surface corresponding to that of the high mountains in the Alpine provinces of Austria, and the marshes and sandy levels of Hungary. But the proportion of land covered with forests, and thus lost to useful cultivation, is far greater in France, and still more in the Austrian empire, than in this country. The inducement to convert such land into pasture is far greater in Britain and Ireland, in consequence of our numerous population, and the high price of butcher-meat, wool, and hides. To this is to be added a very different consideration, viz., that the facility with which all our large towns are supplied with coal makes it quite unnecessary to keep up forests, as on the continent, for the purpose of fuel; and

above all, the high value of arable land in England, owing chiefly to the density of the population.

Land under tillage.

Next, as to the land under tillage, the great proportion of such in France is owing to the lower orders living almost wholly on bread and vegetables, to the exclusion of animal food. In Austria the proportion of land in tillage is equal to that in Great Britain; but there is the greatest difference in the nature of the cultivation, the produce in even the best districts of Lower Austria being thirty per cent. less than would be obtained from similar soils in this country. In the nature of the produce there is a considerable resemblance; the bulk of it in either country consisting of wheat, barley, oats, rye, pease, beans, potatoes, along with flax and hemp. Of rye, the proportion raised is larger in Austria; that of potatoes much smaller. Maize is raised in the southern provinces of Austria, as of France, and is said to yield much more nourishment for either men or horses than could be obtained from wheat on a similar soil.

The total cultivated soil of Austria amounts, in round numbers, to 54,000,000 *hectares*, that of France to 38,000,000; while that of Britain is not above 25,000,000; while the estimate of the comparative *value* of the agricultural *produce* of the three countries gives the following remarkable result:—

Approximate value, in francs, of agricultural produce (not including live stock), in Britain, France, and Austria.....	Britain.	France.	Austria.
	6,900,000,000	4,000,000,000	3,000,000,000

Vines.

The northern parts of the empire, viz. Bohemia, Galizia, and part of Moravia, are too cold for vines; but in the central part of the empire they are cultivated extensively, and wine is sold in large quantities for home consumption. The prices of the different qualities vary from sixpence to one shilling a bottle. The port is far inferior to that obtained from France, in consequence chiefly of the want of conveyance. Lower Austria and Hungary, the fittest countries for the vine, have navigable rivers only to the eastward, and these lead to countries which either raise wine for their own use, or are too poor to make purchases from their neighbours. The exports from the Austrian states are thus limited to small quantities of choice wines, such as the well-known Tokay, which is raised on the last chain of the Carpathians, near the district of Zemplin. This wine is cultivated along a tract of about 70 square miles: its qualities are various; the richest kind proceeding from the grape with little or no pressure; while the inferior sort is said to be made from the dried grape, reduced into a sort of pap, and mixed with other Hungarian wines. But it by no means follows that all the wine sold under the fashionable name of Tokay is the product of the district in question; for even in Vienna there is not perhaps a tenth of real Tokay among the wines which bear that name.

The total produce of wine is estimated at more than 27,000,000 *hecatolitres*, of which 22,000,000 are supplied by Hungary alone. This evinces certainly a degree of abundance in that article, though it is much inferior to the quantity raised in France, which is computed as above 40,000,000 *hecatolitres*.

Manufactures.

Manufactures have in the last and present age received considerable extension in the Austrian dominions. They are still, however, on a footing very different from those of our country. In England they are generally conducted on the plan of particular towns or districts restricting themselves to specific branches; as Manchester to cottons and Birmingham to hardware. Hence our minute division of employment, our nicety in workmanship, and the surprising quantities produced. But in Austria the case is different: woollens, linen, hardware, and of late years cottons, are made in almost every place of considerable population; a sure proof that their establishments are on a small scale, and that they avail themselves very imperfectly of local advantages or of the division of labour. In many parts, indeed, weaving and other sedentary work is performed in cottages, as was the case in England a century ago. Spinning wool and flax has from time immemorial been the habitual employment of the lower class of females in Germany; and still continues to be so, notwithstanding the competition of machinery. Silk is most largely manufactured in Vienna and the Italian provinces. Linens are woven in every province of the empire; but the finest qualities are made in Lower Austria, Moravia, and certain parts of Bohemia. These countries supply little for export beyond the limits of the empire, but a great deal to the adjacent provinces. Woollens also are a very general manufacture throughout the empire. As to hardware, the mines in the mountainous districts supply an ample store of materials, the manufacture of which takes place partly on the spot, partly in the larger towns, such as Vienna, Prague, and Karlsbad. Bohemia is celebrated for the number of its glass works, a consequence of fuel being cheap in several districts which have the advantage of water conveyance. Hungary, Transylvania, and the Buckowine, having extensive pastures, as well as forests containing vast herds of cattle in a wild state, hides are an article of export from the same cause as in the thinly-peopled provinces of Russia or the wilds of Buenos Ayres. The most important articles of export, however, are corn, wool, wine, and cattle. Paper also is made to a considerable extent in the Austrian states, in consequence of the cheapness of linen rags.

All these are manufactures of old date; but cottons are comparatively of recent introduction, and are confined to Vienna and some of the principal towns; as is also the refining of sugar, which has lately received a great impulse. The cheapness of labour is in favour of such undertakings in Austria. One of the chief obstacles, up to a recent date, was the distance which the raw material, whether landed at Trieste or Hamburg, had to be conveyed by land, a disadvantage now partly overcome by the establishment of several lines of railway.

Comparing these different manufactures with those of an improved country like England, we find the foreign articles generally higher in price and more homely in appearance, but at the same time more durable than ours. This distinction is found to hold in regard to fabrics the most different in their nature; the muskets made in Germany and France being heavier, exactly as their woollens, cottons, and linens, are thicker than ours. Lightness of workmanship and despatch in completing an article are the result of long practice: the comparatively limited experience of foreigners, and their imperfect subdivision of work, require both longer time and a larger consumption of raw material.

Foreign trade.

In her intercourse with foreign countries, Austria experiences all the disadvantages of an inland position, and of a very limited access to the sea; the portion of coast belonging to her being in a corner of the empire. Its extent is about 500 miles, comprising the north and east shores of the Adriatic, from the mouths of the Po on the west, to Ragusa and Cattaro on the east. The commercial seaports are Venice, Trieste, and Fiume; the first being the inlet to Friuli and Lombardy, the second to Carniola, and the third to Croatia. From Venice the access to the interior is easy, the country being flat, and admitting of intersection by canals; but Fiume, and still more Trieste, have to the east ranges of mountains, over which the transport of bulky commodities is attended with great labour and expense. It must be remembered, moreover, that the Austrian tariff was the highest in Europe up to the year 1848, and that many articles of manufacture, such as rock-salt, rouge, gold-dust, and tobacco, were entirely prohibited, while the import duty

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on other articles of commerce almost effectually prevented their admission. Hence it followed, that the price of many of the most common articles of clothing (as stated in the *British and Foreign Review*, vol. xi.), was higher from 75 to 100 per cent. than in London. This narrow commercial legislation, coupled with the inland toll, subsisting till 1849, between Hungary and the rest of the empire, could not but materially impede the free development of the commercial resources of the country. In no other department however has so great a progress been perceptible within the last 20 years as in commerce; for we find that in the decade between 1830 and 1840, the value of foreign commerce rose from 170 to 290 millions of florins; while in the year preceding the late war, it increased to upwards of 240 millions. This advance must undoubtedly be attributed in a large measure to the construction of different lines of railway; of which the chief are, the *Northern* or *Ferdinand's Line*, touching the Prussian frontier at Oderberg, and bringing Berlin within slightly more than a thirty hours' journey from the Austrian capital, the *Cracow-Silesian Line*, and the *South-Eastern Line*, running into Hungary. The most important line, however, by which it is contemplated to unite Vienna on the one hand with Galizia, and on the other with Trieste, and thereby with the Italian provinces, is as yet far from completion. In regard to foreign commerce, the seaport of Trieste occupies the foremost place, and owes its flourishing condition to the existence of the Lloyd Company, established in 1833, and three years after taken under government patronage. The steam vessels of this company are nearly forty in number; and, by means of their connection with the German railways, have already rivalled the London Oriental Company by opening up a communication with the East through Trieste. The value of the commerce of Trieste with foreign countries is, according to the latest statistics, 86 millions; that of Venice, 11 millions; and that of Fiume, 4 millions of florins.

In the year 1851, considerable alterations were effected in the Austrian tariff, the object of the government being to form a union with the German *Zollverein;* though it will be seen by a few examples that the duty on many articles of manufacture still amounts to a virtual prohibition. The import duty per cwt. on the following articles stand thus:—

	Florins.		Florins.
Raw coffee	10	Raw tobacco	10
Fine spices	25	Raw and spun silk	15
Tea	15	Cotton goods (according to quality), from	12 to 250
Refined sugar	14		

Woollen and silk manufactures are taxed in the same ratio as the foregoing.

The aggregate value of Austrian manufactures is, according to the last official return, estimated at 795 millions of florins. In this computation the following are the more important branches, and their respective value is thus stated:—

	Florins.
Stone and earthen ware	25,000,000
Glass and mirror manufacture	15,000,000
Hardware	49,000,000
Cotton	43,000,000
Flax and hemp	57,000,000
Silks	57,000,000
Woollens and cloth	63,000,000
Beer and spirits	44,000,000
Sugar	14,000,000

The harbours along the coast of Dalmatia are both numerous and commodious, but their trade must be inconsiderable until the country inland acquire population and wealth. In the northern part of the Austrian empire there are also great obstacles to foreign trade. Bohemia communicates with the sea only by the Elbe, and Galizia with still more difficulty by the Vistula; but these impediments are now almost removed by the establishment of railway communication in both these provinces.

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National Income and Finances.

In commercial countries, the public revenue arises principally from the excise and customs; but in a country chiefly agricultural, the case is very different. In Austria the limited extent of foreign trade renders the customs comparatively small; while the small number of towns, and their scanty population, lessen greatly the produce of the excise. An extra share of the public burdens must therefore fall on land, the assessment of which ought from time to time to be altered according to the amount of rents. In England, since the first imposition of the land-tax in 1692, there has been no renewed survey, or attempt to adapt it to the augmented rental; but in France and Austria the absolute insufficiency of other taxes rendered an increase of the land-tax indispensable. In Austria, the Emperor Joseph, among other changes, proposed a land and poll tax on a uniform plan, and attempted a general survey of the empire. Several years were devoted to this great work; but it encountered many obstacles, as well from the difference of value between the plain and mountain territory, as from the difficulty of computing rents in almost any province of the empire, the property of the peasantry obliging them to pay their landlords in produce or in labour instead of money. Since 1815 the Austrian government has endeavoured to correct defects in the existing assessment, but it is still in a very imperfect state. In 1819 a new regulation of the land-tax was established, which underwent material changes after the war of 1848. In the Hereditary States, as well as in Bohemia and Galizia, the land-tax was levied without distinction of class or rank; but in the aristocratic countries of Hungary and Transylvania the *noblesse* or gentry were exempt from it till 1848.

Public Revenue of Austria.

From the year 1831 to 1841 the average revenue of Austria was 133 millions of florins, which from 1841 down to the time of the last war amounted to an average of 170 millions. This increase, perceptible in the second decade, may be attributed chiefly to the introduction of the stamp-duty and other financial measures by Baron Kübeck; and it may be remarked that the increase of the indirect taxes by far exceeded that of the direct. From this revenue, which nearly covered the state-expenses, the military establishment alone absorbed in the year 1832, in consequence of the French revolution of 1830, as well as in the year 1846, during the troubles in Poland, more than 60 millions, and was never under 55 millions.

The public debt, which, as already observed, amounted, at the end of the war with Napoleon, to 500 millions of florins, was augmented to 800 millions, up till the date of the war of 1848. The interest alone of this debt amounted to 33 millions of florins. From this general view, the reader will understand the resources of Austria at the eve of a war which, while for two years it materially diminished her income, caused on the other hand a great addition to the public debt by reason of the vastly increased expenditure it occasioned. With the end of the war, the system of taxation and the rules in respect to states-revenue and expenditure in general, underwent fundamental alterations.

The injurious effect of the war upon the finances may be gathered from the following statement:—

	Income.	Expenditure.	Deficit in round numbers.
1848	121,819,625 flns.	186,679,486 flns.	65,000,000 flns.
1849	149,617,132 flns.	289,468,048 flns.	140,000,000 flns.

The year 1850 showed a considerable increase of income, which, including the direct and indirect taxes, rose to 195,000,000 florins, while the expenditure amounted to 250,000,000.

The income and expenditure of 1851 were as follow:—

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1. Direct Taxes.		2. Indirect Taxes.	
Land tax	58,684,661	Tax on consumable articles	25,055,640
House tax	7,371,944	Customs	19,918,315
Inheritance tax	130,063	Salt monopoly	28,677,167
Income tax on trades	3,925,860	Tobacco monopoly	13,532,458
Property tax	3,704,957	Stamps, and taxes on processes	15,758,968
Direct taxes of Cracow	156,771	Lottery	3,663,907
Other direct taxes	104,574	Post	132,829
		Turnpike tolls	2,291,271
		Other taxes	388,619
Total	74,078,830	Total	109,419,174

3. Income from State property..... 7,166,169

Total income, in round numbers, including the indemnification paid by Sardinia, 223,000,000 florins.

The total expenditure of this year amounted, in round numbers, to 278,000,000 florins. Deficit for 1851, 55,000,000 florins.

It may be observed that the year 1852, the financial statement for which has not yet been made public, promises a continued increase in the revenue; though the state of the provinces, as well as the general aspect of Europe, do not entitle us to calculate upon a reduction in the chief item of expenditure, viz. the army, which, in 1851, of itself absorbed more than 111,000,000 florins. The public debt amounted, in 1852, according to the estimate formed by the judicious and accurate Otto Hubner, in his *Jahrbuch fur Volkswirthschaftund Statistik*, to 1200 millions of florins, or at the rate of 32 florins per head.

It is thus seen that the revenue of Austria is surprisingly small if compared with England and France. This however is explained by the mere consideration of the manner in which human labour is employed. In manufacturing and commercial countries, such as England, agriculture is conducted with the benefit of capital and machinery; and the labour of 30 or 40 persons in 100 is sufficient to raise subsistence for the community at large. But in other countries of Europe the case is very different, the labour of half or of more than half the inhabitants being required to raise the needful subsistence. Thus in France, a great part of which is more backward than an untravelled Englishman can readily conceive, between 50 and 60 persons in 100 are and must be employed in country work, in consequence of the great inferiority of their agriculture, their farms being small, their ploughs and other implements miserably defective, their capital scanty, and machinery, such as threshing-mills, in a manner unknown. Hungary, Transylvania, and the southern frontier along the Danube, being still more backward than any part of France, more destitute of capital, and more deficient in machinery, the consequence is, that of the average population of the Austrian empire, the labour of not fewer than between 60 and 70 persons in 100 is needed for raising provisions; thus reducing to a comparatively small number the population of the towns, the persons disposable for trade and manufacture. This is at once apparent from a comparison of the town population in these different countries, which, as is evident, is by far the least in Austria. The largest towns in the latter besides Vienna, are Milan, Venice, Prague, and Pesth, each with a population above 100,000, which, taken together, does not much exceed the population of Paris alone, not to mention the immense population of London and other large towns in Britain.

Another very important point in estimating the resources of different countries is the degree of density in the population generally. In England, by the census of the year 1851, it was 4835 persons to a *German* square mile; in France, 3678; while in Austria it was only 3150, though its territory by far surpasses that of France. As to the comparative density of the town and agricultural populations, no satisfactory result has hitherto been obtained by the statistical writers; the prevailing opinion, however, is, that the population of the towns is in the proportion of 1 to 7 in comparison with the remainder. It is necessary, however, to bear in mind that the population of those towns which number less than 2000 inhabitants is generally classed among the agricultural. Now, it almost always happens that in a thickly-peopled district the wages are better and the consumption of taxed articles greater, per head, than in one that is thinly peopled; and hence the contribution to the public treasury is larger. Thus the inhabitants of Lombardy, Bohemia, and the Vienna district, pay considerably more per head than those of Hungary, Carinthia, or Upper Austria. Add to this, in the third place, that while England has all the benefit of an insular situation and liberal institutions, and France possesses an extensive line of coast, with considerable trade, the maritime provinces of Austria are both limited in extent, and but recently acquired; in short, the empire may be said to have as yet wanted almost entirely the stimulus to industry arising from communication by water, from a universally established steam-communication, and, above all, from a liberal commercial legislation.

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Military Establishment.

Austria has taken so prominent a part in the wars of the last and of the present age, that the nature and extent of her military means are subjects of great interest. The disposition of the inhabitants of Hungary, and of the more remote provinces of the empire, is well adapted to a military life. They are accustomed to pass their time out of doors, to indulge in active exercise, to follow the chase, and to occupy themselves with the care of horses. To such men marching and encamping are but a slight deviation from their established habits. The fire of the nightly watch is not more uncomfortable than that of their smoky cottages; whilst a loaf of bread, a slice of coarse pork, and a glass of spirits, are all the food and drink they desire. It is now more than a century since the Prussians began to take a lead in military discipline, the father of Frederick II. having carried both the manual and platoon exercise to a nicety unattempted by almost any other tactician. He left a highly disciplined army of nearly 80,000 men to his son, who, on the death of the Emperor Charles VI. in 1740, conceived that such a force would soon enable him to accomplish the conquest of Silesia. He lost no time in making preparations for war. The court of Vienna, alarmed, sent a special envoy to dissuade him from it; but Frederick was not to be deterred by any remonstrances, however urgent. The envoy adverting, on the one hand, to the careful training of the Prussians, and on the other to the recent practice of the Austrians in the field, declared to the king, "*Vos troupes, Sire, sont belles, mais les nôtres ont vu le loup.*" "*Vous convenez,*" replied the king, "*que mes troupes sont belles, je vous ferai convenir qu'elles sont bonnes.*" The words of the king were made good; the events of the war which ensued, as well as of the more arduous contest begun in 1756, having proved, on many trying occasions, the great advantage of a high state of discipline. This led the Austrian generals and war ministers to follow the example of the Prussians, as well by carefully training their infantry, as by new-modelling the "free corps" of horsemen, Croats, Sclavonians, and Hungarians, who had hitherto been left to their national mode of fighting. By dint of perseverance, Marshal Lascy and other military men in Austria succeeded at last in bringing these half-civilized combatants under the discipline of regular cavalry.

The French, in the wars of the revolution, were remarkable for celerity of movement in collective bodies, but bestowed comparatively little attention on the *minutiæ* of discipline. The Austrians were charged with following a con-

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trary system; with too much care as to details, and too little as to general movements. Their lines are said to have suffered on various occasions, in particular in the dreadful conflicts at Essling and Wagram, from continued exposure to the field-pieces of the enemy; and their infantry was said to be slow in executing most movements except those from front to rear.

In former times the Austrian government, conscious of the deficient education of its subjects, gave important commands to Italian officers, amongst whom the most remarkable were Montecuculi and Prince Eugene. At present there are military schools at Vienna and several of the provincial towns. Up to the year 1848 the Austrian army, though by far inferior in general instruction to those of Prussia and France, was, in a strictly military point of view, and in discipline, held equal to any in Europe. Its prestige was, however, entirely lost during the war of 1848, when a large part of the army, and especially the Hungarians, deserted from the imperial standard to rally round their national colours; a circumstance which led to the complete military demoralization of the whole army. At the conclusion of the war, many of the revolutionary troops were forcibly enrolled into the imperial ranks, a policy which can only serve to infect the whole military force with new ideas, and an anti-dynastic spirit.

The whole army, including the *landwehr*, is computed at 500,000 men, and consists of 63 infantry regiments of the line, 20 grenadier battalions, 14 frontier regiments, and 24 rifle battalions; the cavalry consists of eight regiments of cuirassiers, 7 of dragoons, 12 of hussars, and 11 of lancers, besides the different corps of artillery, and the sappers and miners.[1]

In most of the provinces of the Austrian empire the levies were at first made for militia service (*landwehr*), and the regular regiments were kept up by successive draughts from that force; while in Hungary the diet voted the respective contingents. Since the end of the last war, however, one uniform system of arbitrary recruiting has prevailed throughout the whole empire.

The horses for the Austrian light cavalry are drawn from Hungary and Galizia; those for the heavy cavalry chiefly from Bohemia and Moravia. Clothing, arms, ammunition, and harness, are all furnished at different stations, in Bohemia, Moravia, and the Hereditary States. The duration of military service in Austria was long unlimited; but in the early part of the present century it was reduced, as in this country, to specific periods. For invalids and veteran soldiers there is a provision similar to what is made for our military; they are either received into hospitals or allowed small out-pensions. For further details connected with the Austrian military establishment, see ARMY.

Magnitude of the resources of Austria.

The limited revenue of Austria, and her equally limited credit in a financial sense, prevent her from making a great military exertion at short notice. She cannot, unless when aided by foreign subsidies, equip for offensive operations, or send to a distance, armies of any very considerable force. Hence her power in attack is restricted so as to form a remarkable contrast to the extent of her means for continuing a contest by filling up the blanks in her regiments, year after year, by fresh levies. In her long and arduous struggle with France, the losses of each campaign appeared to be supplied without making a serious impression on her numbers, or distressing her productive industry. The causes of this are obvious. A country like England, possessing monied capital, can at short notice embody an army, and send it to a distance, amply equipped and provided; whilst an agricultural nation like Austria is limited in its extent of exertion at the moment, but, from the amount of its population, almost indefinite in its resources. The long duration of several of her wars is to be ascribed to two causes; her inability, on the one hand, to overpower her opponents by a great effort; and her power on the other, to keep up a certain degree of exertion for a long period. It was thus that Austria carried on the religious war in Germany during thirty years, and persisted in the war with France in 1713, after England and Holland had withdrawn. Maria Theresa would have done the same towards Prussia in 1763, had she not been forsaken by her allies; whilst, in the wars with revolutionary France and Buonaparte, we have seen Austria, worsted in five successive contests, return as often to the charge. At present, however, the whole condition of Austria, in regard to her resources, has been altered in consequence of the late internal revolutions, and the unceasingly disaffected condition of the various nationalities, many of which only await the embroilment of Austria in a foreign war in order to free themselves for ever from her dominancy.

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Ships of war.

The Austrian navy is as yet merely in an incipient state, and is only entitled to notice because the possession of Venice, Trieste, and the fine harbours along the coast of Dalmatia, gives great facility for the creation of a maritime power. At present it consists of 4 frigates, 6 corvettes, 11 brigs, and 6 schooners; in all 27 sailing vessels; besides 10 steamers, the largest of which does not exceed 300-horse power.

Religion, Education, National Character.

Religion.

The population of the Austrian empire, classed according to their respective creeds, will stand thus:—

Catholics	26,357,172	Calvinists	2,161,765
Greek Church	3,694,896	Unitarians	50,541
Non-united Greeks	3,118,605	Jews	729,005
Lutherans	1,286,799	Other religions	2,350

Austria, as is known, was the hereditary foe of Protestantism in the seventeenth century, cruelly persecuting the population of Bohemia, the country of the unfortunate John Huss and Jerome of Prague. In Hungary the struggle of the Protestants against the Hapsburgs continued into the eighteenth century; nor have they ever been permitted the enjoyment of the liberties so often stipulated to them. In more recent times no actual persecutions have taken place, but the Catholic faith has always remained the predominant and privileged religion of the empire. The north and west of Germany frequently exhibit Catholic and Protestant communities in the same vicinity; and nowhere are the superior industry and intelligence of the latter more strongly marked. The traveller who passes from Saxony into Bohemia cannot fail to regret that the Reformation should not have made its way into the Austrian dominions; the result would doubtless have been a very decided advancement in science and productive industry. Literature, manufactures, trade, would then have been cultivated in the south and east of Germany with the same zeal, and probably with the same success, as have marked their progress in the south and west.

In Austria, as in France, the Catholic clergy are generally educated in humbler seminaries than universities. Oratory forms no part of their studies, and would, in fact, be misplaced before a German congregation, which meets for the purpose of fulfilling, soberly and tranquilly, a religious duty. Sermons, therefore, are, in almost all parts of the Austrian dominions, little more than plain moral lessons, deduced from the sacred writings; and the reputation of a clergyman, particularly in country parts, rests chiefly on his attention to the sick, and the performance of private and unostentatious duties. The sovereigns of Austria have in general resisted the pretensions of the popes; reserving to themselves several important rights, such as the imposing of taxes on church property, the nomination of bishops and

[1] The variation between some of the numbers in this estimate and in the article ARMY, will be understood by reference to the fact that the strength of the Austrian military establishment fluctuates with the chances of peace or war.

Austria. archbishops, and the option of restricting or even preventing the circulation of papal bulls. After the late war, however, the Austrian emperor surrendered his right in spiritual affairs to the pope.

The extent of landed property in Austria belonging to the Catholic Church is very considerable, as may be inferred from the number of abbeys and convents. Though a good deal reduced within the last half-century, there are still nearly 300 abbeys and above 500 convents in the empire. The head of the Austrian church is the archbishop of Vienna; but the bishop of St Polten appoints the regimental chaplains, and is the superior of all clergymen doing duty with the army.

National education. A deficiency in national education has long been a subject of reproach to the Austrians; and their apathy in regard to literature and politics may undoubtedly be ascribed to the strict censorship, tending to stifle all liberal and useful inquiry. Always surrounded by the police and by secret spies, the Austrians, and especially the Viennese, have at last naturally become totally disused to anything like serious conversation in public, and appear seemingly satisfied to make up for this deficiency in the enjoyment of the other pleasures offered by life. The desire of acquiring property is of course as strong, or nearly as strong, in this as in other countries; but the inhabitants have still to acquire that intellectual activity which stimulates so largely to exertion in England and France, and, above all, in the Protestant part of Germany; a consummation, however, not to be brought about under absolute rule. Saxony is the centre of literature for that country; and the society which is within the reach of a youth at the university of Vienna is not to be compared to that of Dresden or Leipsic. The Austrian dialect of Germany is unpleasant, having a slowness of accent and a hissing tone, particularly in the mouths of the lower orders. Hence French is the language used, not only at court, and by diplomatists, but by genteel society generally. The universities in the Austrian empire are as follow:—Vienna, Prague in Bohemia, Pesth in Hungary, Lemberg in Galizia, Innspruck in Tyrol, Grätz in Styria, Olmütz in Moravia, and Padua and Pavia in Lombardy; in all, 9 universities, attended by more than 12,000 students. There are besides 43 academies, 33 lyceums or high schools, and 266 gymnasia or Latin schools. Of military schools there are in all 10 in the empire; the two principal in Vienna, the others in provincial towns. The primary or elementary schools throughout the empire correspond in some measure to the parish schools in Scotland. They were greatly increased half a century ago in the reign of Joseph II., and in the Austrian provinces they appear to be adequate to the wants of the population; but in Hungary and the remote parts of the empire there are still great deficiencies in the provision even for this, the first stage of education. The university of Vienna dates from the middle of the thirteenth century, the time when the residence of the court, being fixed in that city, began to give importance to it, and to call for improvements in public education. It was long under the management of the clergy, who, in the middle ages, were the only men of letters; but a century ago Van Swieten, the celebrated physician, induced the government to take it into their own hands, and to give a great extension to the medical department; Vienna, from the number of its inhabitants and the extent of its hospitals, being much fitter for a medical school than any other city in Germany. The consequences of Van Swieten's representations were the fitting-up of a botanical garden, an anatomical theatre, a military hospital, and, at a subsequent date, a veterinary school. The university of Vienna is now at the head of the medical schools in Germany. It contains also public classes for law, theology, classics, philosophy, and general literature, in most of which the reputation of the professors is respectable, though not greater than in other universities, such as Göttingen, Leipsic, and Halle. The number of students at the Vienna university in 1848 was 3215. Vienna contains also an academy for the fine arts, a seminary for the Eastern languages, and facilities for the study of modern Greek. Among the military institutions are a school for cadets, and of late years a polytechnic school for engineers. This capital has also several normal seminaries for training teachers for provincial towns and villages. The imperial library at Vienna is very extensive, as is the collection of medals and coins. The university of Prague is of old date, and well attended by Bohemians, but it does not rank high in the scale of German seminaries. Pesth, Lemberg, Grätz, and the other universities, are of importance only to the population of their respective towns, and their vicinity. Austria.

In travelling for instruction, the Austrians, like the French, are far behind our countrymen, in consequence partly of the want of pecuniary means, partly of their unambitious and uninquiring character. Individuals, however, may be cited among the Austrians, who, like Baron Humboldt among the Prussians, have traversed remote regions in quest of information; but their number is small when compared with the extent and population of the empire. Still Austria can boast of several names of eminence in literature, though the greater part of its distinguished writers, and in particular the poets, have always thought it safer to exchange Vienna for some town of Germany. The most eminent poets of whom the Austrian capital can boast are, Anastasius Greun, and the well-known humourist M. G. Saphir. Hammer, the founder of the Oriental Society at Vienna, has long been known for his acquaintance with Persian literature; while there are many able writers on natural philosophy and geography, connected with the various *Academies of Science* in the empire.

In painting and sculpture, as in architecture, the Austrians have as yet made no great figure; but the case is very different in regard to music. Haydn and Mozart were both formed at Vienna; and it has been said with truth, that a foreigner can hardly receive a higher gratification than by being present at the oratorio at Vienna in commemoration of Haydn. If in vocal music the Germans are inferior to the Italians, they fully maintain the competition in instrumental performance. In short, the passion for music exists here in the humblest ranks, and under circumstances apparently the least favourable to it. This is equally the case in the populous districts adjoining the Danube, and in the secluded spots of Tyrol and Carniola.

National character Statistical writers class the population of the Austrian empire according to national descent, thus,—

Of Sclavonian origin, including the Poles, Croats, and Serbs	15,282,248
Of German	7,917,195
Of Magyar	5,418,773
Of Italian	5,042,225
Of Wallachian	2,640,492

Besides Jews, Armenians, and Gypsies, forming a comparatively small number.

The Sclavonians (called in Latin *Slavi* or *Sclavi*, and in their own language *Slowacs*) inhabited, in remote ages, a part of the vast tract of country known to the ancients by the name of Scythia. Their descendants are widely spread; for their language and habits are to be traced in the Illyrian provinces, in Hungary, Poland, the east of Germany, and even in the western frontier of Russia. Upon the whole, they form the most uncivilized portion of the population of the empire—a circumstance to be partly accounted for by the comparatively small number of their nobility, these having been in the course of time absorbed into the German or Magyar populations. The Wallachians are almost equally backward; but the Magyars are a spirited race, averse to sedentary work, accustomed to exercise in the open air, and

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prompt in obeying a summons to military duty, and, above all, ever ready to join their nobles in the defence of the country.

In Styria, Carinthia, and other mountainous tracts, the manners of the inhabitants are very primitive. Content with the produce furnished by their lands and cattle, and as cheerful and frank as moderate desires can make them, they seem to have no wish beyond the limits of their native districts. They are, it must be allowed, very ignorant and superstitious; being still blindly attached to traditionary usages, and among others, to that of making pilgrimages to a distance as the best means of obtaining forgiveness for trespasses.

The character of the Germans in the Austrian dominions is in general praiseworthy. Sincerity, industry, and habits of order, are all conspicuous in them; and the number of criminal offences committed among them is remarkably small. In many extensive districts, year after year passes without a necessity for capital punishment. The French soldiers, who, in marching through Austria, were very often lodged in detached cottages, and at the mercy of the inhabitants, bore a favourable testimony to their humanity; and there scarcely occurred, either there or elsewhere in Germany, any example of those secret assassinations which were unfortunately so prevalent in Spain.

The habits of the females in Austria, in the large as in the small towns, are very domestic. Without taking so active a part as French women in either business or conversation, they claim regard for a steady fulfilment of the duties of wives and mothers. The lower orders have similar habits; and a traveller may visit village after village without hearing of a single instance of domestic disquietude. The care of children, the performance of their daily tasks, and punctual attendance on divine worship, seem to occupy all their thoughts.

A striking feature in the national character of the Austrians is a continued equanimity, a general good humour and forbearance, as if they had little or no cause for complaint in regard either to individual circumstances or public affairs—a circumstance which rendered the more remarkable the impetuous movement of 1848. This general equanimity and aversion to change produces as its natural consequence a blind adherence to old usages, and a disinclination to almost every kind of innovation. Hence their stationary condition, their backward agriculture, their slowly improving manufactures, and their extravagant deference to hereditary rank—a deference often dearly paid for in war, when men of inferior talents have been intrusted with important commands. On the whole, it must be admitted, that no country in Europe stands more in need than Austria of the benefits arising from the diffusion of knowledge—a remark which applies to the upper as well as to the lower classes.

We should, however, err greatly were we to suppose the apparent slowness of the Austrians indicative of deficiency of invention. On the contrary, their tranquil and sedate habits are more favourable to original combinations than the sprightliness of the French. But in Austria, as in other parts of Germany, mechanical ingenuity is often applied rather to make a display of skill, or to gratify a fancy, than to accomplish a useful purpose. In one part of a journey through that country a traveller finds a machine so framed that, with a slight impulse, it performs the functions of a chess-player; in another part he sees a head which may be made to imitate the human voice; and in a third place, an instrument uniting the most varied sounds of music. In machinery, as in politics, the speculations of the Germans often bear evidence of considerable ingenuity, but at the same time of the absence of practice and experience.

Connection with the Germanic body.

The Germanic confederation bore, as is well known, during many centuries, the name and form of an empire, consisting of a number of separate states, of which Austria was by far the greatest. Her dominions in Germany comprised Bohemia, Moravia, and Silesia, in addition to the circle of Austria, which contained Austria Proper, Styria, Carinthia, and Carniola; hence the successive election, during nearly four centuries, of the head of the house of Austria to the rank of the Emperor of Germany. This dignity being renounced by Francis II. in 1806, the connection of Austria with the rest of Germany on the previous footing was dissolved: nor was it renewed in the final adjustments of 1815, by which the Germanic body was declared a confederation, but not an empire; for it has no longer an acknowledged head, questions affecting the confederation at large being discussed in the diet or assembly of deputies from the different states, and determined by a majority of votes. Each confederate state is pledged to supply, when required by the diet, a military force proportioned to its population. Austria having in Germany a population of twelve millions, her quota in time of war is nearly 100,000 men; that of Prussia is 80,000. It has been seen how Austria desired to enter, with all her provinces, into the German confederacy, and how this scheme failed, in consequence of the remonstrances of the other powers of Europe.

Austria.

Since the abrogation of the imperial form in Germany, the "Circle of Austria" is no longer an official designation; but the name of "Hereditary States," so often used, has reference to the same provinces, viz., Austria Proper, Styria, Carinthia, and Carniola, which during five centuries and upwards have belonged to the house of Hapsburg by hereditary descent. At present, however, all the provinces are governed by the same central jurisdiction and the same organic laws. In these the authority of the emperor is almost uncontrolled. He is the head not only of the executive power, but of the church, and virtually of the legislature.

The Hereditary States.

The judicial body in Austria is far more numerous than in this country, the difficulty in travelling requiring that there should be courts of justice in a great number of provincial towns. Their scale of remuneration, however, is much below ours, being so small as to disincline even the most eminent pleaders from relinquishing their practice. The administration of justice in Austria long took place, as in this country, by reference to ancient usage, and to a multitude of decisions, without much system or consideration of general principles. The perplexity attendant on this vague and undefined course being doubly felt in a country where individuals were in general ignorant, and the press inefficient, the government became aware, so long ago as the middle of last century, of the necessity of publishing the laws in a collective form. Accordingly, in the year 1767, a code was published in eight folio volumes. This was a first step towards improvement; but the work, from its bulk and its deficient arrangement, proving of little use, instructions were given by the government to an eminent civilian named Von Horten, to recast it in a condensed and improved form. This was necessarily a work of great time and labour, and it was not till 1794 that the first part of the civil code came forth in an improved shape. The remainder followed in a few years, when printed copies were distributed in all directions, and local commissions appointed to report on its applicability to the usages of the different provinces of the empire. At last, in 1812, the civil code was definitively promulgated, and applied to practice. With the criminal code a similar course had been adopted somewhat earlier; it had been promulgated in 1803, and introduced into practice the year after. Most of all these, however, were swept away by edicts issued since 1849.

Law.

Of the radical changes the Austrian empire has undergone in consequence of the war of 1848, the following are the most important:—Formerly, the different provinces of the empire were more or less governed by laws proper to

Austria ‖ Automaton.

themselves, being, however, with the exception of Hungary, dependent on the central Board of Vienna in regard to their general administration; but since the new state of affairs, all the provinces, without exception, are ruled by uniform laws, promulgated by the emperor, and all are alike under the immediate jurisdiction of the ministry at Vienna. The governors and district-commissaries of the various parts of the empire are the direct nominees of the emperor, who, in a manifesto dated December 31. 1851, abrogated the *octroyed* constitution of March 4. 1849, declaring also the nullity of the responsibility of ministers, whom he decreed to be responsible to himself alone. Thus did the emperor formally belie his repeated and solemn assurances of transforming Austria into a constitutional monarchy, and the value of the equally solemn assurances in regard to the equalization of the different nationalities of the empire, appears to have amounted up to the present time (1853) to nothing more than that all should alike be subjected to the arbitrary regulations of the emperor and to martial law.

To all that has been said we must only add, in conclusion, that, up to the year 1848, Austria in her foreign policy followed an entirely independent course, acting frequently in concert with England, and, upon the whole, in amicable relations with the Ottoman Porte; while a certain coolness subsisted between her and France from the time of the accession of Louis Philippe. Now, however, the belief prevalent in the Austrian cabinet that the foreign policy of Britain encouraged the late popular movements in Italy and Hungary, has led to an alienation of feeling, undiminished to the present day; and a like feeling has been created towards Turkey, from the refusal of the latter to give up the Hungarian refugees who took shelter in her dominions at the end of 1849. Austria, therefore, is now more than ever influenced by the counsels of the cabinet of St Petersburg, and the more so, in consequence of the armed assistance so readily afforded by the Czar in the crisis of 1849. It would be out of place here to speculate on the probable future of Austria. It may, however, be safely asserted, that the unabated and abiding discontent in the Italian provinces and Hungary, which, now four years after the restoration of peace, are only kept down by force of arms; as well as the disaffected condition of the Sclavonic population, with whom Austria, after having in part used them as an instrument for her own purposes, has never fulfilled the promises she had held out,—cannot inspire much hope of a consolidation of the empire, or afford a reasonable guarantee of any lengthened internal tranquillity. (J. L—E.) (E. S—D.)

Austria ‖ Autonomy

AUTOCHTHONES (*αὐτὸς, self,* and *χθὼν, earth*), an appellation assumed by some nations, importing that they sprung, or were produced, from the same soil which they inhabited. In this sense *Autochthones* is nearly synonymous with *Aborigines*. The Athenians valued themselves on their being Autochthones, *self-born* or *γηγενεῖς, earth-born;* it being the prevailing opinion among the ancients, that, in the beginning, the earth, by some prolific power, produced men, as it still does plants. The proper Autochthones were those primitive men who had no other parent than the earth; but the name was also assumed by the descendants of these men, provided they never changed their ancient abode, nor suffered other nations to mix with them. In this sense it was that the Greeks, and especially the Athenians, pretended to be Autochthones, and, as a badge of this distinction, wore in their hair a golden grasshopper, an insect supposed to have the same origin.

AUTOCRAT, a person vested with an absolute independent power, by which he is rendered unaccountable to any other for his actions. The power of the Athenian generals or commanders was usually limited; so that, at the expiration of their office, they were liable to render an account of their administration. But, on some extraordinary occasions, they were exempted from this restraint, and sent with a full and uncontrollable authority; in which sense they were styled Αὐτοκράτορες. The same people also applied the name to some of their ambassadors, who were vested with a full power of determining matters according to their own discretion. These were denominated Πρεσβεῖς Αὐτοκράτορες, and resembled our plenipotentiaries.

AUTO DA FE. See ACT OF FAITH.

AUTOGRAPH denotes a person's own handwriting, or the original manuscript of any book, &c.

AUTOLYCUS, a famous robber who lived on Mount Parnassus, and was said to be the maternal grandfather of Ulysses.

AUTOLYCUS, of Pitane in Æolis, the author of two astronomical treatises, which are the most ancient specimens of Greek mathematics extant. They are edited by Dasypodius in his *Sphericæ Doctrinæ Propositiones*, Argent. 1572. He probably lived about B.C. 350. See Delambre's *Hist. de l'Astronomie Ancienne.*

AUTOMATON (from *αὐτός, self,* and *μάω. I move*), a self-moving machine, or one so constructed, by means of weights, levers, pulleys, and other mechanism, as to move for a considerable time as if endowed with animal life. According to this description, clocks, watches, and all machines of that kind, are automata.

Under the article ANDROIDES, it was observed that the highest perfection to which automata could be carried was to imitate exactly the motions and actions of living creatures, especially of mankind, which are with more difficulty imitated than those of other animals. Very surprising imitations, however, have been made of other creatures. So long ago as 400 years before Christ, Archytas of Tarentum is said to have made a wooden pigeon that could fly; nor will this appear at all incredible, when we consider the flute-player made by M. Vaucanson, of which an account is given under ANDROIDES. Dr Hooke is also said to have made the model of a flying chariot, capable of supporting itself in the air. But Vaucanson distinguished himself still more, by making a duck, which was capable of eating, drinking, and imitating exactly the natural voice of that fowl. What was yet more surprising, the food it swallowed was evacuated in a digested state; that is to say, considerably altered from what it was when swallowed; and this digestion was performed on the principle of solution, not of trituration. The wings, viscera, and bones, of this artificial duck, were also formed so as to resemble those of a living animal. Even in the actions of eating and drinking this resemblance was preserved; the artificial duck swallowed with avidity and with quick motions of the head and throat, and likewise muddled the water with its bill, exactly like the natural bird. Perhaps not the least ingenious of real automata was that which was exhibited within the last few years at Edinburgh and elsewhere, which enunciated several simple sentences with surprising distinctness. See also ANDROIDES.

AUTONOMY (*αὐτός,* and *νόμος,* a law), a power of living or being governed by our own laws and magistrates. The liberty of the cities under the faith and protection of the Romans consisted in their autonomia; that is, they were allowed to make their own laws, and elect their own magistrates, by whom justice was to be administered, and not by Roman prefects or judges, as was done in other places which were not indulged with the autonomia.

AUTONOMY, a term in the philosophy of Kant, by which

Autumn || Auxerre.

he designates the absolute sovereignty of reason in the sphere of morals. On this *self-legislative* quality of reason is founded, according to him, the true nature and the sole proof of man's *liberty*.

AUTUMN, the third season of the year, when the harvest and fruits are gathered in. Autumn is represented in painting by a man at perfect age, clothed like the spring, and likewise girded with a starry girdle, holding in one hand a pair of scales equally poised, with a globe in each, and in the other a bunch of divers fruits and grapes. His age denotes the perfection of this season; and the balance that sign of the zodiac which the sun enters when our autumn begins.

Autumn begins on the day when the sun's meridian distance from the zenith, being on the decrease, is a mean between the greatest and the least, which in our hemisphere is supposed to happen when the sun enters Libra. Its end coincides with the beginning of winter. Several nations computed the years by autumns; the Anglo-Saxons, by winters. Tacitus tells us that the ancient Germans were acquainted with all the other seasons of the year, but had no notion of autumn. Lidyat observes of the beginning of the several seasons of the year, that

> Dat Clemens hyemem, dat Petrus ver cathedratus,
> Æstuat Urbanus, autumnat Bartholomæus.

Autumn has been reputed an unhealthy season. Tertullian calls it *tentator valetudinum*; and the satirist speaks of it in the same light: *Autumnus Libitinæ questus acerbæ.*

AUTUMNAL EQUINOX, that time when the sun enters the autumnal point. This happens about the 22d or 23d of September.

AUTUMNAL POINT is that part of the equinox from which the sun begins to descend towards the south pole.

AUTUMNAL SIGNS, in *Astronomy*, are the signs Libra, Scorpio, and Sagittarius, through which the sun passes during the autumn.

AUTUN, the capital of an arrondissement of the same name in the department of Saône and Loire, in France, is picturesquely situated on the declivity of a hill, at the foot of which flows the Arroux. This is one of the most ancient towns of France, and when Cæsar invaded Gaul it was by far the greatest and wealthiest town of the Ædui. Its name was then Bibracte, but being afterwards much improved and embellished by Augustus it took that of Augustodunum. Many Roman and other remains still attest its former greatness; among which are large masses of its ancient walls, and two gates in admirable preservation. The cathedral is a structure of the eleventh century, and contains an elegant fountain in its square. Autun is the seat of a bishopric, and has a college, a diocesan seminary, a museum, library, theatre, &c., with tribunals of primary jurisdiction and commerce. It has manufactures of cotton goods, hosiery, leather, and paper, with a considerable trade in timber, hemp, and cattle. Population (1851), 11,094. The arrondissement is divided into 8 cantons and 85 communes. Population in 1851, 100,286.

AUVERGNE, an ancient province of central France, now in the departments of Puy de Dome and Cantal. See FRANCE.

AUVERNAS, a very deep-coloured heady wine, made of black raisins so called, which are produced near Orleans. If kept two or three years it becomes excellent.

AUXERRE, an arrondissement in the department of the Yonne, in France. Its extent is 773 square miles, or 494,905 acres, divided into 12 cantons and 131 communes, with 121,539 inhabitants. The capital, of the same name, is situated on the banks of the Yonne, in a district productive of wine; and is built in an antique fashion, with an ancient cathedral and a splendid palace. It has several normal schools, a society of agriculture, botanic garden, museum, theatre, &c. The Yonne is navigable from a little above the town. Pop. in 1851, 12,673. Besides trade in wine and in fire-wood, there are manufactures of cloths, druggets, serges cotton and woollen stockings, and some considerable tanneries. Long. 3. 34. 21. E. Lat. 47. 47. 57. N.

Auxesia || Ava.

AUXESIA, in *Mythology*, the name under which Persephone or Proserpina was honoured at Troezen and Epidaurus, as presiding over the nourishment and increase of the crops.

AUXESIS (αὔξησις), in *Rhetoric*, a figure whereby anything is magnified too much.

AUXILIARY, whatever is aiding or helping to another.

AUXILIARY VERBS, in *Grammar*, are such as help to form or conjugate others, as *to have, to be.* See GRAMMAR.

AUXONNE, a city in the arrondissement of Dijon and department of Côte d'Or, in France. It is on the Saône, and is strongly fortified. Pop. 5800. Besides their manufactures of cloth and serges, the inhabitants carry on by the river considerable traffic with Lyons. Long. 5. 24. E. Lat. 47. 13. N.

AVA, the capital of the Burman empire. It is situated on the Irawaddy, which is here 3282 feet broad, and which, making a bend out of its ordinary course, flows past the city on the N. On the E. it has the river Myit-nge, a rapid stream 450 feet broad, which flows into the Irawaddy close under its walls. From this river a canal has been dug, through which its waters flow on the S.E. angle of the city, and are again brought into the same river. On the S. flows the deep and rapid torrent of the Myit-tha, an offset of the Myit-nge, which, falling into the Irawaddy, forms the defence both of the S. and W. faces of the town. This place is divided into the upper and lower, or the lesser and the larger town, both of which are fortified. The brick wall that surrounds the city is 15½ feet in height, and 10 feet in thickness, on the inside of which is thrown up a bank of earth forming an angle of 45 degrees. There is a ditch round the outer wall which is inconsiderable, and in the dry season fordable in every part. The lesser town is chiefly occupied by the royal palace, the hall of justice, the council chamber, the arsenal, and the habitations of a few courtiers of distinction. A strong well-built wall of more solid construction than the outer wall of the city, and about 20 feet high, incloses the square in which these buildings are situated, and on the outside is a teak-wood stockade of the same height. The ditch which surrounds the lesser town is moreover deeper and broader than that of the city, and when full is not to be forded. There are, however, three causeways across, which communicate with the adjacent country. The circumference of the city, excluding the suburbs, is about 5½ miles, but over this extensive area the houses are but thinly scattered; some quarters are indeed wholly destitute of habitations, and have the appearance merely of neglected commons. In general the dwellings of the inhabitants are of the most miserable sort, being mere huts thatched with grass. Wretched, however, as are such habitations to European eyes, the poorer classes are perhaps better lodged than in other parts of Asia. Their sleeping places are elevated two or three feet from the ground, which is a convenience not enjoyed by the masses in Bengal. Some of the houses of the chiefs are constructed of planks, and tiled; but there are not, according to Mr Crawford, more than half a dozen houses built of brick and mortar. Ava, like all the other Burmese towns, is adorned with numerous temples, of which the gilded spires rising aloft present on a distant view of the place a splendid and imposing appearance, which is far from being realized on a nearer inspection. The largest of these temples contains two distinct edifices, one in the ancient, the other in the modern form; the former containing an image of Guatama, not of marble as Symes supposes, but of sandstone. It is in a sitting posture, and is 24 feet in height. The head is 8 feet in diameter. There is another very large temple, and a third called the "Beautiful." The one called Maong-Ratna is of great celebrity; it is the one in which the public officers of

Avadoutas ‖ Avallon.

the government take, with the most solemn forms, the oath of allegiance. The temple called Maha-mrat-muni had an addition made to it some years ago, of which Mr Crawfurd mentions that the numerous and richly-gilded pillars and splendid ceiling exceeded anything that was to be seen without the palace. Ava contains eleven markets or bazaars, composed of thatched huts and sheds, which, however, are well supplied with all that is necessary for the wants of the people. Besides native commodities, there are exposed in these markets the produce of China and of Lao, with British cottons, woollens, glass, and earthenware. The Burman monasteries are mostly built of wood; and of those composed of more solid materials, a few ancient ones are nearly all that are to be seen. The only exception is a monastery built some years ago by the queen, adjoining the palace, an unshapely fabric of immense size, but a very conspicuous object.

The capital of the Burman dominions, according to the political divisions of the empire, comprehends the town of Sagaing on the opposite shore of the Irawaddy, and the town of Ummerapoora or Amarapura, four miles to the E. The town of Sagaing extends along the Irawaddy for more than a mile and a half, but is of inconsiderable breadth. It consists of mean houses thinly scattered among gardens and orchards; the principal trees in the latter consisting of fine old tamarinds. Over the site of the town and its environs are scattered innumerable temples, some of them old and ruinous, others modern. On the river face it has a brick wall about 10 feet in height, with parapet and embrazures like that of Ava, and extending for above half a mile along the river. Ummerapoora is a large place, and was formerly the capital; but Ava, which was twice before the capital, was again made so in 1822. To each of the towns of Ava, Sagaing, and Ummerapoora, are attached districts, the two former of which extend 12 miles along the river, and are of equal breadth. The district of Ummerapoora is of equal size, so that Ava must be considered as not only the name of the capital, but of a large district around, which includes an area of 288 miles, containing, according to the most accurate estimate, 354,200 inhabitants. But the city of Ava is not supposed to contain more than 50,000 inhabitants; and according to Mr Crawfurd, half that number would be nearer the truth. The place, taken altogether, affords few or no indications of industry or commercial enterprize. Lat. 21. 52. Long. 96. 1.

The entire territory subject to the Burmese sovereign is sometimes called Ava, the custom of applying to a country or province the name of its chief place being common in the East. It appears, however, preferable, where a distinct name for a country exists, to class the general information relating to that country under such name. The reader, therefore, is referred in this instance for such information to the article BURMAH. (D. B—N.) (E. T.)

AVADOUTAS, a sect of Indian Brahmins, who in austerity surpass all the rest, covering their nakedness with a piece of cloth only, some of them even dispensing with that, and besmearing their bodies with cow-dung. When hungry some enter into houses, and, without speaking, hold out their hands, eating on the spot whatever is given them. Others retire to the sides of holy rivers, and there expect the peasants to bring them provisions, which they generally do very liberally. See HINDUSTAN.

AVAL. See BAHREIN.

AVALANCHE, the name given to a prodigious mass of consolidated snow, which, disengaged from the summits of more elevated peaks, frequently rolls down the sides of the Alps. See ALPS.

AVALLON, an arrondissement in the department of the Yonne, in France, comprehending five cantons and seventy communes. Area, 244,480 acres; pop. 47,524. The capital, of the same name, is a handsome town, finely situated on a granite rock, at the foot of which flows the river Voisin. It has some manufactures of cloth, hats, hosiery, leather, and paper, and a considerable traffic in fire-wood, which is conveyed by the Voisin, the Yonne, and the Seine, to Paris. Pop. in 1851, 5740. Long. 3. 56. E. Lat. 47. 30. N.

Avatar ‖ Avenbrugger.

AVATAR, a Sanscrit word signifying *a descending*, applied in Indian mythology to incarnations of Vishnu, and of some of the inferior deities. See HINDUSTAN.

AVATCHA, a bay on the S.E. coast of Kamtschatka, the best on that coast; Lat. 52. 52. N. Long. 158. 47. E. On this bay is situated a small town of the same name; and about 20 miles inland is the volcano of Avatcha, rising to the height of 9055 feet.

AVEBURY, a village of England, in the county of Wilts, 6 miles W. of Marlborough. It occupies the site of a curious ancient structure, supposed to be Druidical. This consisted of a large outer circle formed of 100 stones of from 15 to 17 feet in height, and about 40 feet in circumference, inclosing an area of about 1400 feet in diameter. This circle was surrounded by a broad ditch and lofty rampart. Within its area were two smaller circles, each consisting of a double concentric row of stones; a stone pillar 20 feet high occupying the centre of the one, and a cromlech that of the other. Two avenues of approach, consisting of double rows of stones, branched off from this structure to other circles about a mile distant towards the S. and W. Few traces of this immense structure now remain,—the stones having been broken down and used in the construction of the houses of the village, and for other purposes. In the vicinity are a number of cromlechs and barrows: among the latter is Silbury Hill, said to be the largest barrow in Europe. It is about 2000 feet in circumference at the base, rising in a conical form to the height of 170 feet—the diameter of the summit being 120 feet.

AVEIRO, a town of Portugal, province of Beira, the seat of a bishopric and college. It has a thriving trade in oil, salt, fish, wine, and oranges. Pop. 4500. Long. 8. 34. W. Lat. 40. 40. N.

AVEIRON. See AVEYRON.

AVELLA, a town of Naples, in the province of Terra di Lavoro, in a fine situation, and commanding most extensive prospects. It is distant about 20 miles from Naples, and contains 6000 inhabitants. Near it are the remains of the ancient Abella. See ABELLA.

AVELLINO, the ancient *Abellinum*, a fortified city of Naples, in the province of Principato Ultra, at the foot of Mount Vergine, and 28 miles E. of Naples. It is the see of a bishop, and has a cathedral, several parish churches, a royal college, &c.;—with manufactories of cloth, paper, maccaroni, and sausages, and extensive dye-works. It has a considerable trade in corn, chestnuts, and hazel-nuts. This city has at various times suffered severely from earthquakes. Pop. 16,000. See ABELLINUM.

AVE-MARIA (*Hail Mary*), a form of devotion in the Romish Church, addressed to the Virgin Mary. It is derived from the salutation of the angel in Luke i. The chaplets and rosaries of Roman Catholics are divided into a certain number of *ave-marias* and *pater-nosters*.

AVENA, a botanical genus of Gramineæ, to which the oat, *Avena sativa*, belongs.

AVENBRUGGER, LEOPOLD, an ingenious physician of Grätz, in Styria. We owe to him the important mode of investigating diseases of the chest and abdomen by *auscultation*. His method was to apply the ear to the chest, and to note the sounds it afforded on percussion by the hand, or what is called *immediate ausculation*. His Latin treatise excited but little attention, until it was translated and illustrated by Corvisart, in 1808; when it soon led the way to Laennec's great improvement of aiding the ear by the stethoscope, or *mediate auscultation*. This latter practice, which has so greatly aided the diagnosis of inter-

Avenches || Avenue.

nal diseases, was employed at Edinburgh several years before it was in general use in other parts of Great Britain. Avenbrugger was born at Grätz in 1722, and died in 1809.

AVENCHES (in German, *Wifflisburg*), a small town of Switzerland, in the canton of Vaud, about 1½ miles from Lake Morat or Murten. It is the ancient Aventicum, the chief city of the Helvetii. Many objects of antiquity have been found here; and remains of an amphitheatre, of an aqueduct, and of the ancient walls, still exist. Avenches contains 1100 inhabitants.

AVENOR, in *Feudal Law*, an officer belonging to the king's stables, who provided oats for the horses.

AVENTINUS (or JOHANN TURMAYR), author of the *Annals of Bavaria*, was born in the year 1466, at Abensperg. He studied first at Ingoldstadt, and afterwards in the university of Paris. In 1503 he privately taught eloquence and poetry at Vienna, and in 1507 he publicly taught Greek at Cracow, in Poland. In 1509 he read lectures on some of Cicero's works at Ingoldstadt, and in 1512 was appointed preceptor to Prince Ludwig and Prince Ernst, sons of Albert the Wise, Duke of Bavaria, and travelled with the latter of these princes. He afterwards undertook to write the *Annales Boiorum*, or *Annals of Bavaria*, being encouraged by the dukes of that name, who settled a pension upon him, and gave him hopes that they would defray the charges of the book. This work, which gained its author great reputation, was first published in 1554 by Hieronymus Zieglerus, professor of poetry in the university of Ingoldstadt; and afterwards at Basil, in 1580, by Nicholas Cisner. Besides his other writings, Gesner attributes to him a curious work, entitled *Numerandi per digitos manusque Veterum Consuetudines*. Aventinus died in 1534.

AVENTINUS MONS, one of the seven hills on which ancient Rome stood. The origin of the name *Aventinus* is uncertain; but this hill was also called *Murcius*, from Murcia (Venus), the goddess of sloth, who had a little chapel there; and *Collis Dianæ*, from the temple of Diana; likewise *Remonius*, from Remus, who was buried there. It was taken within the compass of the city by Ancus Marcius (Liv. i. 33.) To the E. it had the city walls; to the S. the Campus Figulinus; to the W. the Tiber; and to the N. Mons Palatinus. It was two miles and a quarter in circuit.

AVENUE (*ad* and *venio*), a walk planted on each side with trees, and leading to a house, garden-gate, wood, &c. The trees most proper for avenues with us are the English elm, the lime, the horse-chestnut, the common chestnut, the beech, the abele. The English elm will do in all grounds, except such as are very wet and shallow; and this is preferred to all other trees, because it will bear cutting, heading, or lopping in any manner, better than most others. The rough or smooth Dutch elm is approved by some because of its quick growth. This is a tree which will bear removing very well; it is also green almost as soon as any plant whatever in spring, and continues so as long as any; it makes an incomparable hedge, and is preferable to all other trees for lofty espaliers. The lime is valued for its natural growth and fine shade. The horse-chestnut is proper for all places that are not too much exposed to rough winds. The common chestnut will do very well in a good soil, and rises to a considerable height when planted somewhat close, though, when it stands single, it is rather inclined to spread than to grow tall. The beech is a beautiful tree, and naturally grows well with us in its wild state; but it is less to be chosen for avenues than the before-mentioned, because it does not bear transplanting well, and is very subject to miscarry. Lastly, the abele is fit for any soil, and is the quickest grower of any forest tree. It seldom fails in transplanting, and succeeds very well in wet soils, in which the others are apt to fail. The oak is but little used for avenues, because of its slow growth. See HORTICULTURE.

Avenzoar || Average.

AVENZOAR (ABU MERWAN ABDALMALEC EBN ZOHR), an eminent Arabian physician, who flourished about the end of the eleventh or the beginning of the twelfth century. He was of noble descent, and born at Seville, the capital of Andalucia, where he exercised his profession with great reputation. He was contemporary with Averroes, who, according to Leo Africanus, heard his lectures and learned physic of him. This seems the more probable, because Averroes more than once gives Avenzoar very high and deserved praise, calling him *admirable, glorious, the treasure of all knowledge*, and *the most supreme in physic from the time of Galen to his own*. Avenzoar, notwithstanding, is by the generality of writers reckoned an empiric; but Dr Freind observes that this character suits him less than any of the rest of the Arabians. Avenzoar belonged, in fact, to the *Dogmatists* or *Rational Sect*, the antipodes of the *Empirics*. He was a great admirer of Galen; and in his writings inveighs against the quackery of old women, and the superstitious remedies of the astrologers. He shows no inconsiderable knowledge of anatomy in his remarkable description of inflammation and abscess of the mediastinum in his own person, and its diagnosis from common pleuritis as well as from abscess and dropsy of the pericardium. In cases of obstruction or of palsy of the gullet, his three modes of treatment are ingenious. He proposes to support the strength by placing the patient in a tepid bath of nutritious liquids, that might enter by cutaneous imbibition; but does not recommend this. He speaks more favourably of the introduction of food into the stomach by a silver tube; and he strongly recommends the use of nutritive enemata. From his writings it would appear that the offices of physician, surgeon, and apothecary were already considered as distinct professions. He wrote a book entitled *The Method of Preparing Medicines and Diet*, which was translated into Hebrew in the year 1280, and thence into Latin by Paravicius, whose version has passed through several editions.

AVERAGE,[1] a term used in maritime commerce to signify damages or expenses resulting from the accidents of navigation. Average is either *general* or *particular*. General average arises when sacrifices have been advisedly made, or expenditures incurred, with a view to the preservation of the ship, cargo, and freight from the effects of some extraordinary peril; and it implies a subsequent contribution from all the parties concerned, in order to make good the loss which one or more of them may thus have sustained. Particular average signifies the damage or partial loss happening to the ship, goods, or freight, in consequence of some fortuitous or unavoidable accident; and it is borne by the individual owners of the articles damaged, or by their insurers.

It may be here remarked, that the term Average was originally used to signify what is now distinguished as General Average. The expression "Particular Average" is not strictly accurate, as it does not, in its current acceptation, imply the idea of an *equalizing contribution*, as originally signified by the word Average. It has, nevertheless, been generally adopted, and is now fully recognised as the distinctive expression for damage or partial loss falling on *some one* of the individuals interested in a sea adventure.

Petty Average consisted of certain small charges for pilotages, light-dues, &c., which were apportioned one-third

[1] Average is said by Cowell to be derived from the Latin word *averagium*, from the verb *averare*, to carry. He supposes it to have been introduced into commerce to show the proportion to be paid by every man according to his goods *carried*. Loccenius, on the other hand, derives it from the French *havre*, or the German haven, a port; it being a contribution paid for having goods *brought safely to port*. (*De Jure Maritimo*, lib. ii. cap. viii. sect. 1.)

Average. to the ship and two-thirds to the cargo; but this is now superseded by the agreement that the freight payable for the cargo shall include all such expenses; and the term has, consequently, become obsolete.

Although nothing can be more simple than the fundamental principle of general average,—which is, that a loss incurred by one party for the advantage of several shall be made good in equitable proportions by all who are benefited by it,—yet the application of this principle to the varied and complicated cases which arise in the course of maritime commerce has occasioned many diversities of usage in different countries, and even in the same country at different periods. Without entering on so wide a field as the discussion of these diversities would open up, we shall endeavour to present a brief summary of the leading principles which have been established in this country, by usage or by legal decisions, in connection with the subject.

All general average losses may be divided into two principal classes:—1. *Sacrifices* of part of the cargo and freight, or of part of the ship, for the general benefit; 2. *Extraordinary expenditures*, incurred with the same object.

Under the first of these classes we shall begin by noticing the acts which involve sacrifices of *part of the cargo and freight.*

When a part of the cargo is thrown overboard (or *jettisoned*, as it is termed) to save the ship from foundering in a storm, or to float her when stranded, or to facilitate her escape from an enemy, the loss of the goods and of the freight attached to them must be made good by average contribution. In like manner, if goods be damaged in the ship by opening the hatches in order to effect a jettison, or by being brought upon deck for that purpose, the damage forms a general average charge. But if goods jettisoned have been originally stowed *on deck*, no contribution can be demanded for them, unless they are so carried according to the common usage and course of trade on the voyage for which they were shipped.

If, instead of being thrown overboard, the goods are put into boats or lighters, and lost or damaged before reaching the shore, such loss is regarded as a virtual jettison, and gives a claim to average contribution. The same rule applies to damage occasioned by the goods being put ashore on muddy ground, as may sometimes happen, when there is no other place where they can be landed.

But when the goods have been conveyed to a place of ordinary safety, they are no longer at the risk of the *general* interest; and should they be damaged by fire or other accidents, the loss must be borne by the *individual* proprietors, or by their insurers.

The loss of corn, salt, guano, or similar goods, arising from their being pumped up or baled out with the water in the vessel, cannot be recovered by average contribution.

If, in consequence of there being no other means of raising money at a foreign port, a part of the cargo be sold for the purpose of repairing losses or defraying expenses which are themselves of the nature of general average, the loss arising from the sale gives a claim to contribution. But if the funds are required for the purpose of repairing particular average losses on the ship, or of defraying the ordinary expenses of the navigation, the loss must be borne by the shipowner.

The damage done to the cargo by means of water thrown down the hatches to extinguish an accidental fire, or by scuttling the ship for that purpose, is excluded, *by usage*, from general average. This point seems to have never yet been settled by any legal decision; and the usage referred to is considered by several writers of high authority to be at variance with sound principle. It is sometimes defended on the ground that the damage in question is *secondary* and *incidental*, and not *primary* and *intentional*. But this reason seems somewhat fanciful for the purposes of equity, and is, besides, inconsistent with the analogy of certain other cases, where an opposite principle is practically recognised; as, for instance, in the case of goods incidentally damaged in effecting a jettison of other goods. Average.

The amount of compensation to be made for goods sacrificed by general average acts is determined by the nett market price they would have produced on arrival at the port of destination had they not been sacrificed; but under deduction of the freight attaching to them (which is made good to the shipowners), and of the charges for duties and landing expenses which are saved.

We now proceed to notice the general average acts which involve sacrifices of part of the *ship or her materials.*

The same principles which regulate the case of goods thrown overboard apply also to the jettison of the ship's chains, anchors, hawsers, spars, boats, or other stores. But if water-casks are stowed on deck, or if chains and hawsers are carried on deck when the vessel is not near the land, so as to render it necessary that they should be so carried, the loss arising from the jettison of these articles falls on the shipowner; and if boats are jettisoned in consequence of their having been broken adrift from their fastenings on deck by the force of the sea, they are excluded from general average, and are charged to particular average on the ship.

The damage done to the ship by cutting holes to effect a jettison of the cargo, or to pour down water to extinguish a fire, or by scuttling her for that purpose, is allowed as a general average charge. The damage arising from cutting or knocking away a portion of the ship's bulwarks in order to prevent the deck from being flooded in a storm, is compensated in the same manner.

When sails or masts are cut away in order to righten a ship which has been thrown on her beam-ends, or to prevent her from driving on a lee shore, the loss is made good by average contribution; but if the object in cutting away a sail or spar be merely to *save a mast*, the loss is not made good in general average.

It frequently happens that masts or yards are sprung and carried away by the force of the wind, and are left entangled in the rigging, or hanging over the ship's side in what is termed "a state of wreck;" in these circumstances it becomes necessary to cut them away, with the sails and rigging attached, and to throw the whole overboard, otherwise they would impede the navigation, and endanger the ship and cargo. On this ground it is held by some authorities that the loss caused by the act of cutting them away should be made good by average contribution. But this act is the direct consequence of the previous accident, which places these articles in a situation where it is impossible to save them without imperilling the ship, cargo, and lives. It would not be reasonable to imperil these for such a purpose; whence it follows that the displaced articles are already *virtually* irrecoverably lost by means of the original accident, before the loss is *actually* consummated by cutting them away. And as the *general* interest ought not to be endangered for the purpose of attempting to save these articles, so neither should it be implicated in the loss resulting from the only remaining alternative of clearing them away. This loss is accordingly excluded, by the usage of this country, from average contribution. On the same principle, no contribution can be demanded for any articles which are sacrificed as having themselves become, through previous accident, the immediate cause of danger to the whole interest.

The loss of sails or spars, in consequence of carrying a press of canvas to avoid a lee-shore, or to escape from an enemy, is not the subject of general average in this country; neither is the damage suffered by the ship from *straining*, under any such extraordinary press of sail.

When anchors and cables are slipped from in order to work a vessel off a lee-shore, or to avoid collision with another ship, the loss is made good by average contribution;

Average. but if the cable is slipped in order that the vessel may join convoy, or because the anchor has become hooked to some object at the bottom and cannot be raised, the loss is borne by the shipowner.

When sails, ropes, or other materials, are cut up and used at sea for the purpose of stopping leaks or to rig jurymasts, or when the common benefit requires that they should be applied to some purpose for which they were not originally intended, the loss is made good in general average. The same rule applies to the case of hawsers, cables, anchors, sails, or boats, lost or damaged in attempting to force off a stranded vessel from the shore.

The damage sustained in defending a ship against a pirate or an enemy is not the subject of general average in this country; it is treated as particular average on the ship.

It has been much debated by writers on maritime law, whether the voluntary stranding of a ship, in order to prevent her from foundering, should be treated as a general or as a particular average loss. In the United States it has been settled, by judicial decision, that the loss in question constitutes a general average claim; but the opposite doctrine is acted upon in the usage of our own country, and the point has never been raised before the courts of law. It appears to us that the argument greatly preponderates against the rule adopted in the United States, and in favour of the usage established in this country. The only reason for regarding this loss as the subject of general average is, that it originates in the intentional act of running the ship aground, for the preservation, as far as possible, of the whole interest concerned. But it can seldom be known beforehand how the different interests at stake will be specially affected by the act in question;—whether, for instance, the damage to the cargo may not be more serious than the damage to the ship, or *vice versa*. Thus no particular part of the interest can be said to be intentionally sacrificed for the benefit of the whole; the intention, indeed, is not to sacrifice any one part, but to place the whole interest in a situation of less peril than it would otherwise have been in. What particular damages may thereafter ensue to either ship or cargo will depend, in each case, on a variety of circumstances entirely accidental in their character, and therefore in no proper sense the subject of previous intention. The same rule, therefore, which excludes from general average accidental damages in all other cases, ought to exclude them in this case also. Moreover, when the alternatives are, either that the vessel be left to founder, or that she be run ashore with a chance of preservation, there can really be no room for choice, or, at all events, the elements of will and intention are entirely subordinate in the part they must play under the pressure of the existing circumstances; and in this view the stranding is as truly inevitable as if it had been caused by the force of the winds and waves alone.

But, even were these reasons less weighty than we hold them to be, a serious practical objection might be urged against the doctrine that voluntary stranding should be a general average loss, on the ground that it would in most cases be impossible to distinguish between the damages received by the ship and cargo prior to the stranding, and those sustained after or in consequence of it. It is needless to remark, that before a ship can be in such imminent danger of foundering as to render it necessary to run her ashore, she must be presumed to have sustained a very considerable amount of damage; and the probability is, that the cargo also will have suffered to a corresponding extent. Up to this point these damages are confessedly *particular* average; and were it held that the damages *after* the stranding were the subject of *general* average, it would, of course, be necessary to distinguish the separate damages that belonged to each. But in every case these different damages would exist in varying proportions, yet always so incorporated together that justice could never have a more perplexing task than that of discriminating between them. No general rule could be applied that would meet the widely different circumstances of each particular case; and the arbitrary method of adjustment that would alone be possible would doubtless give rise to endless dissatisfaction and dispute. On the ground of expediency, therefore, as well as on that of principle, the usage now established in this country ought to be maintained, notwithstanding the high authorities by whom the opposite practice has been countenanced. Average.

The amount of general average losses on the ship is compensated by allowing to the owners the cost of repairs, or of new materials in place of those sacrificed, subject to the deduction of one-third for the difference of value between old and new; but no deduction is made from the cost of new anchors, and only one-sixth is deducted from the cost of new chain cables. If the ship be on her first voyage (which is held to include the homeward as well as the outward passage), the repairs and new materials are allowed in full.

We now proceed to notice the second principal class of general average losses, consisting of extraordinary expenditures incurred with a view to the common benefit.

When a ship is obliged to put into a port of refuge, in consequence of damage received in the course of the voyage, the usage in this country is to allow as general average all the charges connected with the entrance of the vessel into the port, and with the landing and warehousing of the cargo, when this is necessary to admit of the ship being repaired. Thus the expenses of pilotage or other assistance into the port, the harbour dues and similar charges, the costs of the protest taken by the master and crew, and of the survey held to ascertain whether the cargo requires to be discharged, together with the charges for landing the cargo and conveying it to a warehouse or other place of safety, are all made good as general average. The costs of repairing the ship are charged to general average only in so far as the repairs may refer to damages which are themselves the proper subject of general contribution. If the damages are of the nature of particular average, as is more usually the case, they are charged accordingly; or if they proceed from "wear and tear," they are stated against the shipowner.

The warehouse rent for the cargo at a port of refuge, and any expenses connected with its preservation, form special charges against that particular interest, and are borne by the proprietors of the goods, or by their insurers. When goods are insured "free from particular average, unless the ship be stranded," it is necessary, if the ship has not been stranded, to distinguish the charges for warehouse rent and fire insurance from those incurred in connection with the preservation of the goods from the effects of damage; the underwriters being liable for the former, but not for the latter.

The expenses of reshipping the cargo, and the pilotage or other charges *outwards*, are borne by the freight. If the entire cargo cannot be taken on board again, from the want, at the port of refuge, of the usual facilities for stowing it, the loss or expenses resulting from the exclusion of part of it are not treated, in this country, as the subject of general contribution.

The wages and provisions of the master and crew during the period of detention at a port of refuge, are not admitted as a charge against general average; it being held that the shipowner is bound to keep a competent crew on board the ship from the commencement to the end of the voyage at his own expense.

The charges for agency at a port of refuge are brought against the general average, even though they may have been originally made in the form of separate charges against the ship and cargo respectively. Commissions on money advanced, maritime interest on bottomry and *respondentia*, and the loss on exchanges, &c., are apportioned relatively

Average. to the gross sums expended on behalf of the several interests concerned.

The expenses incurred in getting a stranded ship off the ground, the hire of extra hands to pump a ship which has sprung a leak, and the sums awarded for salvage or for other services rendered to the ship and cargo under any extraordinary emergencies, are compensated by average contribution. But this rule applies only to the *extraneous* assistance that may have been obtained; the crew being bound to do their utmost in the service of the ship on all occasions, without extra remuneration for what they might consider extraordinary exertions on their part.

The costs of reclaiming the ship and cargo after having been captured, are allowed as general average charges; and although *ransom* to an enemy is prohibited in this country by legal enactment, it seems that this does not apply to the case of money or goods given up by way of composition to pirates for the liberation of the ship and cargo, and that this would also form a subject of average contribution.

When the ship and cargo arrive at the port of destination, it is unnecessary, in ordinary cases, to distinguish, in the adjustment of the general average, between the losses which have arisen from *sacrifices*, and those which have resulted from *expenditures* for the common benefit. But if the ship and cargo should be lost before reaching their destination, no contribution is due for the goods or ship's materials which may have been *sacrificed* at a former stage of the voyage, the owners of these being in no worse position than any of their coadventurers. On the other hand, it is evident that when money has been *expended* for the common benefit, the subsequent loss of the ship and cargo should not affect the right of the party who has made the advance to recover it in full from all the parties for whose advantage it was originally made. Hence, while *sacrifices* are made good only in the event of the ship and cargo being ultimately saved, *expenditures* must be reimbursed whether the ship and cargo be eventually saved or lost; and the contribution for these expenditures must be regulated by the values of the ship, cargo, and freight, as they stood at the time when the advances were made.

If, however, the money required for average expenditures has been raised by means of bottomry, and the ship be lost before completing the voyage, there can be no claim for reimbursement; the risk being assumed by the bottomry lender in consideration of the premium he receives on the sum advanced. It is by no means clear that the average expenditures which have been advanced without any contract of bottomry form a specific insurable interest, according to the law of this country, although in practice they are very frequently insured. When this has been done, and when the amount has been recovered on the subsequent loss of the ship, no claim can be *equitably* made against the individuals who would otherwise have been liable. But if the expenditures are not insured, either by a bottomry contract, or by a special policy, and if the ship and cargo be totally lost in the subsequent course of the voyage, the parties for whose benefit the expenditures were incurred must reimburse them on the principles already explained. These parties, however, have recourse on their original insurers, not only for the total loss of the interests insured, but also for the previous expenditures, although the insurers may thus be called on to pay a *larger sum* than the amount of the insurance.

The contribution for general average losses is regulated by the values of the respective interests for the benefit of which they were incurred. The practical rule adopted, in all ordinary cases, is to estimate the ship, cargo, and freight, at their *nett* values to their owners, in the state in which they arrive at the port of destination, *but including in these values the sums made good for sacrifices*, and to assess the contribution accordingly The necessity for including the amount of compensation made for sacrifices in the valuations on which the contribution is charged, arises from the principle that all the parties interested in the adventure should bear the ultimate loss in exact proportion to their respective interests, which would not be the case if the owners of the articles sacrificed were to recover their full value without being themselves assessed for the loss thereon in the same manner as their coadventurers. Average.

The contributory value of the *ship* is accordingly her actual value to her owner in the state in which she arrives, whether damaged or otherwise, including the sum made good in the general average for any sacrifices which may have been made of part of the ship or her materials.

The value of the *cargo* for contribution is its nett market value on arrival, after deducting the charges incurred for freight, duty, and landing expenses, but without deducting the costs of insurance or commission. If goods be damaged, they contribute only according to their deteriorated value; and if special charges have been incurred on the cargo at a port of refuge (as for warehouse rent, &c.), the amount of these charges is deducted. The sum charged to general average for goods sacrificed is of course added to the valuation. All goods carried in the ship for the puposes of traffic must be included in the valuation of the cargo; but the wearing apparel, or personal effects, of the passengers and crew are exempted from contribution.

The value of the *freight* for contribution is the sum received by the shipowner on the completion of the voyage for the carriage of the cargo, after deducting from that sum the wages then due, the port charges at the place of destination, and the special charges against the freight which may have been incurred at a port of refuge, consisting of the costs of reshipping the cargo, and of outward pilotage, &c. The provisions for the voyage are not deducted, as these are held to have formed part of the original value of the *ship*. If the freight has been paid in advance, it forms part of the value of the *goods*, and, consequently, does not contribute as a separate interest. It has been decided, that when a vessel has been originally chartered for a double voyage, the *whole* freight to be earned under the charter-party must contribute at its nett value, after deducting the wages and other charges which must be incurred in earning it. The effect of this rule is to render the freight attaching to the *return* voyage, as well as that attaching to the voyage *outwards*, liable to contribute for average losses arising in the course of the outward passage; a result the equity of which is not always very apparent.

An adjustment of general average made at any foreign port where the voyage may terminate, if proved to be in conformity with the law and usage of the country to which such foreign port belongs, is binding on all the parties interested as coadventurers, although they may be subjects of this country, and although the adjustment may be made on principles different from those sanctioned by the laws or usages of Britain. The reason for this rule is, that the parties engaging in the adventure are held to assent to the known maritime usage according to which general average is adjusted on the arrival of the ship and goods at the port of destination.

The subject of general average is only incidentally connected with that of marine insurance, being itself a distinct branch of maritime law. But the subject of particular average arises directly out of the contract of insurance, and will therefore be best considered in connection with it. (See INSURANCE, MARINE.)

For further information with respect to the subject of average, the reader is referred to the famous work of M. Valin, *Commentaire sur l'Ordonnance de* 1681, tome ii. p. 147–198, ed. 1760; to Emerigon, *Traité des Assurances*, tome i. p. 598–674; Park *On Insurance*, chap. vii.; Marshall *On Insurance*, book i. chap. xii. sect. 7; Stevens's

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Essay on Average; Benecke *On the Principles of Indemnity in Marine Insurance;* Lord Tenterden's excellent work on the *Law of Shipping*, part iii. chap. viii. &c.; Arnould *On Marine Insurance;* Baily *On General Average.* (J. W—K.)

AVERNUS, a lake of Campania in Italy, near Baiæ, occupying the crater of an extinct volcano, and about a mile and a half in circumference. It is described by Strabo as situated within the Lucrine Bay, deep and darksome, surrounded with steep overhanging banks, and only accessible by the narrow passage through which you sail in. Black aged groves stretched their boughs over the watery abyss, and with impenetrable foliage excluded almost every ray of wholesome light; and mephitic vapours ascending from the hot bowels of the earth, being denied free passage to the upper atmosphere, floated along the surface in poisonous mists. Hence these gloomy shades were regarded as sacred to the infernal gods; while a colony of Cimmerians, as well suited to the rites as the place itself, cut dwellings in the bosom of the surrounding hills, and officiated as priests of Tartarus. Superstition, always delighting in dark ideas, early and eagerly seized upon this noxious spot, and hither she led her trembling votaries to celebrate her dismal orgies. Here she evoked the manes of departed heroes; here she offered sacrifices to the gods of the infernal regions, and attempted to dive into the secrets of futurity. Poets enlarged upon the popular theme, and painted its awful scenery with the strongest colours of their art. Homer brings Ulysses to Avernus; as to the mouth of the infernal abodes; and, in imitation of the Grecian bard, Virgil conducts his hero to the same gloomy regions. Whoever sailed thither, first did sacrifice, and endeavoured to propitiate the infernal powers, with the assistance of some priests, who attended upon the place and directed the mystic performance. Within, a fountain of pure water broke out just over the sea, which was fancied to be a vein of the River Styx. Near this fountain was the oracle; and the hot waters, frequent in those parts, were supposed to be branches of the burning Phlegethon. The poisonous effluvia from this lake were said to be so strong that they proved fatal to birds endeavouring to fly over it. Hence the name is said to be derived from ἄορνος, i. e. *without birds.* Virgil ascribes the exhalation, not to the lake itself, but to the cavern near it, which was called *Avernus*, or *Cave of the Sybil*, and through which the poets feigned a descent to Orcus. Others say the proper name of the lake is *Lacus Averni*, the lake near the cavern, as it is called by some ancient authors. It is still called *Lago Averno.*

The sanctity of these shades remained unimpeached for many ages. Hannibal marched his army to offer incense at this altar; but, according to Livy, he was led to this act of devotion rather by the hopes of surprising the garrison of Puteoli, than by his piety. After a long reign of undisturbed gloom and celebrity, a sudden glare of light was let in upon Avernus; the horrors were dispelled, and with them vanished the sanctity of the lake. The axe of Agrippa levelled its forest with the ground, disturbed its sleepy waters with ships, and gave room for all its malignant effluvia to escape. The virulence of these exhalations, as described by ancient authors, has appeared so very extraordinary, that some modern writers, who know the place in a cleared state only, charge these accounts with exaggeration; but others think them entitled to more respect, since even now the air is feverish and dangerous, as the jaundiced faces of the vine-dressers, who have succeeded the Sybils and Cimmerians in the possession of the temple, most ruefully testify. It would appear that the ancients regarded Avernus as a divinity, to whom they offered sacrifices. (See SERVIUS, *ad Virg. Georg.* ii. 161.)

AVERROES (a corruption of IBN-ROSHD), the most illustrious of Arabian philosophers, was born, according to El Ansari, in the year of the Hegira 520 (A.D. 1120), at Cordova, of one of the best families in Andalucia. His grandfather and father successively held the office of cadi in Cordova, a dignity which Averroes himself also enjoyed for many years. After studying theology and jurisprudence, he applied himself with zeal to mathematics, medicine, and philosophy. His preceptor in the latter was the celebrated Avenpace (Ibn-Badja). The sudden overthrow of the dynasty of the Almoravides in 1130 by the Almohades was favourable to the interests of science; and Averroes enjoyed, with his friends Ibn-Tofail and Ibn-Zohar, the patronage successively of Abdal-Mumen, Yusuf, and Almansur. In 1169 he was appointed cadi of Seville, and about this time he began to employ his leisure in the composition of the works to which he owes his celebrity. In 1182 he was called to Marocco, to fill the office of physician to the Sultan Yusuf; but some time after returned to Spain as cadi of Cordova. Under Yusuf's son, Almansur, he long enjoyed the highest favour; but towards the close of his life the jealousy of his enemies procured his banishment to Elisana (Lucena), a town not far from Cordova. The charge brought against him was that he corrupted the minds of his pupils by impious and heterodox doctrines. Another version attributes his disgrace to a careless expression in his commentary on Aristotle's Zoology, which had offended the pride of Almansur. He had called the sultan simply *King of the Berbers*, which was construed into an insult to the sovereign both of Spain and of Marocco. Averroes, however, was soon restored to favour, and returned once more to the court of Marocco, where he died in 1198, at an advanced age.

Averroes

The fame of Averroes is mainly connected with his commentaries on the works of Aristotle, which procured him the same title bestowed in a former age on Alexander the Aphrodisian, of *The* Commentator. To this distinction, alike by the extent and the quality of his labours, he is well entitled. Without pretending to found a system distinct from that of his great master, he modified with the rest of the Arabian philosophers the Aristotelian doctrines, by the infusion of new elements derived from Neo-Platonism. It may be mentioned, that Averroes wrote also a commentary on the *Republic* of Plato. Though professedly a Mussulman, the tendency of his doctrines was such as not unreasonably to call his orthodoxy in question. Holding that what was true in religion was not necessarily so in philosophy, he seems to have regarded the one as but a system of exoteric doctrine, of which the other was the proper interpreter and the final consummation.

Arabian philosophy attained its culminating point in Averroes, and after him no eminent name is found in its history. His doctrines were long of high authority in the Jewish and even in the Christian schools. They gave rise in the thirteenth century to great contentions, which continued till the sixteenth century, when Leo X. issued a bull against them in 1512. The disputes were carried on principally between the followers of Alexander of Aphrodisias, or Alexandrians, and the Averroists, or professed disciples of the Arabian philosopher. One of the chief points on which the latter laid themselves open to the charge of heresy, was the immortality of the soul. Among others Albert the Great and Aquinas wrote treatises against the principles of Averroes.

Many of the treatises of Averroes have never been printed. The first complete Latin edition of his works, containing also the Latin of the Aristotelian text, is that of Mantinus, a Jewish physician, in 11 vols. fol., Venice, 1552. The first eight volumes contain the *Commentaries;* the ninth, besides two other treatises, the *Destruction of the Destruction*, written in reply to Algazel (see ALGHIAZZALI); and the tenth is chiefly taken up with his great medical work the *Colliget* (*Kulliyyat.*) The last contains miscellaneous treatises. There have been numerous

Averrunci || Avianus.

editions of separate treatises of Averroes. (Brucker, *Hist. Crit.* iv. 62, Leipz.; Tennemann, *Geschichte der Philos.; Dict. de Sc. Philos.;* Wüstenfeld, *Geschichte der Arab. Aertze*, Götting. 1840; Renan's *Averroes et l'-Averroisme*, Paris, 1852.)

AVERRUNCI (Dei), in *Pagan Mythology*, a name given to certain gods who were specially invoked to avert misfortunes; as Apollo and Hercules among the Greeks, and Castor and Pollux among the Romans.

AVERSA, a town of Naples, province of Terra di Lavoro, situated in a beautiful plain covered with orange-groves and vineyards, about midway between Naples and Capua. It is the seat of a bishopric, said to be the richest in the kingdom, and its foundling hospital and lunatic asylum are very celebrated. Pop. 16,000.

AVESBURY, Robert of, an English historian, of whom little more is known than that he was a keeper of the registry of the court of Canterbury in the reign of Edward III. He wrote a history in Latin of the reign of that prince, ending with the battle of Poictiers, in the year 1356. It was printed at Oxford in 1720 by Hearne.

AVESNES, an arrondissement in the department of Nord, in France, containing 10 cantons and 152 communes. Pop. in 1851, 145,046. The capital, of the same name, is situated in a fertile district on the Greater Helpe. It is generally well built, and is fortified on Vauban's system. Its principal building is the cathedral, surmounted by a tower 330 feet high, which is raised on four columns, and has a fine chime. It is the seat of a sub-prefect, and has a tribunal of primary jurisdiction, an agricultural society, and a communal college. Pop. in 1851, 2946. The principal manufactures are hosiery, coarse serge, and soap; there are also breweries, tanneries, salt-refineries, and brick and marble works. A great part of the town was destroyed by the explosion of a powder-magazine during the siege by the Prussians in July 1815.

AVESTA, a mining village of Sweden, on the Dal-elf, 35 miles S.E. of Fahlun. It has extensive copper and iron founderies, cloth manufactories, and saw-mills. The copper coin of the country was formerly struck here. Pop. 700.

AVEYRON, a department in the S. of France, in the ancient province of Guienne. Area 3429 square miles. It is divided into five arrondissements as follows:—

Arrond.	Cantons.	Communes.	Pop., 1851.
Rodez.....	11	75	108,588
Espalion	11	43	67,698
Milhau.....	7	46	65,625
St Affrique	6	41	60,038
Villefranche	7	54	92,234
	42	259	394,183

A portion of this department is mountainous, but about one-half is under cultivation, nearly one-fourth heath, one-tenth woods and forests, and rather more than an eighth part meadow land. Vineyards occupy about one-twelfth part of the cultivated land. It has mines of copper, lead, silver, iron, zinc, and antimony; besides considerable coal-fields of great value. The inhabitants are extensively engaged in the rearing of cattle; and there are manufactures of paper, woollen and cotton goods, and leather, to which water-power is skilfully applied. Aveyron exports corn, chestnuts, almonds, hemp, wool, wax, cheese, timber, and cattle. The capital is Rodez.

AVEZZANO, a town of Naples, in Abruzzo Ulteriore II., containing a castle belonging to the Colonna family. Pop. about 3000. Long. 13. 32. E. Lat. 41. 58. N.

AVIANUS or Anianus, *Flavius*, the reputed author of 42 Æsopean fables in Latin elegiac verse. They are of little merit, and apparently belong to the third or fourth century of our era. *Editions.* By Cannegieter, Amstel. 1731; Nodell, Amstel. 1787; Lachmann, Berol. 1845. They were translated into English by Caxton in 1483.

Aviary || Avicenna.

AVIARY, a place set apart for feeding and breeding birds. Aviaries are of various kinds, being sometimes artificially warmed to adapt them for exotic birds. They are occasionally of great extent, inclosing large trees by means of netting thrown over them.

AVICENNA (a corruption of Ibn-Sina), a celebrated Arabian physician and philosopher, honoured with the title of *Sheikh-al-rais*, or the *prince of physicians*, was born at Afshena, near Kharmeithan, a city of Bokhara, where his father, a native of Balkh in Persia, held the office of governor. After some years his father returned to the city of Bokhara, and here Avicenna was educated with extreme care. At the age of ten he was already perfectly versed in the theology of the Koran, in arithmetic, algebra, and the principles of grammar and law. Abu-Abdallah Nathili, a native of Naplous in Syria, at that time professed philosophy at Bokhara with high reputation. Under him Avicenna studied Porphyry's *Introduction to the Categories of Aristotle*, Euclid's *Elements*, and the *Almagest* of Ptolemy; and having soon surpassed the attainments of his master, he began to study the higher sciences alone. In philosophy he devoted himself chiefly to the works of Aristotle, whose *Metaphysics* he is said to have read *forty* times before he fully apprehended the meaning. At the age of 16, he was seized with a passion for natural philosophy and medicine, which he studied under a Christian physician named Ben-Yahya. After some time he resumed his philosophical studies with so much ardour, that for a year and a half he never slept for a whole night at a time. At the age of 18 he had acquired so high a reputation that the Emir Nouk Ibn-Mansur, who was a sufferer from severe disease, put himself under his care, and derived so much benefit from his skill, that Avicenna was loaded with favours. Among these not the least was the use of the rich library of the prince, in which he found opportunity for perfecting himself in scientific knowledge. This library was some time after consumed by fire, an accident which was maliciously attributed to Avicenna, who was accused of wishing to destroy the works by which he had so amply profited. At the age of 21 he composed a complete body of science, with the exception of mathematics, to which he gave the name of the *Collection*. On the death of his father, whom he had latterly assisted in his public duties, he quitted Bokhara and lived for some time in Djordjan, and other towns of Kharasm and Khorassan. At Djordjan he formed the acquaintance of Abu-Mohammed Schirazi, a powerful patron of science, who gave him a house, in which he delivered public lectures on logic and the *Almagest*. Here Avicenna wrote several treatises for his friend, and began his great work the *Canon of Medicine*. On leaving Djordjan he changed his residence several times, and finally settled at Hamadhan, the prince of which, Schems-ed-Daulah, in reward for his medical services, made him his vizier. Having given dissatisfaction to the emir's troops, he was forced to retire into concealment, but was soon recalled, and restored to all his honours. Every evening he gave lessons in philosophy and medicine, at the conclusion of which musicians and dancers were called in, and the rest of the evening was spent in festivity. During this time he composed his great philosophical work the *Al-Schefa*, and continued to write the *Canon*. After the death of Schems-ed-Daulah, Avicenna lost favour at court, and having been convicted of secretly corresponding with the prince of Ispahan, he was shut up in a fortress. He succeeded at length in making his escape, and found his way to Ispahan, where he enjoyed an honourable repose during the last fourteen years of his life, during which time he composed the greater part of his numerous works. He accompanied his new master in numerous warlike expeditions,

Avienus || Avila.

the fatigues of which finally subdued a constitution injured by severe study and excess. Seeing his end approaching, he distributed his goods among the poor, freed his slaves, and betaking himself to devotion, prepared to die as a good Mussulman. He died at Hamadhan in the 428th year of the Hegira (A.D. 1036) in the 57th year of his age. His excesses and infirmities gave rise to the saying, that the profound study of philosophy had not taught him good morals, nor that of medicine the art of preserving his own health.

Avicenna, after his death, enjoyed so great a reputation, that till the twelfth century he was preferred for the study of philosophy and medicine to all his predecessors. Even in the schools of Europe his writings were held in high esteem. Of his works, said to amount to more than a hundred, the principal are his *Canon of Medicine*, which long enjoyed an immense reputation as a body of medical science, and has been often reprinted in a Latin translation; and the *Al-Schefa* or *Healing*, an encyclopædia of philosophy, of which the greater part exists in MS. in the Bodleian library. (Abulfarag. *Hist. Orient.* ed. Pocock, Oxon. 1672; Ibn-Khallikan, *Dict. Biogr.* ed. M. de Slane, Paris, 1842; Casiri *Biblioth. Arab. Hisp.*; Aboulfeda, *Annales*, Copenh. 1789; *Mines de l'Orient*, t. iii. p. 167.)

AVIENUS, Rufus Festus, a Latin poet, who appears to have flourished in the latter half of the fourth century. He is the author of the following works:—1. *Descriptio Orbis Terræ*, sometimes called *Metaphrasis Periegeseos Dionysii*, being derived from the περιήγησις of that writer; 2. *Ora Maritima*; 3. *Aratea Phænomena*, and *Aratea Prognostica*, which are paraphrases of two works of Aratus. These poems, with the exception of the last two, are contained in Wernsdorf's *Poëtæ Latini Minores*, vol. v. pt. ii.

AVIGLIANO, a town of Naples, province of Basilicata, 11 miles N.N.W. of Potenza. It stands on the declivity of a hill, and has a fine collegiate church, several convents, and a royal college. The surrounding country is said to produce the finest cattle in the kingdom. A part of the town was destroyed by a land-slip in 1824. Pop. 9000.

AVIGNON, an arrondissement in the department of Vaucluse, in France, divided into 5 cantons and 20 communes; area 124,304 acres. Pop. in 1851, 78,382. The capital, of the same name, is situated in a beautiful valley on the left bank of the Rhone. It is surrounded by walls planted with trees, which form an agreeable promenade. The houses are old but large, the streets narrow and crooked; but several of the public edifices are magnificent, particularly the cathedral and the ancient palace of the popes. Pop. 31,812. It is the seat of an archbishop, and has tribunals of primary jurisdiction and commerce, a royal college, a theological seminary, a society of arts, a normal school, a public library, theatre, &c. The chief object of industry is the preparation of silk, and the manufacture of silk goods; there are also manufactures of paper, leather, hats, jewellery, &c. Till the French revolution this city belonged to the papal see, and was the residence of the several popes from 1303 to 1376. It was seized by the republicans in 1791, and after some barbarous proceedings was at length united to France. The name of Petrarch is associated with Avignon; and here he first beheld the Laura whom he has immortalized. Long. 4. 52. 20. E. Lat. 43. 56. 58. N.

AVILA, a province of Spain, one of the modern divisions of the kingdom of Old Castile. It is situated between Long. 4. 14. and 5. 55. W., and Lat. 40. 48. and 41. 18. N.; and is bounded on the N. by Valladolid; E. by Segovia and Madrid; S. by Toledo and Caceres; and W. by Salamanca. Area 277 square leagues; population in 1849, 132,936. It contains one city, 72 towns, 326 villages, and 334 parishes. It is judicially divided into 6 districts or *partidos*; but naturally consists of two sections, differing completely in soil, climate, productions, and social economy. The northern portion, comprehending the Moraña, the district of Arevalo, part of Avila and Piedrahita, and the plain of Pajares, is generally level; the soil is of indifferent quality, strong and marly in a few places, but in all the valleys of the Sierra de Avila, rocky; and the cold of winter is compensated by extreme heat in summer. The population of this part is agricultural. The southern division, comprehending the districts of Arenas de San Pedro, Cebreros, Barco, and part of Piedrahita and Avila, is one mass of rugged granitic *sierras*, interspersed, however, with sheltered and well-watered valleys, abounding with cattle and rich vegetation. The winter here, especially in the elevated region of the Paramera and the waste lands of Avila, is long and severe, but the climate is not unhealthy. The inhabitants live by the rearing of cattle. The principal mountain chains are the Guadarrama, separating this province from Madrid, and the Sierras de Avila, a continuation of them westward, the Sierra de Gredos, running from the S. of Piedrahita through Barco, Arenos, and part of Cebreros, and the Paramera, stretching southwards from the city of Avila into Arenas and Cebreros. The various ridges which ramify from the latter are covered with wood, presenting a striking contrast to the bare peaks of the Sierra de Gredos, and the barren levels in which they rise on the N. The principal rivers are the Alberche, flowing through the districts of Piedrahita and Avila towards Madrid and Toledo; the Tormes, through Piedrahita and Barco into Salamanca; the Corneja, from E. to W. through the valley of the same name and joining the Tormes; the Adaja, rising at the foot of the Pass of Villatoro, flowing through the valley of Ambles, and entering Valladolid; and the Tietar through Cebreros and Arenas into Caceres. The mountains contain silver, copper, iron, and lead, but their mineral wealth has been greatly exaggerated, and has not yet been subjected to any continued trial. Quarries of fine marble and jasper exist in the district of Arenas.

Avila || Aviles.

This once flourishing province has gradually declined in wealth and population during the last two centuries, a result due less to the want of activity on the part of the inhabitants than to the oppressive manorial and feudal rights and the strict laws of entail and mortmain, which have acted as barriers to improvement. The principal production is the wool of the Merino sheep, which at one time yielded an immense revenue. Game is plentiful, and the rivers abound in fish, especially trout. There is little trade, and the manufactures are few, consisting chiefly of copper utensils, lime, soap, cloth, paper, combs, &c. The state of elementary education is comparatively good, and the ratio of crime is proportionately low. (Madoz, *Diccionario de España.*)

Avila (ancient *Abula*), a city of Spain, the capital of the above province, is situated on the right bank of the Adaja, about 3000 feet above the sea-level, at the termination of the Guadarrama Mountains. It is surrounded by an ancient wall still in good preservation, about two miles in circumference, crowned by a breastwork, with towers of great strength. Avila is the seat of a bishop suffragan to Santiago, and has a Gothic cathedral, 8 parish churches, several monasteries and schools, an infirmary and a foundling hospital. It was formerly the seat of a university, and had large woollen manufactures, but its institutions and industry have greatly decayed. The inhabitants now maintain about 15,000 head of sheep. This is the birthplace of Sta Teresa de Jesus, the patroness of Spain. Pop. 4121.

Avila, *Gil Gonzalez d'*, a Spanish biographer and antiquary, born at Avila about the year 1577, died in his native city in 1658. He was made historiographer of Castile in 1612; in 1641 he was made, in addition, historiographer of the Indies. Among his numerous works, the most valuable are his *Teatro de las Grandezas de Madrid* (Madrid, 1623, fol.), and his *Teatro Eclesiastico*, descriptive of the metropolitan churches and cathedrals of Castile, with lives of the prelates. (Madrid, 1645–53, 4 vols. 4to.)

AVILES, *San Nicolas de*, a town of Spain, province of

Avison ‖ Avon.

Oviedo, about a league from the sea-coast, in Lat. 43. 34. N. Long. 5. 58. W. It has a considerable trade by means of its port, which affords good anchorage for all classes of vessels; and has been chosen as the terminus for the great North of Spain Railroad to Madrid. A line of steam packets between Falmouth and Aviles will thus bring London and Madrid within four days of each other, should that line ever be completed. There are here some copper works, and in the neighbourhood are veins of iron and coal, which, however, have not been worked. The stone quarries are extensive and productive. Aviles has two parish churches, a theatre, and an excellent public school, with an attendance of 400 pupils. Pop. 5600.

AVISON, CHARLES, an organist at Newcastle-on-Tyne, was a pupil of Geminiani, that able violinist, but dry and uninteresting composer. In 1752, Avison published *An Essay on Musical Expression*, in which he had the amazing folly to hold up his master as superior to Handel. It appears that this book was not written by himself, but by his friends Dr John Brown and William Mason. Dr William Hayes, Professor of Music at Oxford, published in 1753 *Remarks* on Avison's Essay, in which he severely criticised the latter, as well as Avison's musical compositions. Avison replied unsatisfactorily in a second edition of his Essay, in the same year. Avison's music has little merit; but he did a service to the art, by pointing out in his essay the excellence of B. Marcello's music to the psalms, and by proposing their republication in England with English words. Mr John Garth, organist at Durham, undertook to do this, and, aided by an extensive subscription, completed the work in eight volumes folio. Avison died at Newcastle in 1770. (G. F. G.)

AVIZ, a walled town of Portugal, on the river of the same name in Alentejo, and containing about 1500 inhabitants. It is still the headquarters of the knights of the order of *Avis*, founded by Alphonso I. in 1146. Its defences are in ruins.

AVLONA or VALONA, a town and seaport of Albania, capital of the pashalic of the same name. It stands on an eminence near the Gulf of Avlona, an inlet of the Adriatic, and has a fort in Lat. 48. 27. 5. N. Long. 19. 26. 5. E. The port, which is protected by the island of Sasseno, is the best on the Albanian coast. Population, including suburbs, about 9000, comprising Christians, Turks, and Jews. The Christian population are principally engaged in commerce, and the Turks in the manufacture of woollen stuffs and arms. The material imported into this country for tanning, under the name of *Valonia*, is the pericarp of an acorn produced in that country.

AVOIRDUPOIS, the name of a weight, derived from the French, *avoir du poise, to have weight*. Its pound contains 16 ounces, in distinction to the pound troy which has only 12. This weight is used for groceries and all other commodities except the precious metals, gems, and medicines. The pound avoirdupois contains 7000 grains troy, and is equal to 8532·5 Paris grains. See WEIGHTS and MEASURES.

AVOLA, a city on the coast of Sicily, in the intendancy of Syracuse, with 7000 inhabitants. There are sugar plantations near it; and it has some trade in wine, grain, oil, honey, &c.

AVON, a Celtic word signifying a river, is the name of several rivers in Britain, the principal of which are:—1. UPPER AVON, which rises at Avon-well, near Naseby, in Northamptonshire, flows through the counties of Leicester, Warwick, and Worcester, passing Stratford and Evesham, and falls into the Severn at Tewkesbury. Its length is nearly 100 miles, and it is navigable for barges of 40 tons up to Stratford. Its principal affluents are the Alne, the Leame, the Stour, the Sow, and the Swift.—2. LOWER AVON rises near Tetbury, flows westward through the counties of Gloucester, Wilts, and Somerset, and passing Bristol enters the Bristol Channel 10 miles below that city, after a course of about 80 miles.—3. AVON, HAMPSHIRE, rises near Devizes, flows generally southward through Wiltshire and Hampshire, and falls into the English Channel a little below Christchurch, after a course of 65 miles.

Avranches ‖ Axholm.

AVRANCHES, an arrondissement in the department of Manche, in France, containing 9 cantons and 123 communes. Area 243,292 acres. Pop. in 1851, 117,032. The chief town, Avranches (*Abrincæ*), was in the time of the Romans an important military station, and has in more modern times sustained several sieges. It stands on a wooded hill, commanding a fine view of the bay and rock of St Michel, about three miles distant. At the foot of the hill flows the River Seez, which at high tide is navigable from the sea. The principal trade is in corn, cider, and salt. Avranches was formerly a bishop's see; and its cathedral, destroyed in the time of the first French Revolution, was the finest in Normandy. Its site is now occupied by an open *place*, called after the celebrated Huet, Bishop of Avranches. The agreeable situation and climate of this town make it a favourite residence of English families. Pop. 8580.

AWARD, in *Law*. See ARBITRATION.

AWE, LOCH, a large and picturesque fresh-water lake of Scotland, in the county of Argyle, eight miles N.W. of Inverary. It is 24 miles in length, with an average breadth of 1 mile, and is surrounded by lofty mountains of a rugged and savage aspect, the highest of which (Ben Cruachan) rises to the height of 3670 feet. It receives several small streams, one of which connects it with Loch Avich, a small lake about 6 miles long, 3 miles distant. The Awe, a small river 7 miles in length, connects it with Loch Etive, an arm of the sea, at Bunawe. Loch Awe contains about 24 small islands, some of them beautifully crowned with trees. On one of these, Innis Aill', or the Beautiful Isle, are the ruins of a small Cistercian nunnery, and an old churchyard, containing a number of ancient tombstones curiously carved. On Innis Fraoch, or the Heather Isle, are the ruins of an ancient castle, once the residence of the chief of the Macnaughtans. The ruins of the celebrated castle of Kilchurn stand on a slightly elevated neck of land at the head of the lake. Its square tower is said to have been erected in 1443 by the lady of Sir Colin Campbell, the Black Knight of Rhodes, and founder of the powerful family of Breadalbane. So late as 1745 Kilchurn was garrisoned by the king's troops, and all the exterior and the greater part of the interior walls are still entire. The lake abounds in fish, and is especially famed for the size and excellence of its trout.

AXAMENTA or ASSAMENTA, in *Antiquity*, verses or songs of the *Salii*, which they sung in honour of Mars, certain other gods, and heroes. The *axamenta* were not composed, as some have asserted, but only sung by the *Salii*. They were as old as the Roman state, but tradition made Numa their author. They grew in time so obscure that the *Salii* themselves did not understand them. Varro, *De Ling. Lat.*, vii. p. 285; Quint., *Inst. Or.*, lib. i. c. 11.

AXBRIDGE, a market-town, formerly a borough, in the county of Somerset, 130 miles from London. It is situated on the river Axe, below the range of the Mendip hills, near the great chasm known by the name of Chedder Clift. The church is a large Gothic edifice of great antiquity, near which stands the market-house. Market-day, Saturday. Pop. in 1851, 939.

AXE, a carpenter's instrument for hewing wood. It is furnished with a long handle or helve, for the purpose of being used with both hands. The small axe for one hand is called a hatchet.

AXEL, a small fortified town of Holland, province of Zealand. Long. 3. 54. E. Lat. 51. 16. N.

AXHOLM, an island in the N.W. part of Lincolnshire, England, formed by the rivers Trent, Idle, and Don. It is

about 17 miles in length by 5 in breadth, and comprises the parishes of Althorpe, Belton, Crowle, Epworth, Haxey, Luddington, and Owston.

AXILLA, in *Anatomy*, the armpit, or the cavity under the upper part of the arm. See ANATOMY.

AXIM, a town on the Gold Coast of Africa, belonging to the Dutch. Lat. 4. 52. N. Long. 2. 14. W.

AXINOMANCY, AXINOMANTIA, (from ἀξίνη, *an axe*, and μαντεία, *divination*;) an ancient species of divination, or a method of foretelling future events by means of an axe or hatchet. This art was in considerable repute amongst the ancients, and was performed, according to some, by laying an agate stone on a red-hot hatchet, and also by fixing a hatchet on a round stake so as to be exactly poised; then the names of those suspected were repeated, and he at whose name the hatchet moved was pronounced guilty.

AXIOM, AXIOMA (from ἀξιόω, *I account worthy*), a self-evident truth, or a proposition the truth of which every person perceives at first sight; as, *the whole is greater than its part; a thing cannot at the same time be and not be; from nothing nothing can arise.* Every science has its particular axioms or elementary principles, which are assumed as the necessary basis of all reasoning. Thus, it is an axiom in physics, that nature does nothing in vain; that effects are proportional to their causes, &c. It is an axiom in geometry, that things equal to the same thing are also equal to one another; that if to equal things you add equals, the sums will be equal, &c. And it is an axiom in optics, that the angle of incidence is equal to the angle of reflection, &c.

AXIS, in *Geometry*, the straight line in a plain figure, about which it revolves, to produce or generate a solid. Thus, if a semicircle be moved round its diameter at rest, it will generate a sphere whose axis is that diameter.

AXIS, in *Astronomy*, is an imaginary right line through the centre of the earth, or through that of a heavenly body, about which it performs its diurnal revolutions.

AXIS, in *Conic Sections*, a right line dividing the section into two equal parts, and cutting all its ordinates at right angles.

AXIS, in *Mechanics*. The axis of a balance is that line about which it moves, or rather turns about. *Axis of oscillation* is a right line parallel to the horizon, passing through the centre, about which a pendulum vibrates.

AXIS in Peritrochio (περὶ *about*, and τροχὸς, a *wheel*), one of the six mechanical powers, consisting of a peritrochium or wheel concentric with the base of a cylinder, and moveable together with it about its axis. See MECHANICS.

AXIUS, a river of Macedonia, now the Vardar, falling into the Gulf of Salonichi.

AXMINSTER, a market-town in the hundred of the same name, county of Devon, 147 miles from London, and 24 from Exeter. It takes its name from the river Axe, on which it stands. The ancient abbey church or minster which ornaments the centre of the town, was built by King Athelstane to commemorate a victory over the Danes. The town is distinguished for its manufactory of the best and most costly description of carpets; and has also manufactures of broad and narrow cloths, cotton, leather, gloves, tapes, and druggets. Market-day, Saturday. Pop. in 1851, 2769.

AXUM, the old capital of Abyssinia. There is here a monolith obelisk 60 feet high, covered with hieroglyphics, but different from those of Egypt. See ABYSSINIA.

AY, or AI, a town of France, 5 leagues S. of Rheims, in the department of Marne. It is celebrated for its wines, which are esteemed superior to any in Champagne. Pop. 3382.

AYACUCHO, a plain in Peru, on which the power of Spanish South America was broken by the republicans in 1824. The viceroy, 15 generals, and 3200 men were made prisoners.

AYAMONTE, a city of Spain, in the province of Huelva, on the left bank of the Guadiana, which empties itself into the ocean about two miles from this place. Ayamonte is well fortified, and the harbour is good, but, on account of a bar at its mouth, it is of difficult entrance. The principal employment of the inhabitants is afforded by the fisheries, especially for sardines, tunny, cod, and horse-mackerel. But this branch of industry has suffered by the extension of the general coasting traffic. Ayamonte is said to have had in the sixteenth century 16,000 inhabitants. Present Pop. 4675. Lat. 37. 9. N. This also is the name of a town in Portugal, in the province of Alentejo, 3 miles N.W. of Minfort.

AYEEN-AKBERY, a statistical account of the Indian Mogul empire during the reign of Akbar, by his vizier Abul-Fazi. It has been translated into English by Gladwin, and is esteemed for its accuracy.

AYLESBURY, a market and borough town of England, county of Buckingham, 39 miles N.W. of London. It stands on a gentle eminence in the centre of a fertile vale, and consists of several streets and lanes irregularly built, but well paved and lighted. The county-hall, market-house, and new county-gaol are handsome buildings, as is also the parish-church, an ancient structure with a tower rising from the centre. It has a free grammar-school, several other schools and charities, three banks, a savings-bank, and places of public worship for Roman Catholics, Methodists, Baptists, Independents, &c. It is governed by a mayor, aldermen, and councillors, and returns two members to parliament. The assizes, quarter sessions, and the elections of members for the county are held here. The inhabitants are principally employed in the manufacture of bonelace and straw plaiting, besides the rearing of ducks, which are sent in large quantities to the London market at Christmas. A branch canal six miles in length connects it with the Grand Junction Canal; and a branch railway at Cheddington connects it with the London and Birmingham line. Population of parliamentary borough in 1851, 26,794.

AYLESFORD, a village of England, county of Kent, 3½ miles from Maidstone, and 32 from London. It stands at the base of a hill on the right bank of the Medway, which is here crossed by a stone bridge of six arches. The church stands on an eminence behind the village. At a short distance to the W. was a Carmelite friary, founded in 1240, the remains of which now form a part of the family mansion of the Earl of Aylesford. The vicinity exhibits several remains of antiquity, among which is a cromlech called Keit's Coty House, about a mile N.E. from the village. It is said to mark the burial-place of Catigern, who was slain here in a battle between the Britons and Saxons in A.D. 455. Pop. of parish in 1851, 1487.

AYLMER, JOHN, bishop of London in the reign of Queen Elizabeth, was born in the year 1521 at Aylmerhall, in the parish of Tilney, in the county of Norfolk. Whilst a boy, he was distinguished for his quick parts by the Marquis of Dorset, afterwards Duke of Suffolk, who sent him to Cambridge, and made him his chaplain, and tutor to his children. One of these children was the accomplished and unfortunate Lady Jane Grey, whose extraordinary proficiency in the Greek and Latin languages reflects no small honour on her preceptor Aylmer. His first preferment was to the archdeaconry of Stow, in the diocese of Lincoln; which gave him a seat in the convocation held in the first year of Queen Mary, where he resolutely opposed the return to popery, to which the generality of the clergy were inclined. He was soon after obliged to fly his country and take shelter among the Protestants in Switzerland. While here he wrote a reply to Knox's famous *Blast against the monstrous Regiment of Women*, under the title of *An Harborowe for Faithfull and Trewe Subjects*, &c. On the accession of Queen Elizabeth he returned to England. In 1562 he obtained the archdeaconry of Lincoln, and was a member of the famous synod of that year, which reformed

Aylsham ‖ Ayr.

and settled the doctrine and discipline of the Church of England. In 1576 he was consecrated bishop of London. He died in 1594.

AYLSHAM, a market-town of England, county of Norfolk, hundred of South Erpingham, 118 miles N.N.E. of London. It stands on the River Bare, which is here navigable for boats of 13 tons. It was formerly celebrated for its linen manufacture, and more recently for its hosiery; but both these have declined, and the inhabitants are now chiefly engaged in agriculture. Pop. in 1851, 2184.

AYORA, a well-built town in the *partido* of Jarafuel and province of Valencia, in Spain. It is pleasantly situated in a hollow at the side of a mountain, which protects it from the S. and E. wind. Pop. 3785, chiefly agricultural.

AYR, a royal burgh, the capital of Ayrshire, is situated at the mouth of the river Ayr, 30 miles S.S.W. from Glasgow. The spot has been inhabited from a remote antiquity. It was the site of a Roman station; and it has been ascertained that a hamlet remained here until the year 1197, when William the Lion engrafted a new town upon it, which about the year 1202 he constituted a royal burgh. In ancient times Ayr was distinguished both for its trade and military strength; and being an important point of concentration on the W., it was the scene of frequent conflicts, and repeatedly changed hands during the wars of Scottish independence in the time of the Edwards and the Bruces. Here Edward I. fixed a powerful garrison, and here the patriotic exploits of Sir William Wallace commenced. When Scotland was overrun by Oliver Cromwell, he fixed upon it as the site of one of the four forts which he built to command the country. This fortification, termed the citadel, inclosed an area of about ten or twelve acres, including the old church where the Scottish parliament met and confirmed the title of Robert Bruce to the throne. The church was converted into a storehouse; the Protector partly indemnifying the inhabitants for this seizure by liberally contributing towards the erection of a new place of worship, which was made large enough to accommodate 2000 individuals. The town of Ayr forms a tolerably regular parallelogram, extending up the S. side of the river Ayr, which is crossed by two bridges; and it possesses several good streets and a number of elegant public and other buildings. The Ayr academy is a handsome edifice; and the town-house is considered one of the finest structures of the kind in the W. of Scotland. There are also the county buildings, which afford extensive accommodation for the circuit and provincial courts and the various local authorities. Contiguous to these stands the jail, a well-regulated establishment. In addition to the church already mentioned, there is another parish church of modern erection, besides several dissenting places of worship and a Roman Catholic chapel. The new "Wallace Tower," a Gothic structure, erected on the site of the old one, which was taken down in 1835, has, at the top, the clock and bells of the dungeon steeple. In a niche in front is a rude statue of Wallace, executed by Thom, a self-taught sculptor. The "Public Buildings" is a handsome edifice, containing assembly rooms and a reading room, and surmounted by a spire 217 feet high. Ayr possesses numerous charitable establishments, a dispensary, a mechanics' institution, an extensive subscription library, a theatre; and it also supports two weekly newspapers. There are two weekly markets and four yearly fairs. The principal manufactures of Ayr are woollen and cotton goods, carpets, shoes, &c.; the fisheries and ship-building are also carried on to a small extent. It has a considerable general trade, and imports timber and deals from America, hemp and iron from the Baltic, and provisions from Ireland. Its principal export is coal. The gross amount of customs collected at the port during 1850 was L.1835. The harbour at the mouth of the river is formed by two piers projecting a considerable way into the sea, but the bar has only a depth of about 5 feet of water at ebb tides, and not above 15 at high-water springs. On the north pier in Lat. 55. 27. N. Long. 4. 38. W. are three lights, two bright and one red, from 12 to 35 feet above high water. In 1849, 49 vessels (of 6483 tons) belonged to the port. Ayr is connected by railway with Glasgow, Kilmarnock, &c. It unites with Campbeltown, Inverary, Irvine, and Oban, in returning a member to parliament. In 1851 the municipality of Ayr contained 9115 inhabitants; the parliamentary burgh 17,624, consisting of part of the parish of Ayr (7894), of Newton-upon-Ayr (4470), and of St Quivox (5260). Alloway Kirk, and Burns' Monument, are within 2½ miles of Ayr.

Ayr ‖ Ayrshire.

AYR, NEWTON UPON. While the town of Ayr extends along the S. side of the river Ayr, this small parish is situated on the N. side of the same river. It is a burgh of considerable consequence, having a baronial jurisdiction, and is governed by a magistracy elected by freemen, and (since 1832) is comprehended within the parliamentary burgh of Ayr. It is of very ancient erection, owing its privileges to Robert Bruce; who, upon being attacked by leprosy, came to reside in this place, and was induced to establish a lazarhouse, and to confer considerable favours on the town, and on the small village of Priestwick, about two or three miles distant. In Newton-upon-Ayr are a number of very good houses. From its situation on the banks of the Ayr and the sea-coast, the soil is mostly flat and sandy. Its extent is about three miles in length and one-and-a-half in breadth. Pop. in 1851, 4814.

AYR, a river in Ayrshire, which takes its rise in the high grounds dividing the shire on the E. from Lanarkshire, and pursuing a westerly course for 18 miles, falls into the sea at the town to which it gives name. The volume of its waters is not large, but it sometimes shifts its bed, and does considerable damage. It contains those whetstones called Water-of-Ayr stones, which are exported in considerable quantities.

AYRSHIRE, a county in the W. of Scotland, considerable for its population and industry, is bounded by Wigtonshire and the stewartry of Kirkcudbright on the S., by the counties of Dumfries and Lanark on the N.E. and E. by Renfrewshire on the N., and by the Irish Sea and the Firth of Clyde for about 70 miles on the W. It contains 1015 square miles, or 650,156 statute acres. The middle part of the county, where it is broadest, is about 25 miles across. The high ridgy land which stretches along its eastern boundary shuts it out, in a general sense, from the adjacent counties, and the surface inclines either to the sea or to the rivers which flow towards it. Ayrshire possesses only six rivers of note, Ayr, Stinchar, Girvan, Doon, Irvine, and Garnock; but the streams are very numerous, and fresh-water lakes abound, of which the most extensive is Loch Doon, the parent of the river of that name. None of the mountains are deserving of particular notice. In former times the shire was divided into three districts; Carrick lying on the southern side of the Doon; Kyle, lying between the rivers Doon and Irvine; and Cunningham, comprehending the whole of the county N. of the river Irvine. These divisions, although abolished by the statute, still continue to be recognized in statistical descriptions of the county. Carrick is a hilly, wild region, and only of value in its northern quarter. It contains nine parishes, and comprises 380 square miles. Kyle possesses much valuable land towards the coast, but the interior is rough and mountainous; it contains 21 parishes, with a superficies of 395 square miles. But the most fertile part of the county is Cunningham, which is comparatively level, comprising 240 square miles, and 16 parishes. The valued rent is L.191,605, 0s. 7d. Scots, and in 1843 the annual value of houses and land was L.520,828 sterling. It returns a member to parliament. The advantages possessed

Ayrshire. by Ayrshire, besides its sea-coast and several excellent harbours, may be traced to the great abundance of coal and limestone found in almost every part of it,—the one so necessary to its manufactures, and the other to its agriculture; and the chief natural disadvantage under which it labours is the humidity of its climate, aggravated by the quality of a considerable part of the soil, which is a tenacious clay.

Agriculture. Agriculture, according to the more approved courses of management, has nevertheless made considerable progress of late in this county. Somewhat more than half a century ago, the greater part of it consisted of moss and moorlands, or of an unproductive clay or sandy soil. Since then great advances have been made, particularly within the last 10 or 15 years. One-half of the country is now under cultivation; improved rotations have been introduced, and draining has been carried on to a great extent, by means of which, as well as by being mixed with lime and other manure, much of the clay soil has been turned into a rich and productive mould; and now oats, wheat, barley, pease, beans, potatoes, and other agricultural produce are extensively raised. The dairy is, however, the chief object of attention to the Ayrshire husbandmen, and their valuable breed of cows, and rich yet mild cheese known by the name of Dunlop cheese, are in great repute. Their horses, under the general name of Clydesdale or Lanarkshire horses, are highly valued; almost every small farmer either rearing one or more himself, or purchasing them when young, and selling them to the eastern counties after a year or two of very moderate labour.

Manufactures. Ayrshire, as a manufacturing district, seems to stand next in importance among the Scottish counties to the contiguous shires of Lanark and Renfrew. Various branches of the woollen manufacture are carried on to a considerable extent in Kilmarnock, and other places, and extensive cotton works have been established at Catrine. Muslin, shawls, carpets, cloth, flax, linen, and silk goods, nails, leather, saddlery, and earthenware, are among its manufactures.

Minerals. Within these few years Ayrshire has become one of the most important counties of Scotland by the development of its mineral traffic. In the hands of persons of great capital and enterprize immense fields of ironstone are being worked at Dalry, Kilbirnie, New Cumnock, and Dalmellington; while coal, generally of good quality, is exceedingly abundant in the districts of Kyle and Cunningham. The coal and iron are extensively shipped at the ports of Troon and Ayr. There are coal-mines at Dalry, Kilwinning, Galston, Muirkirk, St Quivox, Coylton, and Riccarton; at Muirkirk, Glenbuck, and other places iron founderies have been erected; tiles are made of the clay for draining and other purposes; and millstones are quarried at Kilbride. On the property of the Honourable Colonel Macadam Cathcart, of Craigengillan, at Carsphairn, on the borders of Kirkcudbrightshire, lead mines have been for a period of years in operation, but without yielding large returns. The hills consist chiefly of granite, with whinstone, greenstone, red sandstone, &c.; and lime and whetstones abound.

Commerce. Ayr, Irvine, and Saltcoats, were, till very lately, the only harbours much frequented; and at these places there has long been a little trade with Ireland, America, and the Baltic, and a considerable coasting trade. Coal is the staple article of export, and corn the most considerable of its imports: the ports on the Clyde having hitherto been the grand emporium of the W. of Scotland.

Among the antiquities of Ayrshire are the cairns at Galston and Lorn; camps, supposed to be Danish, at Dundonald and on the hill of Knockgeorgan near Ardrossan; the castles of Loch Doon, Turnberry, Dundonald, Portincross, &c.; the abbeys of Crossraguel, and Kilwinning; and the kirk of Alloway, immortalized by Burns in his "Tam o' Shanter."

This county exhibits striking examples of public spirit in its great landed proprietors. The harbour and other works at Ardrossan, begun under the auspices of the late Earl of Eglinton, the harbour of Troon, and the railway from thence to Kilmarnock, formed almost entirely at the expense of the Duke of Portland, are monuments, no less of the energy and enterprizing spirit than of the wealth of these noblemen. Ayrshire || Ayscue.

Ardrossan harbour. The harbour of Ardrossan has been for many years in a state to receive shipping, and is considered as one of the safest, most capacious, and most accessible on the W. coast of Scotland; possessing many advantages over the harbours in the Firth of Clyde, situate in a narrow channel, which can be navigated only when the wind blows from particular points, and which, for upwards of 20 miles below Glasgow, is both shallow and dangerous. A circular pier of 900 yards was finished in 1811; and the wet dock and other appendages, which, according to Mr Telford's plan, were to contain from 70 to 100 vessels, in water 16 feet deep, were begun and nearly completed, when the death of the late Earl of Eglinton in 1820 brought them to a stand. They have now been completed by the present Earl. Excellent baths have been constructed, which draw to it a number of visitors during the summer season; and there is one expressly for the use of the poor, for which no charge is made. The harbour of Ardrossan was only part of the general plan, and that from which, viewed by itself, the smallest advantages perhaps were to be expected. The leading idea was to open up a direct communication between Glasgow, Paisley, and other large towns in the vicinity, and the W. coast, instead of the present circuitous passage by the Firth of Clyde. A canal was therefore to be cut from Glasgow to Ardrossan, about 31½ miles, at the estimated expense of L.125,000. Of this only a third has been executed, that is, from Glasgow to Johnstone, which cost about L.90,000, the canal having been superseded by the Glasgow and Ayr Railway. Canal.

Troon harbour. The harbour at Troon, connected as it now is with Kilmarnock by means of a railway, seems to possess the same advantages as that of Ardrossan. The wet and dry docks are excellent, and are well employed. There are also extensive warehouses, and a yard for building vessels. The railway from Troon to Kilmarnock, a distance of 10 miles, has been in operation for many years, and answers all the purposes for which it was originally intended. There are upwards of 3000 acres of coal fields in its course, which must in time indemnify the Duke of Portland for his outlay both on this and the harbour. This railway has cost the duke upwards of L.50,000, and the harbour is estimated at about the same sum. The Glasgow and Ayr Railway was opened in 1840, and is 40 miles in length; a branch of which goes from near Dalry to Kilmarnock, and another from near Kilwinning to Ardrossan. The Glasgow, Dumfries, and Carlisle Railway passes Kilmarnock, and sends off a branch to Muirkirk. A line from Ayr to Dalmellington is in progress. Railway

Population. The following abstract will exhibit a view of the population of Ayrshire in 1851:—

1851.						
Districts.	Houses.			Inhabitants.		
	Inhabited.	Uninhabited.	Building.	Male.	Female.	Total.
Carrick	4,575	128	15	15,455	15,847	31,302
Kyle	9,455	363	57	35,394	36,890	72,284
Cunningham	9,524	333	57	42,081	44,191	86,272
County	23,554	824	129	92,930	96,928	189,858

AYRY, or Aery, a nest or company of eagles or hawks, so called from the old French word *aire*.

AYSCUE, Sir George, a gallant English admiral, descended from a good family in Lincolnshire. He obtained the honour of knighthood from Charles I., but adhered to the parliament in the civil war. He was by them appointed admiral of the Irish seas, where he did great service to the

Ayton ‖ Azerbijan.

Protestant interest. In 1651 he reduced to the obedience of the parliament Barbadoes and Virginia, which then held out for the king; and after the Restoration he behaved with much gallantry in the war with the Dutch. In the famous engagement in the beginning of June 1666, when Sir George was admiral of the white squadron, his ship, the Royal Prince, ran upon the Galoper-sand, where, being surrounded with enemies, his men obliged him to strike. He went no more to sea after this, but spent the rest of his days in retirement.

AYTON, Sir Robert (1570–1638), a Scottish lyrical poet, was the son of Ayton of Kinaldie in Fifeshire. He was knighted by James VI., and held various important offices at court. Like his contemporary Drummond of Hawthornden, he had the advantage of foreign travel and acquaintance with English poets, among others with Ben Jonson. That great man seemed proud of the friendship, for he told Drummond that Sir Robert loved him dearly. Ayton wrote but little, and that little was in the English dialect. The smoothness of his rhythm, and the delicacy of his fancy, give an exquisite charm to the few pieces of his that have come down to us. His odes *On Woman's Inconstancy*, and *I do confess thou'rt smooth and fair*, may take rank with the finest pieces of Herrick or Suckling.

Ayton, a village and parish of Scotland, county of Berwick, on the River Eye. Pop. of parish in 1851, 1959. It is 7½ miles N.W. of Berwick.

AZAMOR, a small seaport town in the kingdom of Marocco, in the province of Dukalla. It is situated in a very fruitful district, near the mouth of the River Morbeya. Long. 8. 15. W., Lat. 33. 17. 37. N. Pop. 3000.

AZARIAH, or Uzziah, ninth king of Judah, succeeded his father Amaziah 810 years B.C. He assembled an army of above 300,000 men, with which he conquered the Philistines, demolishing the walls of Gath, Jabniel, and Ashdod, and built up the walls of Jerusalem, furnished the city with conduits, and planted gardens and vineyards; but at last, being elated with his prosperity, and resolving to usurp the office of high-priest, he was struck with leprosy, which obliged him to remain shut up in his palace for the rest of his days. He died about 757 years before the Christian era, and was succeeded by Jotham his son. (2 Kings; 2 Chron.) There are twelve other persons of this name mentioned in the Sacred Scriptures.

AZERBIJAN, a province of Persia, part of the ancient Media. It is separated from Armenia on the N. by the River Araxes; and from Irak on the S. by the Kizil-Ozein, or Golden Stream. It has the Caspian Sea and Ghilan on the E., and Armenia and Kurdistan on the W. The country is superior to the southern provinces of Persia, being richly diversified with wood and water. It differs entirely from the provinces of Fars and Irak, as it consists of a regular succession of undulating eminences, partially cultivated, and opening into extensive plains such as Anjan, Tabreez, and Urumea or Van. Near the centre of the province the mountains of Sahend rise in an accumulated mass to the height of 9000 feet above the sea. Mount Sevellan, towards its eastern frontier, attains a height of nearly 13,000 feet; and the Talish Mountains, which run from N. to S., parallel to and at no great distance from the Caspian, attain an altitude of 7000 feet. Azerbijan is a fertile country, and of a most pleasing aspect. It is reckoned one of the most productive provinces of Persia, and the villages have a more pleasing appearance than those of Irak. The orchards and gardens, in which they are for the most part embosomed, yield delicious fruits of almost every description. Provisions are cheap and abundant, and wine is made in considerable quantities. This province is watered by several considerable rivers, namely, the Araxes, the Kizil-Ozein, and the Juggaty. The Yezdican and the Harasa are tributaries of the Araxes; and the Agi and Shar flow into the lake of Urumea. This lake is about 300 miles in circumference. Its waters are more intensely salt than the sea. It is surrounded by some of the most fertile districts in Persia. The country to the N. and W., namely, the districts of Urumea and Selmart, is the most picturesque and prosperous part of Azerbijan; yet even here the traveller from the more civilized regions of Europe laments at every step the sloth and want of enterprize among the inhabitants, who entirely neglect the natural advantages of their country. There are many rivers which fall into the lake, by which the produce of the rich and well-cultivated valleys through which they run might be transported across its waters, and dispersed among the different towns in the province. The truth, however, is, that individual exertion is damped by the tyranny of the government; the inhabitants fearing that, if boats were constructed for the navigation of the lake, they would be subjected to heavy duties, or arbitrarily impressed into the service of government. The bulk of the people are so held down by their rulers, that, in the hope of bettering their condition, they would hail with pleasure the approach of a Russian army. Lead, copper, saltpetre, and sulphur, are found within the confines of Azerbijan; also a kind of beautiful transparent marble or jasper, which takes the highest polish, and is used in the buildings of Tabreez, Schiraz, and Ispahan, under the name of Tabreez marble. The chief towns are Tabreez, Urumea, Ardebil, and Khoee. The climate is healthful—in summer and autumn hot, but cold in winter, which is severely felt by the lower orders, owing to the want of fuel, for which there is no substitute except dried cow-dung, mixed with straw. The spring is temperate and delightful in the plains, but on the mountains snow lies eight months in the year; and hail-storms are so violent as frequently to destroy cattle in the fields. The best soils yield from fifty to sixty fold when abundantly irrigated; and supplies of water for this purpose are drawn from the many small rivers by which the province is intersected. Oxen are generally used to draw the plough. (Kinneir's *Geographical Memoir of the Persian Empire*; Fraser's *Travels and Adventures in the Persian Provinces on the Caspian Sea.*) (D. B—N.)

Azimuth ‖ Azoph.

AZIMUTH, in *Astronomy*, an arch of the horizon intercepted between the meridian of the place and the vertical circle passing through the centre of the object.

Azimuth, Magnetical, an arch of the horizon, intercepted between the vertical circle passing through the centre of any heavenly body and the magnetical meridian.

Azimuth Compass, an instrument for finding either the magnetical azimuth or amplitude of a heavenly object.

Azimuth Circles, called also *azimuths* or *vertical circles*, are great circles of the sphere intersecting each other in the zenith and nadir, and cutting the horizon at right angles. On these are reckoned the height of the stars and that of the sun when not in the meridian.

AZOGA Ships (from the Spanish *azogue, mercury*), vessels which carried quicksilver to the Spanish West Indies, in order to extract the silver from the mines of Mexico and Peru. They carried no goods except for the king.

AZOPH, or Asow, a city on the left bank of one of the arms of the Don, about 20 miles from its mouth. It was formerly a place of great importance, but has declined since 1774, when it became a fixed part of the Russian empire. The harbour is nearly choked up, and the fortifications are neglected. Pop. 1200. The country around, although unhealthy, is fruitful in vines. Long. 39. 8. E. Lat. 47. 6. N.

Azoph, *Sea of* (the *Palus Mæotis* of the ancients), an inland sea of Southern Europe, communicating with the Black Sea by means of the Strait of Yenikalé, the ancient *Bosphorus Cimmerius*. It lies between Lat. 45. 20. and 47. 18. N. and Long. 35. and 39. E.; its length from S.W. to N.E. being about 235 miles, and its greatest breadth 110 miles. The rivers Don, Kuban, Kalmius, and Breda, enter this sea, rendering its waters much less salt than the ocean; and in-

Azores. deed they are little more than brackish. Near its coast are the towns of Taganrog, Mariupol, Yenikalé, Azoph, and Berdiansk, which last has risen since 1835, from a mere village, to be the most important commercial town on this coast. Polybius affirmed that this sea was gradually filling up, so that at no remote period it would be unfit for navigation; and since his time the common opinion has been, that it was decreasing in depth; but recent observations have proved this idea to be erroneous. (Jones' *Travels*, vol. ii. p. 145.) Near the mouth of the Don the water is exceedingly shallow, being only from three to ten feet, according to the direction of the wind; but otherwise it varies from 42 feet in the centre, to an average of about 18 feet close to the shore. The Strait of Yenikalé has at all times a depth of at least 14 feet; and vessels of a greater draught may find secure anchorage where they can discharge their cargoes. The shipping season extends from about the middle of April to the end of November, and the sea is generally frozen from December to March. The fisheries here are very important.

AZORES, or Western Islands. These form a range situate in the Atlantic Ocean, extending in an oblique line from N.W. to S.E., between 37° and 40° N. Lat., and 25° and 32° W. Long. It has been a subject of some controversy among geographers, to what division of the globe they ought to be referred; but they are now generally considered as pertaining to Europe.

It does not appear that the ancients had any knowledge of the Azores, or of any group in this sea, except the Canaries, to which they finally applied the celebrated appellation of the Fortunate Islands. But the Arabian geographers, Edrisi and Ibn al Vardi, describe, after the Canaries, nine other islands in the Western Ocean. That these were the Azores is highly probable, since their number is exactly nine; and because a species of hawk is specially noticed by these writers as existing there in great abundance,—a circumstance that afterwards appeared to the Portuguese so remarkable, that they gave them the name of Azores, or Hawk Islands. The climate in which they are placed also makes them north of the Canaries. Some other coincidences also might be pointed out; and, upon the whole, there appears no reason to doubt that the Azores are really the nine islands enumerated by the Arabians. The Arabian writers represent them as having been populous, and as having contained cities of some magnitude; but they state that the inhabitants had been greatly reduced by intestine warfare. At the time of their discovery, they were uninhabited, and covered with forests and underwood, which have now entirely disappeared.

History. The first European discovery of this group is claimed by the Flemings. A Flemish merchant named Van der Berg, is reported, in sailing from Lisbon, to have been driven upon these shores in the year 1439. The intelligence soon reached the court of Lisbon, where it excited considerable interest; and the navigator Cabral was sent to prosecute the discovery. In 1459 the islands began to be planted and colonized, and in so fertile a soil the inhabitants rapidly multiplied. In 1580 they fell, with the other Portuguese territories, under the dominion of Spain. At this time the Azores were the grand rendezvous in the voyage homewards of the fleets, which came laden with the wealth of both the Indies. Hence they became a theatre of that maritime warfare which was carried on with such spirit by the English under Queen Elizabeth against the peninsular powers. In 1586 Sir Walter Raleigh equipped two pinnaces of 35 and 40 tons, the command of which he gave to Captain Whiddon. Having taken two or three prizes, they fell in, off St Michael, with the great fleet of Spanish galleons, consisting of 24 sail, two of them caracks of 1000 or 1200 tons. They attacked them, however, without hesitation, hoping to cut off some straggling member of this great body, but were unable to make any impression upon it. In 1587 Sir Francis Drake, after having swept the harbour of Cadiz, sailed for the Azores, where he took an East India carack, richly laden, and the first that had ever fallen into the hands of the English. In 1589 the Earl of Cumberland fitted out a squadron, sailed for the Azores, and made numerous prizes. Azores.

Under the active administration of Pombal, considerable exertions were made for the improvement of the Azores; but the stupid and bigoted government which followed rather tended to destroy these benefits, and to make the islands take a retrograde course.

The Azores within a recent period attracted some attention as the theatre of contest between the parties contending for the crown of Portugal. The adherents of the constitution, who supported against Miguel the rights of Maria da Gloria, obtained possession of Terceira, where they succeeded in maintaining themselves. After various struggles, Queen Maria's authority was eventually established over all these islands.

The aspect of all the islands is very similar in general characteristics, presenting an elevated and undulating outline, with little or no table-land, and rising into peaks, of which the lowest (that of St Mary's) is 1889 feet, and the highest (that of Pico) 7613 feet above the level of the sea. Their lines of sea-coast are with few exceptions high and precipitous, with bases of accumulated masses of fallen rock, in which open bays, or scarcely more inclosed inlets, form the harbours of the trading towns. The climate is particularly temperate and equable, the extremes of sensible heat and cold being, however, increased by the degree of humidity present in the atmosphere. The range of the thermometer is from 45° Fahr., the lowest known extreme,—or 48° the ordinary lowest extreme of January,—to 82° the ordinary, or 86° the highest known extreme of July, and near the level of the sea. Between these two points (both taken in the shade) there is from month to month a pretty regular gradation of increase or decrease, amounting to somewhat less than four degrees (*Geographical Journal*, vol. xv.) They have an aggregate area of 700 square miles, and in 1841 had a population of 214,300. St Michael, the largest and most populous of these islands, has an area of 224 square miles, and (1840) 80,809 inhabitants. Proceeding from E. to W., this island presents a considerable variety of surface. The E. end rises from a bluff sea-cliff of between 1200 and 1400 feet elevation, to a lofty inland peak from which a central range, varying in height from 2000 to 2500 feet, runs to the westward, terminating in the Serra da Agoa de Pao, 3060 feet above the sea. The sea-coast gradually declines in approaching the last point, where it is not more than about 100 feet high. The part next seen is lower, and its outline, as presented by the summits of numerous volcanic monticules of about 1300 feet elevation, united in a central ridge more undulating; the western extremity being marked by the conspicuous Serra Gorda, 1574 feet above the sea; and its shores on both sides are low, broken, and rocky. Of the remaining part the aspect is that of a vast truncated cone, irregularly cut off at an elevation of about 800 feet, and falling on the N., S., and W. sides to a perpendicular coast of between 300 and 800 feet high. The outline is varied by the intervention of peaks, thrown up on the summit and flanks, and round the foot of the mountain. In the higher parts, the surface is generally covered with an undergrowth of heaths, cedar, laurel, laurestinus, and other evergreen shrubs, which give the mountains an exceedingly rich and wooded appearance. Like all volcanic countries, the face of the island is uneven and irregular, being deeply excavated by numerous ravines and roughened by streams of semi-vitrified and scoriaceous lava that resist all atmospheric influences and repel vegetation. Heavy rains falling on the mountains afford a constant supply of water to four lakes at the bottom of extinct craters or subsidences, and a number of minor reservoirs; and through them to small streams running rapidly down on all sides into the sea.—(*Geographical Journal*, vol. xv.) Physical aspect.

Azores.

Volcanic phenomena.

In the year 1591 a most tremendous earthquake appears to have been felt all over the Azores, and to have shaken St Michael for twelve days without intermission. Since that period there is no record of any such great convulsion, except one in 1757, of which we have no particulars, and it was probably much less formidable; nor are any of its volcanoes at present in a state of action. Hot springs abound in every part of the island, and from almost every crevice vapour is seen issuing. But the most remarkable phenomena are the Caldeiras or boiling fountains, which rise chiefly from a valley called the Furnas, near the western extremity of the island. The water ascends in columns to the height of about 12 feet, after which it dissolves in vapour, forming clouds of various shapes and colours. The heat is such as to boil an egg in two minutes, though the sulphurous impregnation unfits it for being employed in culinary purposes. The ground in the immediate vicinity is entirely covered with native sulphur, like hoar frost. At a small distance is a remarkable phenomenon called the Muddy Crater, the vertex of which, 45 feet in diameter, is on a level with the plain. Its contents are in a state of violent and continual ebullition, accompanied with a sound resembling the waves of a tempestuous ocean. Yet they never rise above its level, unless occasionally to throw to a small distance a spray of the consistence of melted lead. The Furnas abounds also in hot springs, some of which it is impossible to touch without being scalded. There is almost always, however, a cold spring near to the hot one, so that the water can be brought to any temperature that may be desired. These springs, after being long neglected, have, within the last half century, been greatly resorted to, and the cures performed in cases of palsy, rheumatism, and similar maladies, are said to have been very wonderful.

Vegetable products.

The plains are fertile in wheat, barley, and Indian corn; whilst vines and oranges grow luxuriantly on the sides of the mountains. They are made to spring even from the interstices of the volcanic rocks, which are sometimes blasted in order that they may receive the plants. Raised in this manner, these fruits are said to be of superior quality; but the great expense originally required in such a mode of cultivation confines it to persons of some capital. The western part of the island yields hemp, which might be raised to a considerable extent. The exports consist of wine, fruit, and provisions. Foreign intercourse used to be confined rigorously to Lisbon; but since the emigration of the court, the inhabitants have assumed the privilege of trading directly with England, America, and other countries.

The principal town in the island is Ponta Delgada, which contains about 20,000 inhabitants. It is built with tolerable regularity, the streets being straight and broad. The religious edifices are numerous and elegant. When visited by Captain Boid in 1831, it had six churches, eight monasteries, and four convents; but these last, which were noted for the irregular lives of their vestals, have since been suppressed. The harbour receives only small vessels: those of any magnitude must anchor in an open road, which, though not dangerous, cannot be occupied during the prevalence of southerly gales. Its other towns are Villa Franca, Ribeira, Grande, Alagoa, Agoa de Pao, &c.

St Mary.

St Mary is a small island immediately adjacent to St Michael, through the medium of which its trade is conducted, as it has no good harbours of its own. It has an area of 36 square miles, producing wheat in abundance, of which a considerable quantity is exported. It is of trap formation, and contains beds of marine shells. Pop. in 1840, 4666.

Terceira.

Terceira, though smaller than St Michael, yet being placed in a more central position with respect to the other islands, has been chosen as the seat of government. The port of Angra is also superior to any of those in St Michael. This island does not exhibit nearly the same extensive traces of volcanic action; and the summits of its mountains are generally level. It is represented by Adanson, however, as entirely composed of volcanic products. The lava, he says, is of a thicker grain than that of Teneriffe. It abounds in grain and cattle; but the wines are inferior, and the fruits are raised merely for internal consumption. The residence of the government renders the society somewhat superior to that which is found in the other islands. The number of inhabitants is estimated at 50,000.

Azores.

Fayal.

Fayal is the most frequented of all the islands after St Michael, as it has one of the best harbours in the Azores, and lies directly in the track of vessels that are crossing the Atlantic in any direction. Its principal town is Villa de Horta. Captain Cook found that all sorts of fresh provisions might be obtained there: the bullocks and hogs are good, but the sheep small and poor. The town is defended by two castles and a wall, both in decay, and serving rather for show than strength. The city contains two convents for monks and three for nuns, with eight churches. These are the only good buildings in it, no other having glass windows. The bay is two miles in length and three-quarters of a mile in breadth, and the depth of water from 6 to 20 fathoms. Though a good road, it is not altogether free from danger in S.S.W. and S.E. winds. Pop. 23,000.

Pico.

A considerable quantity of wine is exported from Fayal under the appellation of Fayal wine, but really the produce of Pico, one of the most remarkable of the Azores. This island is composed of an immense conical mountain, rising to the height of 7613 feet, and bearing every trace of volcanic formation. The soil consists entirely of pulverized lava, and the ground has even been said to sound hollow when struck. All the lower parts of the mountain are in the highest state of cultivation, and covered with vine and orange plantations. The wine, which forms a sort of inferior Madeira, is in considerable demand. Pico produces also a valuable species of wood, resembling and equal in quality to mahogany. Pop. 26,000.

Graciosa and St George.

Graciosa and St George are two small islands, situated between Fayal and Terceira. Graciosa is chiefly noted for the extreme beauty of its aspect and scenery. About 50 years ago St George suffered from one of those awful visitations to which the Azores are subject. In 1808 a caldeira, situate in the centre of the island, was observed to be in a state of violent fermentation. It continued during several days to emit subterraneous noises, and to cause violent convulsions throughout every part of the island. At length the great crisis came; vast streams of fire issued forth in every direction, with clouds of smoke, which, but for the volcanic light, would have involved everything in midnight darkness. The principal stream took its direction towards the beautiful town of Ursula, which it seemed on the point of swallowing up; but suddenly changing its direction, it rushed into the sea by a different channel; a happy event, which superstition ascribed to the prayers of the Ursuline nuns. Many hundred acres of fertile land, however, were covered with scoriæ and ashes; some lives were lost, and general gloom and consternation diffused throughout the island. The inhabitants, however, soon applied themselves to repair the injury which their land had sustained. Population about 20,000.

Corvo and Flores.

The two small and most westerly islands of Corvo and Flores seem but imperfectly to belong to the group. They lie also out of the usual track of navigators; but to those who, missing their course, are led thither, Flores affords good shelter in its numerous bays. Its poultry is said to be the finest in the world; and the cattle are numerous, but small. The surplus produce of these islands is not of much importance. Population above 15,000.

It would be improper to close this notice without mentioning one of the most striking occurrences in nature, sometimes exhibited in this quarter—the sudden emersion of new islands from the bosom of the ocean. The first relation of

Azote ‖ Azpeitia.

such an event is given by Kircher in his *Mundus Subterraneus*. He describes it as announced by violent earthquakes, which lasted for eight days; then a fire broke from the surface of the sea, and rose to the clouds, whilst vast quantities of stones, earth, sand, and minerals, were at the same time vomited out. At length a group of rocks burst forth, which gradually increased till they covered several miles in circumference, and, after being shattered by a new earthquake, settled into a solid consistence.

A narrative of a similar phenomenon is given in the 32d volume of the *Philosophical Transactions*. John Robison, master of a small vessel, is stated to have arrived on the 10th December 1720 at Terceira, "near which island he saw a fire break out of the sea." On his arrival at Angra, the governor hired his vessel for the purpose of going to view it. "On the 19th," says he, "at two afternoon, we made an island all fire and smoke. The ashes fell on our deck like hail and snow. The fire and smoke roared like thunder or great guns." He adds, that quantities of pumice stone, probably common lava, and of half-broiled fish, were found floating on the sea in its vicinity.

A similar phenomenon took place in June 1811, about half a league from the western extremity of the island of St Michael. On the 13th of that month an island was thrown up in the sea, to which was given the name of Sabrina, by the commander of the British man-of-war of that name, who witnessed the explosion. It was soon worn away by the sea, and is now only to be traced in a submarine cone 15 fathoms under the surface.

See Hartmann's *Edrisi; Voyages des Hollandois*, tome i.; Astley's *Collection*, vol. i.; Masson's Account of St Miguel, in *Phil. Trans.* 1778; Cook's *Second Voyage*; Adanson's *Voyage to Senegal; History of the Azores*, London, 1813; Boid's *Azores; London Geographical Journal.*

AZOTE (*α*, priv., and *ζωή, life*), one of the gases. See CHEMISTRY.

AZOTUS, or ASHDOD (now ESDUD), a city of Palestine, near the sea-coast, 10 miles N.N.E. of Askelon. It was the chief town of one of the five states of the Philistines, and the seat of the worship of Dagon. Although assigned to the tribe of Judah, it was many centuries before it was subdued, and it appears never to have permanently been in their possession. The site is marked by ancient ruins, such as broken arches and fragments of marble columns. There is also what appears to be a very ancient khan, the principal chamber of which had obviously at some former period been used as a Christian chapel.

AZPEITIA, a Spanish town in the province of Guipuzcoa, on the left bank of the River Urola, on the N. side of Mount Itzarritz. The neighbouring country is fertile, and quarries of marble are wrought in the mountains. Pop. 5300.

Aztecs ‖ Azzara.

AZTECS, the native name of the nation that last occupied the table-land of Mexico before the arrival of the Spaniards in America. They came from a country in the N.W. of that continent, to which they gave the name of Aztlan, about the year 1160 of our era; and they settled at first on the banks of the Rio Gila. They gradually increased their influence among other tribes, until, by union with the Toltecs, who occupied the table-land before them, they extended their empire to an area of from 18,000 to 20,000 square leagues. The researches of Humboldt afforded us the first clear insight into those early periods of their history. See MEXICO.

AZUNI, DOMENICO ALBERTO, a celebrated jurisconsult, born at Sassari, in Sardinia, in 1760, and author of an esteemed work on *The Maritime Law of Europe*. He died in Sardinia in 1827.

AZURE. See HERALDRY.

AZZARA, DON FELIX DE, a celebrated Spanish naturalist, was born 18th May 1746. He studied first at the university of Huesca, and afterwards at the military academy of Barcelona. In 1764 he entered the army as a cadet, and in 1767 obtained an ensigncy in the engineer corps. In 1781 he was appointed, with the rank of captain in the navy, on a commission to lay down the line of demarcation between the Spanish and the Portuguese territories in South America. There he spent many years, observing and collecting specimens of the various interesting objects of natural history that abound in those wide and little known regions. In 1801 he obtained leave to return to Spain, and was afterwards appointed a member of the *Junta de fortificaçiones y defensa de Ambos Indias*, a public board in which chiefly was centred the home government of the Spanish colonies. He died in 1811. His principal work is his *Travels in South America from* 1781 *to* 1801; published in French from the author's MS., by C. A. Walckenaer. with atlas and plates, 4 vols. 8vo, Paris, 1809. It contains a valuable account of the discovery, conquest, civil and natural history of Paraguay and Rio de la Plata; and embodies his former contributions to the zoology of these countries. The work is enriched with the notes of Walckenaer and Cuvier, and a notice of the author by the former.

AZZARA, *Don Jose Nicolas de*, the elder brother of the naturalist, was an eminent collector of Italian antiquities; and withdrew to Florence when the French took possession of Rome in 1798. He was afterwards Spanish ambassador at Paris, but was displaced by Godoy, and was preparing to return to his antiquarian studies in Italy in 1808, when he died. His best claim to notice is the active part he took, as a minister under Val, in the difficult and hazardous task of the expulsion of the Jesuits from Spain. He died at Paris in 1804.

B.

P. B, the second letter, and first consonant, in all known alphabets excepting the Ethiopic, where it occupies the ninth place. It is a labial and mute, representing the compression of the lips, and consequently incapable of being uttered or pronounced without the aid of a vowel, or a forcible expiration equivalent in effect to vocality. This letter has a near affinity to the other labials, with which, indeed, it is interchangeable according as the compression of the lips, which it primarily indicates, is modified by simultaneous expiration; and hence, although its ordinary power or effect is intermediate between the smooth and easy sound of P, and the rough aspirations of PH, F, and V, yet, in the articulation of many languages, it is habitually confounded with one or other of the letters of the same class, and in the same language at different times, is frequently interchanged with its cognate consonants. Thus, *βόσκω* in Greek becomes *pasco* in Latin; *γίλβος, gilvus; βρέμω, fremo; πύξος, buxus; ἄμφω, ambo; φάλαινα, balæna; θρίαμβος, triumphus*; and so in many other instances. Again, in Latin, the B of the olden time, and of the inscriptions, passes into V in a subsequent age; while, on the other hand, the P of the antique orthography is commuted into B in that of a more recent date. Hence we have *abavus* for *ababus, ave* for *abe, vixit* for *bixit, curvatus* for *curbatus*, and hundreds of other analogous instances; while *Poplius* for *Publius, Poplicus* for *Publicus, Poplicola* for *Publicola*, are of frequent occurrence in the inscriptions and other elder monuments of the Latin language. This letter is also sometimes inserted in the middle of compound words for the sake of euphony, and to prevent the *hiatus* which would otherwise result from the concurrence of vowels, as *ambages, ambio, amburo;* it is servile in the dative and ablative plural of the third, fourth, and fifth declensions of Latin nouns, and in the præterimperfect and future tenses of the first and second conjugations; and it is interchangeable with P, F, and other letters, both in the composition and conjugation of a number of verbs. In Hebrew, the name of the second letter בֵּית, *bith* or *beth*, indicates the original hieroglyph to have represented a house or temple; whilst an abbreviated form of the figure has been employed to denote the initial sound of the word in the spoken language; a principle, also, upon which the ancient Egyptians appear to have constructed their phonetic alphabet, or used the symbolical characters of their complex system of writing for representing the constituent sounds of proper names and of legends. A difference, however, will be observed between the two Phœnician forms of this letter, the first of which is that of a house or temple, whilst in the second another figure seems to have been combined with the first; from which it is probable that this people, the inventors of alphabetical characters or signs, had originally two hieroglyphs for the letter, and consequently two words by which it was named. This compound hieroglyph seems to have been composed of the *beth* or house, and of the head and horns of some animal placed over it, perhaps those of a בּוֹקֵר, *boker*, ox or wild goat; which would explain the assertion of Hesiod, that the second or third letter of the Phœnicians was represented by an ox. At all events the Phœnician, reproduced in the early Greek, has served as the basis of most modern varieties in the languages of the West; and, amidst every change which time, accident, or caprice, has superinduced, it is still easy to detect and distinguish the elementary or primitive form. With regard to the different sounds or powers attached to the letter in modern languages, these have varied within the limits of its natural affinity; the Germans giving it the effect of P, the Spaniards, Gascons, and others, that of V; and the modern Greeks sometimes that of V, but more frequently sounding it as we do F. The satirical epigrammatist who affirmed that in Gascony *bibere* is the same as *vivere*, stated a literal truth, in as far at least as the pronunciation of the words is concerned. (J. B—E.)

Baal ‖ Baalbec.

BAAL, the same as BEL or BELUS, an idol of the Chaldeans and Phœnicians or Canaanites. The word *Baal*, in the Punic language as well as in the Hebrew, signifies "lord" or "master," and doubtless meant the supreme Deity; yet there is no evidence that the Israelites ever called Jehovah by the name of Baal; for the passage in Hosea ii. 16, which has been cited as such, only contains the word *baal* as the sterner, less affectionate, representative of *husband*. Some learned men identify the Baal of the Phœnicians with the Saturn of the Greeks; others with the Phœnician or Tyrian Hercules, a god of great antiquity in Phœnicia.

BAAL-BERITH, the god of the Shechemites. Bochart conjectures that Berith is the same as *Beroe*, the daughter of Venus and Adonis, who was given in marriage to Bacchus; and that she gave her name to the city of Berith in Phœnicia, of which she became the patron goddess.

BAAL-PEOR, *Baal-phegor*, or *Beel-phegor*, an idol of the Moabites and Midianites. Baal-peor is identified by Jerome with *Priapus;* by Selden, again, with Pluto—which he grounds upon these words of the Psalmist, "They joined themselves unto Baal-peor, and ate the offerings of the dead;" and by others, with *Chemosh*.

BAAL-ZEBUB, *Beel-zebub*, or *Belzebub*, the god of the Ekronites. In Scripture he is called the Prince of Devils. His name is usually rendered the "Lord of Flies," which, some think, was a mock appellation bestowed on him by the Jews. But Scaliger derives the name from *Baalim-zebahim*, which signifies the "Lord of Sacrifices."

BAALBEC, an ancient city of Syria, celebrated for the magnificence of its ruins, which, with the exception of those at Palmyra, are the most extensive in Syria. Baalbec in the Syrian language signifies the "City of Baal," or of the Sun, and the Greek name Heliopolis (*i.e.* city of the sun) is a translation of this term. It is supposed to be the same with the Baal-Gad of Scripture said to be "in the valley of Lebanon under Mount Hermon." There is not sufficient authority for supposing this to be the Baalath built or fortified by Solomon. It is pleasantly situated on the lowest declivity of the Anti-Libanus, at the opening of a small valley into the plain El-Bekaa, 109 geographical miles from Palmyra, and 38¾ from Tripoli; Long. 36. 11. E. Lat. 34. 1. 30. N. Through this valley runs a small stream divided into numberless rills for irrigation.

The origin of this city appears to be lost in the most remote antiquity, and the historical notices of it are very scanty; the silence of the classical writers respecting it would alone seem to imply that it had previously existed under another name. In the absence of more positive information, we can only conjecture that its situation on the high road of commerce between Tyre, Palmyra, and the farther East, must have contributed largely to the wealth and magnificence which it manifestly attained. It is mentioned under the name of Heliopolis by Josephus (*Antiq.* xiv. 3, 4), and also by Pliny (*Hist. Nat.* v. 22). Two Roman inscriptions of the time of Antoninus Pius give sanction to the statement of John of Antioch, who alleges that this emperor built a great temple to Jupiter at Heliopolis, which was one of the wonders of the world (*Hist. Chron.* lib. xi.) From the reverses of Roman coins we learn that Heliopolis was constituted a colony by Julius Cæsar; that it was the seat of a Roman garrison in the time of Augustus; and obtained the *Jus*

Baalbec. *Italicum* from Severus. Some of the coins of later date contain curious representations of the temple.

From the accounts of Oriental writers, Baalbec seems to have continued a place of importance down to the time of the Moslem invasion of Syria. They describe it as one of the most splendid of Syrian cities, enriched with stately palaces, adorned with monuments of ancient times, and abounding with trees, fountains, and whatever contributes to luxurious enjoyment. After the capture of Damascus it was regularly invested by the Moslems, and after a courageous defence, at length capitulated. The ransom exacted by the conquerors, consisted of 2000 ounces of gold, 4000 ounces of silver, 2000 silk vests, and 1000 swords, together with the arms of the garrison. It afterwards became the mart for the rich pillage of Syria; but its prosperity soon received a fatal blow from the khalif of Damascus, by whom it was sacked and dismantled, and the principal inhabitants put to the sword (A.D. 748). During the Crusades, being incapable of making any resistance, it seems to have quietly submitted to the strongest. In the year 1400 it was pillaged by Timour Beg, in his progress to Damascus, after he had taken Aleppo. Afterwards it fell into the hands of the Metaweli—a barbarous predatory tribe, who were nearly exterminated when Djezzar Pasha permanently subjected the whole district to Turkish supremacy.

From the S., the city is first discovered at the distance of about a league and a half, behind a hedge of trees, over the verdant tops of which appears a white edging of domes and minarets. After about an hour's journey the traveller reaches this hedge, which is composed of very fine walnut trees, and soon after, crossing some ill-cultivated gardens by winding paths, arrives at the entrance of the city. Here he perceives a ruined wall, flanked with square towers, which ascends the declivity to the right, and traces out the precincts of the ancient city. This wall, which is only ten or twelve feet in height, admits a view of those void spaces and heaps of ruins which are invariable characteristics of every Turkish city; but what principally attracts attention is a large edifice on the left, which, by its lofty walls and rich columns, is soon recognized as one of those temples which antiquity has left for our admiration. These ruins, which are among the most beautiful and best preserved of any in Asia, merit a particular description.

To form a just idea of them, the reader must imagine himself descending from the interior of the town. After crossing the rubbish and huts with which it is filled, the first thing deserving of notice is a vacant space, which appears to have been a square: there, in front, towards the west, is a grand ruin, consisting of two pavilions ornamented with pilasters, joined at their lower angle by a wall 160 feet in length. This front commands the open country from a sort of terrace, on the edge of which are with difficulty distinguished the bases of twelve columns, which formerly extended from the one pavilion to the other, and formed a portico. The principal gate is obstructed by heaps of stones; but, that obstacle surmounted, the traveller enters an empty space, which is a hexagonal court of 180 feet in diameter. This court is strewed with broken columns, mutilated capitals, and the remains of pilasters, entablatures, and cornices; and around it is a row of ruined edifices, which display ornaments of the richest architecture. At the end of this court, towards the west, is an outlet, which formerly was a gate, through which is perceived a still more extensive range of ruins, of great magnificence. To have a full view of these, it is necessary to ascend a slope, at the top of which is the entrance to a quadrangular court much more spacious than the former, being 350 feet in width and 336 in length. The eye is first attracted to the end of this court, where are six enormous and majestic columns nearly entire. Another object not less interesting is a second range of columns to the left, which appear to have formed part of the peristyle of a temple. Baalbec. But the edifices which inclose this court on either side claim attention in the first instance. These form a sort of gallery containing various chambers, seven of which may be reckoned in each of the principal wings, namely, two in a semicircle, and five in an oblong. The base of the apartments still retains pediments of niches and tabernacles, the supporters of which have been destroyed. On the side of the court they are open, while four columns on the one side and six on the other have been totally destroyed. It is not easy to conceive the use of these apartments; but this does not lessen the admiration excited by the beauty of their pilasters and the richness of the frieze of the entablature. Neither is it possible to avoid remarking the singular effect which results from the mixture of the garlands, the large foliage of the capitals, and the sculpture of wild plants, with which they are everywhere ornamented. In the middle of the court is a little square esplanade, where anciently stood a pavilion, of which nothing now remains but the foundation. With regard to the six columns above mentioned, it is impossible to survey them without being struck with the boldness of their elevation and the richness of their workmanship. Their shafts are 21 feet 8 inches in circumference, and 58 in height; and the total height, including the entablature, is 75 feet 10 inches. The sight of this superb ruin, thus solitary and desolate, is exceedingly imposing; but a more attentive examination discovers a series of foundations, marking an oblong of 268 feet in length and 146 in width, which probably formed the peristyle of a grand temple, the primary purpose of this whole structure. It presented to the great court, that is, to the E., a front of 10 columns, with 19 on each side; which, with the six already mentioned, make in all 54. The ground on which it stood is an oblong, on a level with the court, but considerably narrower, so that there was only a terrace of 27 feet wide round the colonnade; while the esplanade thus produced fronts the open country towards the W., by a sloping wall of about 30 feet. In approaching the city this descent becomes less steep, so that the foundation of the pavilion is on a level with the termination of the hill; whence it is evident that the whole ground of the courts has been artificially raised. Such seems to have been the former state of this edifice; but the southern side of the grand temple was afterwards blocked up in order to build a smaller one, the peristyle and walls of which are still remaining. This temple, situated somewhat lower than the other, presents a side of 13 columns by 8 in front, or 32 in all. These are likewise of the Corinthian order: their shafts are 15 feet 8 inches in circumference, and 44 feet in height. The building they surround is an oblong, the front of which, turned towards the E., is out of the line of the left wing of the great court. To reach it the traveller must cross trunks of columns, heaps of stone, and a ruinous wall, by which it is now hid. After surmounting these obstacles, he arrives at the gate, where he may survey the inclosure which was once the habitation of a god; but, instead of the awful scene of a prostrate people, and sacrifices offered by a multitude of priests, the sky is seen through the open roof, which lets in light enough to show a chaos of ruins covered with dust and weeds. The walls, formerly enriched with all the ornaments of the Corinthian order, now present nothing but pediments of niches and tabernacles, of which almost all the supporters have fallen to the ground. Between these niches is a range of fluted pilasters, the capitals of which support a broken entablature; but what remains displays a rich frieze of foliage resting on the heads of satyrs, horses, bulls, and other animals. Over this entablature was the ancient roof, which was 57 feet in width and 110 in length. The walls which supported it are 31 feet high, and without a window. It is impossible to form any idea of the ornaments of this roof, except from the fragments lying on the ground; but it could scarcely have been richer in orna-

Baba ‖ Baboon.

ment than the gallery of the peristyle. The principal remaining parts contain tablets in the form of lozenges, on which are represented Jupiter seated on his eagle, Leda caressed by the swan, Diana with her bow and crescent, and several busts of emperors and empresses. It is unnecessary to enter more minutely into the description of this astonishing edifice. The lovers of the arts will find it described with the greatest truth and accuracy in a work published at London in 1757, under the title of *Ruins of Baalbec*, by Messrs Wood and Dawkins, as well as in the more recent works of Volney, Burckhardt, Richardson, Addison, Lord Lindsay, and Dr Wilson.

The present Baalbec is a miserable village, to the east of the ruins, consisting of a few mud-built houses, with a population not exceeding 2000.

BABA, Cape, the ancient Lectum, on the coast of Anatolia, a promontory between Mytelene and Tenedos. It is bold and rocky, and is in Lat. 39. 30. N. Long. 26. E.

BABATAG, or Babadag, a city in the government of Bulgaria and sanjak of Silistria, in Turkey in Europe. It stands on the lake or estuary Rasein, which communicates with the Black Sea, and is surrounded by mountains covered with woods. Pop. 10,000, amongst whom are many Jews and Greeks. It used to be the winter headquarters of the Turkish army during their wars with Russia. Long. 28. 32. E. Lat. 44. 55. N.

BABEL, a city and tower attempted to be built by the human race soon after the Flood, and remarkable for the miraculous frustration of the attempt by the confusion of languages (Gen. xi. 1–9.) Most authors are of opinion that the ancient Babel occupied the exact site of the future Babylon. The expression "*reach unto heaven*," as our translation of the Hebrew text has rendered it, may be well translated *represent the heavens;* hence some suppose that the top of this tower was not meant to reach up to heaven, but to be consecrated to the heavens, that is, to the worship of the sun, moon, and stars, of the fire, air, &c., and other natural powers, as deities. Less speculative persons think that the tower was erected as a fortress for the establishment of tyrannical power. It is generally supposed to be the same with the tower of Belus, described in the article Babylon.

BABELMANDEB (i.e. *the gate of tears*, so called from the dangers attending its navigation, or, according to an Arabic legend, from the numbers who were drowned by the earthquake which separated the coasts of Asia and Africa) is the strait lying between the coasts of Arabia and Abyssinia, and connecting the Red Sea with the Indian Ocean. The distance across, from a projecting cape on the Arabian shore to the opposite coast of Africa, is about 20 miles. The intermediate space contains several small islands, Perim, the largest, being in Lat. 12. 35. 30. N. Long. 43. 28. E. Perim divides the strait into two channels, of which the eastern, though the smaller, is the most frequented. It is from 1½ to 4 miles in breadth, with a depth of from 7 to 14 fathoms: the western channel has a depth of about 180 fathoms.

BABER, Zehir-Ed-din Mohammed, the founder of the Indian Mogul or Tatar empire, was the fifth in descent from Timur. After two unsuccessful attempts, he succeeded in 1519 in subjugating Hindustan; and extended his conquests from the Indus to the Ganges, subduing Afghanistan, the Punjaub, and Delhi. See Hindustan. (*Memoirs of the Emperor Baber*, translated by Leyden and Erskine, 1826.)

BABINGTON, Gervase, bishop of Worcester, was born, according to Fuller, in Nottinghamshire; but in what year is uncertain. He died in 1610. All the historians who have mentioned this prelate give him the character of a learned and pious man. His works, consisting of Notes upon the Pentateuch, an Exposition of the Creed, &c., were printed both in folio and quarto in 1615, and again in folio in 1637.

BABOON. See Mammalia, *Index*.

Babrius. ‖ Babylon.

BABRIUS, Babrias, or Gabrias, an ancient Greek fabulist, whose metrical tales are quoted by Suidas and others. Fragments only of them were known until lately, when M. Minoïde Mynas discovered a MS. copy in the convent of St Lawrence on Mount Athos, and transcribed 123 of them, which were first published at Paris in 1844, by Boissonade, with a Latin translation. Babrius probably flourished about the Augustan era. His fables have since been edited by Lachmann, Berol. 1845; by Orelli and Baiter, Turic. 1845; and by G. C. Lewis, Lond. 1847.

BABYLON, the metropolis of the Babylonio-Chaldæan empire, was situated in a wide plain on both sides of the River Euphrates, which divided it into two nearly equal parts. Ancient writers are not agreed as to who was the founder of this city,—some ascribing it to Semiramis, and others to Belus. It is generally supposed to have been the same with, or at least to have occupied the site of, the Babel of Nimrod's kingdom. The tower of Belus in like manner is supposed to have been the same with that of Babel; and indeed Babel is the only name given in the Hebrew or Chaldee of the Bible to this city. But by whomsoever it was founded, it was only after the fall of the Assyrian empire that it became the capital of the Eastern world; and Nebuchadnezzar was the person to whom it was chiefly indebted for those immense structures that made it one of the wonders of antiquity.

Ancient Historians.

Of the accounts given of this city by ancient authors, that of Herodotus is undoubtedly the one upon which the greatest reliance can be placed. Not only is he the earliest profane writer upon this subject, but he is the only ancient historian that we know to have been there in person, and that, too, while it was yet in a state of tolerable preservation; and although he may be liable to the imputation of occasionally retailing marvellous stories, yet in no one instance, where he speaks from his own observation, can he be accused either of partiality or invention. Diodorus is by no means so well entitled to credit as Herodotus; for, never having been there in person, his account is taken from other writers, and chiefly from Ctesias, an author of no great authority. We have no proof that either Arrian or Strabo visited Babylon, though the treatise of the former is valuable from his information being derived from the notes of Aristobulus, and Ptolemy the son of Lagus, who were there with Alexander. Quintus Curtius also formed his account upon the reports of the followers of Alexander, many of whom kept journals of the expedition.

Description of city.

According to Herodotus, Babylon was built in the form of a square—each side of which was 120 stadia in length; its circumference being therefore 480 stadia, or 55 of our miles. It was surrounded by a wall 87 feet thick, and 350 feet high, outside of which was a vast trench filled with water, and proportioned in depth and width to the elevation of the wall. The earth taken out of the trench was made into bricks for the construction of the wall. These were baked in furnaces, and afterwards cemented by heated bitumen, and layers of reeds were interposed for thirty courses of bricks. Upon the extreme margins of the wall a number of buildings of one story were erected opposite each other, with sufficient space between them for a chariot drawn by four horses to turn round. Another wall encircled the city within this one, not much weaker, but more narrow. The city was divided into two parts by the River Euphrates, along each bank of which extended an embankment of furnace-dried bricks. There were in all 100 gates in the wall; that is 25 on each of the four sides, all of brass, the posts and lintels being of the same metal. The city, which contained several houses of three or four stories, was intersected by streets running from each of the gates, and crossing each other at right angles. Opposite the ends of the streets leading to the river were openings in the embankments with brazen gates, and steps leading down to the

Babylon. river; and these gates were open by day but shut by night. It was by means of these gates, which had been left open, that Cyrus obtained access into the city.

Tower of Belus. In each of the two divisions of the city, in a conspicuous situation, was a walled inclosure, in the one of which was the palace, and in the other the temple of Belus. The latter inclosure was a square of two stadia, in the middle of which stood a solid tower of a stadium both in length and breadth. Upon this tower stood another tower, and another upon that, to the number of eight. The ascent to them was made in a circular form, leading round all the towers on the outside, with resting-places in the middle of the ascent. This temple, according to Strabo, was also a stadium in height; but this is not mentioned by Herodotus. Here was a large golden image of the god, and near it a golden table, the pedestal and pediment being of the same metal. These were said by the Chaldæans to have been made out of 800 talents of gold. There was also in the temple a golden statue of 12 cubits—"but this," says Herodotus, "I did not see,"—and many other statues and sacred vessels. This tower stood till the time of Xerxes; who, on his return from his Grecian expedition, having first plundered it of its immense wealth, laid it in ruins. Alexander, on his return to Babylon from his Indian expedition, proposed to rebuild it, and accordingly set 10,000 men to clear away the rubbish; but the work proved too herculean for such means, and his death happening soon after, put a stop to all further proceedings.

Palaces. The palace of Nebuchadnezzar was eight miles in circumference, and splendidly decorated with statues of men and animals. On the opposite side of the river, according to Diodorus, stood the old palace of the kings of Babylon; but it was much inferior in size to the new one, being only about four miles in circumference. The two palaces were connected by means of a bridge of great beauty thrown across the river, as well as by a subterraneous passage.

Hanging gardens. Nothing, however, at Babylon, was more wonderful than the hanging gardens which Nebuchadnezzar constructed in compliance with a wish of his queen Amytis, to possess elevated groves such as she had enjoyed on the hills around her native Ecbatana. For this purpose an artificial mountain was reared, in the form of a square, of four plethra or 400 feet on each side, with terraces rising one above another to a height overtopping the walls of the city; the ascent from terrace to terrace being by steps ten feet wide. The terraces were reared to their various stages on ranges of regular piers, which, forming a kind of vaulting, rose in succession, one over the other, to the required height of each terrace, the whole being bound together by a wall 22 feet thick. The floor of each terrace or garden was formed in the following manner: on the tops of the piers was first laid a pavement of flat stones, 16 feet in length and 4 in breadth, over which was a layer of reeds, mixed with a great quantity of bitumen; and this, again, was covered with two courses of bricks closely cemented together with plaster; while over all these were placed thick sheets of lead, on which was laid the earth or mould of the garden. This floorage was designed to retain the moisture of the mould; and in order to provide a sufficient depth for the largest trees to take firm root, immense hollow piers were built and filled with earth. Upon the uppermost of these terraces was a large reservoir, supplied with water from the river by means of an engine; and from this reservoir the terraces were irrigated, as occasion required.

Canals. Canals were cut out on the east side of the river, above the town, to prevent any inconvenience from its swellings, by conveying the superabundant waters into the Tigris. The principal of these was the Naher Malcha, or Royal Canal.

A lake was dug to the west of the city to receive the waters of the river while the embankments on each side of it were building. This lake is said to have been 160 miles in circuit, and 35 feet in depth. After the completion of the embankments, the lake and the canal which led to it were preserved, having been found very useful as a reservoir, from which, by means of sluices, the water was let out on certain occasions, for the irrigation of the land. Babylon. Lake.

Such is the description given by ancient historians of this city, which must have been much larger than we can form an idea of by comparison with the largest modern cities. Much doubt has been cast upon the statements of Herodotus as to the immense size of this city; but even taking the account of Diodorus, who ascribes to it the least extent of any of the ancient authors, it had a circuit of 41 of our miles, while Herodotus makes it 55 miles. Moreover, if we confine the city to the limits assigned by Diodorus, it will not include all the existing remains; whereas the limits assigned by Herodotus include all those venerable ruins in the vicinity of Hillah, that still astonish us by their stupendous dimensions. The accuracy and truthfulness of Herodotus whenever he speaks, as in this instance, from his own observations, entitle him to greater credit than Diodorus, who had his account only at second-hand. Nor, when we consider the vast pyramids of Egypt, or the wall of China, is there any reason to doubt the ability of Nebuchadnezzar or others to raise these immense walls and structures with their tens of thousands of captives. Authors have attempted to reduce the extent of the city as given by Herodotus, by questioning the length of the stadium used by him. Ukert, however, has satisfactorily shown that the Greeks had not different standards of measurement, but always used the Olympic stadium. The differences between the distances of places as given by the ancients, compared with their modern measurements, are accounted for by these distances not being measured, but computed by the number of stadia that a good traveller could perform in a day, which would vary considerably according to circumstances. It seems most probable, however, that in this instance Herodotus converted the Babylonian measurements into Grecian stadia. (See Smith's *Dictionary of Greek and Roman Antiquities—Art. Mensura.*) Extent.

We cannot, however, suppose that the population of Babylon bore any proportion to its size, or that in this respect it resembled our densely peopled modern towns. It is generally supposed that it at no period contained more than two millions of inhabitants. It indeed rather resembled an inclosed district, where every house was a villa, than a closely built town. The statement of Herodotus that some of the houses were three or four stories high, clearly indicates that they were not generally of that height; and probably most of them had only one story. "Quintus Curtius says positively that there was pasture and arable land in the inclosure, sufficient to support the whole of the population during a long siege; and Xenophon reports, that when Cyrus took Babylon (which event happened at night), the inhabitants of the opposite quarter of the town were not aware of it till the third part of the day, *i. e.* three hours after sunrise; which was very possibly owing to the great distance of one cluster of houses from another, since, had they been connected with each other in regular streets, the noise and confusion would, I think, have spread the information of the event with much greater rapidity."—(*Rich.*) Population.

The destruction of Babylon has generally been referred to the migration of its inhabitants to Seleucia, about 300 years before Christ. How long it survived the establishment of that colony does not appear; all we know is, that, in the time of Diodorus, the greater part of its area was ploughed up; and St Jerome in the fourth century describes it as a hunting park of the Parthian kings.

There can be little doubt that the ruins in the vicinity of Hillah, a small town on the banks of the Euphrates, about forty-eight miles S. of Baghdad, are those of the ancient Babylon. 1*st*, The whole district has been known from the Site.

Babylon. most ancient times by the name of *El-aredh Babel, i. e.* the Land of Babel. 2*d*, Its position on the Euphrates, and its distance from the bituminous fountains of Is or Hit, as given by Herodotus and from Seleucia, as given by Strabo. 3*d*, The character and extent of these ruins. If these be not the ruins of the ancient Babylon, there are no remains elsewhere in Mesopotamia to correspond with the vast edifices of that great city.

Modern travellers. The traveller who has devoted most time and patience to the illustration of Babylon and its ruins is Mr Rich, who, during the many years that he resided at Baghdad as British resident, had great facilities and opportunities for the task he undertook. Among the travellers who visited these ruins before his time was Pietro della Valle, who was there in 1616, and has left a fuller account of them than any previous traveller. In 1657 a Carmelite monk, named Vincenzo Maria di S. Caterina di Sienna, sailed up the Euphrates from Bassorah; but his account of the various places which he passed is so mixed up with geographical errors as to be almost unintelligible. A few years later, another Roman Catholic missionary, Pere Emanuel de S. Albert, visited and described the ruins, with much greater minuteness and accuracy than his predecessor. Niebuhr visited them in 1765, and mentions that the place was still called *Ard-Babel*, and that on both sides of the Euphrates were mounds or little hills full of bricks. M. Beauchamp, who resided for some years at Baghdad as the pope's vicar-general, had frequent opportunities of visiting and examining the ruins. He drew up, on the spot, a memoir, which was read before the Academie des Belles Lettres, and printed in their journal for December 1790.

Rich's account of the ruins. According to Rich, the ruins of Babylon, on the eastern side of the Euphrates, may be said to commence at Mohawil; the whole country between that and Jumjuma, two miles from Hillah, exhibiting at intervals traces of building, in which are discoverable burnt and unburnt bricks, and bitumen. Three mounds, in particular, attract attention from their magnitude, Amran, Kasr, and Mujelibé.

In proceeding northwards from Hillah, and after passing some smaller mounds, he came to a vast mass 1100 yards in length, and 800 in its greatest breadth, whilst its most elevated part rose 50 or 60 feet above the level of the plain.

Amran. Just below the highest part of it is a small dome, in an oblong inclosure, said to contain the body of a son of Ali, named Amran, together with seven of his companions, all slain at the battle of Hillah. This, however, is one of those frauds not uncommon with the natives, Ali having had no such son. Mr Rich distinguishes this mound by the name of Amran.

Kasr. North of Amran is a valley of 550 yards in length, crossed by lines of ruins of little elevation, and to this succeeds the second grand mass of ruins, which is nearly a square of 700 yards in length and breadth. This is the most interesting part of the ruins of Babylon; every vestige discoverable in it showing it to have been composed of buildings far superior to any other edifice, in the eastern quarter, of which we have any traces. It has, however, been excavated and hollowed out in every direction by workmen, in extracting the bricks, which are of the finest description. In these excavations, walls of burnt brick, laid in lime mortar of a very good quality, are seen; and in addition to the substances generally strewed on the surfaces of these mounds, are found fragments of alabaster vessels, fine earthenware, marble, and great quantities of varnished tiles, the glazing and colouring of which are remarkably fresh. Here Mr Rich found a lion of colossal dimensions standing on a pedestal of a coarse gray granite, and of rude workmanship;—in the mouth was a circular aperture into which a man might introduce his fist. A part of this ruin, called by the natives the Kasr or palace, but which term Rich applies to the whole mass, is so remarkably fresh in appearance, that it was only after a minute inspection that he was satisfied as to its being a Babylonian remain. It consists of several walls and piers (which face the cardinal points) eight feet in thickness, in some places ornamented with niches, and in others strengthened by pilasters and buttresses, built of fine burnt brick (still perfectly clean and sharp), laid in lime cement of such tenacity that it is extremely difficult to extract them whole. The tops of these walls are broken, and may have been much higher; and some detached walls of the same kind standing at different distances show what remains to have been only a small part of the original fabric. A little to the N.N.E. of this ruin is the famous tree called by the Arabs *Atheleh*, and which they affirm to have flourished in the ancient Babylon, having been preserved by God from the destruction which overwhelmed that city, that it might afford shelter to the Khalif Ali after the battle of Hillah. They assert that there is no other tree of the kind in the world; it is, however, believed to be a species of tamarisk. Its trunk, which was once enormous, is now so worn away, that nothing more than one side of it remains; yet it bears spreading and ever-green branches, which are peculiarly beautiful, being adorned with long tress-like tendrils resembling heron-feathers growing from a central stem. These slender and delicate sprays bending towards the ground give the whole the appearance of a weeping willow, while their gentle waving in the wind produces a low and melancholy sound.

Mujelibé. A mile to the N. of the Kasr, or fully five miles from Hillah, and 950 yards from the river bank, is the mound called by the Arabs *Mujelibé*, or *overturned*. Its shape is oblong; its height irregular; and its sides face the cardinal points. The northern side is 200 yards in length, the southern 219, the eastern 182, and the western 136; and the elevation of the S.E. or highest angle is 141 feet. The western side, which is the least elevated, is the most interesting, on account of the appearance of building it presents. Near its summit appears a low wall composed of unburnt bricks, mixed up with chopped straw or reeds, and cemented with clay-mortar of great thickness, having between each layer of bricks a layer of reeds. On the N. side are also some vestiges of a similar construction. The S.W. angle is crowned by something like a turret or lantern; the other angles are in a less perfect state, but may originally have been ornamented in a similar manner. All the sides are worn into furrows, which in some instances are of great depth. The summit is covered with heaps of rubbish, in which layers of broken burnt bricks cemented with mortar have been found, and also entire bricks with inscriptions. Scattered over the whole are fragments of pottery, brick, bitumen, pebbles, vitrified brick or scoria, and even shells, bits of glass, and mother-of-pearl. In the northern face, near the summit, is a niche or recess high enough for a man to stand upright in, at the back of which is a low aperture leading to a small cavity, whence a passage branches off to the right, sloping upwards in a westerly direction till it loses itself in the rubbish. Being informed that in this place, about four years previously, a human body had been found, swathed in a wrapper partially covered with bitumen, and inclosed in a coffin of mulberry wood, Rich was induced to excavate here. He dug into a shaft or hollow pier 60 feet square, lined with fine brick, laid in bitumen and filled with earth; in this was found a brass spike, some earthen vessels, and a beam of date-tree wood. After digging some way farther, they came to a narrow passage nearly ten feet high, flat on the top, and exhibiting both burnt and unburnt bricks; the former with inscriptions on them, and the latter, as usual, laid with a layer of reeds between each row, except in one or two courses near the bottom, where they were cemented with bitumen. In a continuation of this passage to the eastward, he discovered a wooden coffin containing a skeleton in good preservation. Under the head of the coffin was

Babylon. a round pebble; attached to the coffin on the outside was a brass bird, and inside an ornament of the same material, which had apparently been suspended to some part of the skeleton. A little farther, the skeleton of a child was found. About 70 yards from the foot of the Mujelibé, on the northern and western sides, are traces of a low mound of earth which may have formed an inclosure round the whole.

Western side. Mr Rich, after examining the eastern side of the Euphrates, proceeded to take a survey of the remains on the western side of that river. He found the whole bank to be a flat, intersected by canals, the principal of which were the Tajia or Ali Pacha's trench and the canal of Tahmasia. The only vestiges were two small mounds of earth opposite the mass of Amran, overgrown with grass, forming a right angle with each other, and a little farther on two similar ones. These did not exceed 100 yards in extent, and the place was called by the peasants Anana.

Birs Nimroud. But although there are no ruins in the immediate vicinity of the river, by far the most stupendous and surprising mass of all the remains of Babylon is situated in this desert about six miles to the S.W. of Hillah. It is called by the Arabs Birs Nimroud, and by the Jews Nebuchadnezzar's Prison. It is a mound, of an oblong figure, the total circumference of which is 762 yards. At the eastern side it is not more than 50 or 60 feet high, and is cloven by a deep furrow; but at the western it rises in a conical form to the height of 198 feet; and has on its summit a solid pile of brick 37 feet high by 28 in breadth, and diminishing in thickness to the top. It is perforated by small square holes disposed in rhomboids. The bricks are of the finest description, with inscriptions on them, and so well cemented, apparently with lime mortar, that it is nearly impossible to extract one of them entire, though the layers are so close together that it is difficult to discern what substance is between them. The other parts of the summit of this hill are occupied by immense fragments of brick-work of no determinate figure, tumbled together and converted into solid vitrified masses, as if they had undergone the action of the fiercest fire or been blown up with gunpowder. The whole of this mound is channelled by the weather, and strewed with the usual fragments, and with pieces of black stone, sandstone, and marble. No reeds were discernible in any part, a circumstance which Mr Rich thinks may be an argument for the superior antiquity of this ruin. At the foot of the mound, a step may be traced scarcely elevated above the plain, exceeding in extent, by several feet each way, the true or measured base; and there is a quadrangular inclosure surrounding the whole as at the Mujelibé, but much more perfect and of greater dimensions. At a short distance, and parallel with its eastern face, is a mound not inferior to the Kasr in elevation, but much longer than broad. There are numerous other mounds besides those described, but the principal of them are beyond any possible limits that can be ascribed to Babylon; as the ruins called by the natives Boursa, four leagues below Hillah, and which Mr Rich conjectures to be the Borsippa of Strabo, and the Barsita of Ptolemy. Such was the state of the ruins of this ancient city when visited by Mr Rich: we shall now give a short account of Mr Layard's recent visit, and conclude with an attempt to identify some of these remains with parts of the ancient city.

Layard's account. The successes that attended the labours of Mr Layard among the ruins of Nineveh induced him to turn his attention also to those of Babylon. He accordingly proceeded there with a party of workmen; but after various excavations, the discoveries were far less numerous and important than he had anticipated, "nor did they tend to prove that there were remains beneath the heaps of earth and rubbish which would reward more extensive excavations." This is to be accounted for by the city having been built in the midst of an alluvial country far removed from the hills, and with no quarries of alabaster or limestone such as existed near Nineveh. The people were therefore content to use such building materials as were to be found on the spot, and made bricks with the mud of their alluvial soil, while bitumen and other substances from the vicinity furnished them with an excellent cement; and the walls of their temples and palaces were coated with mortar and plaster. The ornaments and paintings on these would consequently not be so durable as the sculptures on the slabs and stones of Nineveh. Babylon.

During Mr Layard's stay at Babylon, the troubled state of the country prevented him from making more than a hurried visit to Birs Nimroud. In the mound of Mujelibé he sought the subterranean passage which had been previously opened and described by Mr Rich; and on removing the rubbish, he soon came to that part of the passage where Mr Rich found the coffin of wood, containing a skeleton still well preserved. "The entrances to other galleries which had not been explored, were still closed with large burnt bricks, amongst which were a few square stones inscribed on one edge with two lines of cuneiform characters, containing the name and titles of Nebuchadnezzar, king of the Chaldees, the inscription usually found on Babylonian bricks. It was evident that they had originally belonged to an edifice erected by that monarch, and had been taken from its ruins to form this covering to the vaults and tombs. Beneath this masonry were found several entire coffins precisely similar to that discovered by Mr Rich. They still held skeletons more or less entire, which fell to pieces as soon as exposed to the air. No relic or ornaments had been buried with the bodies. The wood of the coffins was in the last stage of decay, and could only be taken out piecemeal." "The coffins discovered at Babel (Mujelibé) are of a comparatively recent period, and are not pure Babylonian. At the very earliest, they may be of the time of the Seleucidæ, but I am inclined to think that they are even of a still later date. It is evident that they were buried after the destruction of the edifice covered by the mound. Upon that great heap over the fallen palace or temple, was probably raised one of those citadels which formed the defences of a city built long after the destruction of the Babylonian empire and its magnificent capital, and which resisted the arms of Demetrius Poliorcetes. Of this stronghold the thick wall of sun-dried brick on the northern side is probably the remains."—(*Layard.*) The masonry of this wall is not united by bituminous cement, but apparently by simple mud, as in modern Arab buildings. Excavations and trenches were made in other parts of this mound, but without any important results. Mujelibé.

Numerous relics were found similar to those that had already been brought to this country by other travellers: among these were arrow-heads in bronze and iron, small glass bottles, some coloured or ornamented, and vases of earthenware of various forms and sizes, sometimes glazed with a rich blue colour. These are considered to belong to a period subsequent to the fall of the empire; the earliest probably about the time of the Greek occupation, and the latest about the sixth or seventh century of the Christian era. Mr Layard judging, therefore, that the remains of the ancient edifice, if any still existed, were to be sought far beneath the surface, opened tunnels at the foot of the mound, nearly on a level with the plain. On the eastern, western, and southern sides, they soon came to remains of solid masonry, evidently of the ancient building. On the eastern side eight or ten piers and several walls branching in various directions were uncovered, but no plan could be traced, nor any remains of sculptured stone or painted plaster discovered.

In the Kasr, the loose nature of the ruins prevented him from making any extensive excavations, and the only object of interest discovered was a fragment of limestone, on which were sculptured parts of two figures undoubtedly of gods, with the name of one of them inscribed in Babylonian characters. Excavations were made in several of the smaller mounds, but without any important results. Kasr.

Amran. In the mound Amran, or Amzan ben Ali, no traces of masonry were discovered, but some specimens of glass, and several terracotta figures, lamps, and jars were found. Among these were five cups or bowls of earthenware, and fragments of some others, covered on the inner surface with letters written in a kind of ink. The characters upon them are in form not unlike the Hebrew, and on some they resemble the Sabæan and Syriac. Similar relics have been found in other ruins near Babylon. Mr Thomas Ellis, of the manuscript department in the British Museum, was the first to decypher these inscriptions. The subjects are amulets or charms against evil spirits, diseases, and every kind of misfortune; one of them being a bill of divorce to the devil and other evil spirits. The writers were evidently Jews, probably descendants of those who were carried captive by Nebuchadnezzar into Babylon; and they must have been written long prior to any known existing manuscripts of the ancient Hebrew or Chaldæan languages, as, except in one case, there are no divisions between the words; nor are there any vowel points. —(Layard's *Nineveh and Babylon.*)

Identification of the ruins. The identification of the present ruins with parts of the ancient city has been found to be a matter of considerable difficulty. We are told that the city was built upon both sides of the river, and that its principal buildings were the tower or temple of Belus, Nebuchadnezzar's palace, and the hanging gardens; and the principal existing ruins are the mounds of Amran, Kasr, Mujelibé, and Birs Nimroud. The principal question has been, whether the Birs Nimroud or the Mujelibé represents the tower of Belus. Herodotus states that the tower and palace stood on opposite sides of the Euphrates; and previous to the time of Rich it was the received opinion that the latter had stood on the W. and the former on the E. side of that river. This was Mr Rich's opinion on visiting the Birs Nimroud; and on examining that ruin he could not help exclaiming, that "had this been on the other side of the river, and nearer the great mass of ruins, no one could doubt of its being the remains of the tower." As to the side of the river on which the tower stood, this is not expressly stated by any ancient author, and it had only been inferred from an ambiguity in the account of Diodorus. Notwithstanding the distance of the Birs Nimroud from the other remains, it would have been included within the city, if we consider as correct the account of Herodotus, who, as has been already said, is the most trustworthy of our ancient historians on this subject. If the Birs Nimroud form no part of the ruins of Babylon, it is surprising that it is not noticed by any ancient author, in giving an account of that city, which is scarcely credible, seeing that it is a mass of ruins "by far the most stupendous and surprising" of any that are allowed to belong to that city. It has been supposed, from Herodotus' having used the term ἐν μέσῳ in his description of the tower and palace, that they must each have been in the centre of their respective divisions. Though this term may generally be translated "in the centre," there is the highest authority for saying that, when used as it is in this case, it is very frequently applied to an object as lying in the way, or occupying a conspicuous position.—See *Schneider's Greek Lexicon*, by Passow.

Pietro della Valle was the first to assert that Mujelibé was the ancient tower, and his statement was followed, among others, by Major Rennell, author of the *Geography of Herodotus*. The opinion given out by Mr Rich that the Birs Nimroud might possibly represent the tower, called forth an article from Major Rennell in the Archæologia, in vindication of his own account of Babylon in the *Geography of Herodotus*. This was ably answered by Mr Rich in his *Second Memoir of Babylon*. Major Rennell rejects the idea that the Birs Nimroud was the temple of Belus, mainly on the ground that its distance was too great from the river and the rest of the ruins, to have been included in the circuit of the ancient city. According to him, the Mujelibé represents this temple, and considering this as certain, he proceeds to dispose of the other ruins in conformity with that. To make good this hypothesis, he is obliged to have recourse to the supposition that the river originally ran through the present ruins. This is denied by Mr Rich. "I carefully examined," says he, "the whole of the ground between Hillah and Mujelibé, with the view to ascertain the possibility of a change; but I was totally unable to discover the smallest vestiges indicative of it. The same examination was made by others during my stay, and since that time with the same result." This is also corroborated by Mr Layard, who says:—"After the most careful examination of the country, I could find no traces whatever of its having at any time flowed much farther than it now does to the east."

But the assertion that the river never flowed much farther to the eastward than it does at present, involves the question of what has become of the ruins on its western side, as it is expressly stated that the city stood upon both sides of the river. Niebuhr, who visited the spot in 1765, states that there were then mounds or little hills which were discovered to be full of bricks on both sides of the river; and Mr Rich says that he found opposite the mass of Amran two small mounds of earth overgrown with grass, and a little farther on two similar ones. Sir R. K. Porter seems to have subjected the plain on the western side of the Euphrates to a more minute examination, for the purpose of finding, if possible, some traces of the second palace. About 50 yards N.W. of Anana, a small village on the western bank of the river, 3 miles N.W. of Hillah, he found a considerable ridge of mounded earth 14 feet high, running due N. for 300 yards, and then, forming a right angle, continued on in that direction till it met the river. On the face of this ridge terminating at the water-edge, courses of sun-dried bricks are still distinctly visible; though the level of this land is now so equal with that of the river, that no traces are visible of any corresponding embankment on the other side. Some trifling mounds were observed a little to the S. of the village. After riding onward for about a mile to the S.W. in the direction of the Birs Nimroud, he found the vegetation gradually disappear, and the ground become perfectly sterile, presenting evident signs of its having been once covered with buildings. These indications increased at every step for more than a mile, when he came to another and more conspicuous range of mounds, the most considerable of which was about 35 feet high. From the top of this he observed that the face of the country, both to the N. and S., for more than a mile either way, bore the same hillocky appearance; besides being thickly scattered with those fragments of past habitations which in all Babylonian ruins have so particularly marked their character. "Here," says Sir R. K. Porter, "I think it is possible I may have found the site of the old or lesser palace; which, probably, was the temporary abode of Alexander during his inspection of his workmen, while clearing away the ruins of its fallen superstructures from the base of the temple of Belus. In the midst of the labour, and after having been engaged nearly two months in that attempt, we are told that he died; but previous to the event, he ordered himself to be removed from his residence on one side of the river to *his palace* on the other, and the eastern having been the more stately of the two, we can hardly entertain a doubt of its having also been the conqueror's more stationary habitation. Hence, there seems good reason to conclude, that it was on some spot amongst the ruins of the Kasr that the Macedonian hero breathed his last." Beyond this mass of mounds which, for perspicuity, he designates the Lesser Palace, and in the same direction (S.W.), he crossed a space of high grass and rank weeds for nearly a mile. He then found the plain again arid and undulated with multitudes of mounds, but of inferior elevation to those last described; these, too, were attended by the

Babylon. usual exterior fragments of ruins, spreading in a circular form for rather more than half a mile in width; then followed more than a mile of cultivated land to a canal which he crossed, and half a mile more brought him to an extensive wood of date trees, in the bosom of which stands the village of Tahmasia. For two miles the cultivation continued, and at the end of this a vast tract opened before him, covered with every minor vestige of former buildings, which appearances continued all the way to the eastern verge of the boundary around Birs Nimroud, a distance of nearly three-quarters of a mile. The remains seemed to him not only to establish the fact that the western plain of the Euphrates sustained its portion of the city of Babylon as well as the eastern bank, but that Birs Nimroud, otherwise the temple of Belus, did actually stand in one division of the city.

Mr Layard thinks that the fact of there being few remains on the western side may be accounted for from the Euphrates having a tendency to change its course in that direction, and to lose itself in the marshes to the W. of its actual bed. The low country on that side was subject to continual inundations from the earliest period; and Arrian states that the western quarter of the city was surrounded and defended by enormous marshes, which prevented all access to it. "Supposing, therefore, the river from different causes to have advanced and receded during many centuries, between the Hindiyah marshes and its present channel, it will easily be understood how the ruins which may once have stood on the western bank have gradually been washed away, and how the existing flat alluvial plain has taken their place."—(*Layard.*)

Captain Mignan, who has published the result of a most careful and meritorious survey of these ruins, adopts the opinion of Major Rennell, and asserts that the Birs Nimroud formed no part of the ancient Babylon. His description of the ruins, however, seem to tell rather against than for his opinion. The comparative claims of the two structures cannot bear comparison. The Mujelibé is an irregular oblong mass, little more than half the height of its rival, and composed almost entirely of the inferior material of sun-dried bricks. The Birs Nimroud, on the contrary, is much more elevated than any of the other remains, is built of the finest materials, and is of a form such as the tower is described to have been, having been evidently built in successive receding stages. Mr Buckingham is of opinion that the traces of four stages are clearly discernible. The opinion that this structure formed a part of the ancient city is strengthened by the observations of Captain Mignan, that instead of standing solitary, as had generally been supposed, it is surrounded by extensive ranges of ruins, bearing in their shattered fragments every mark of ancient importance. "If any building," says Mr Rich, "may be supposed to have left considerable traces, it is certainly the Pyramid or Tower of Belus, which, by its form, dimensions, and the solidity of its construction, was well calculated to resist the ravages of time; and if human force had not been employed, would, in all probability, have remained to the present day in nearly as perfect a state as the Pyramids of Egypt." "I am of opinion," he continues, "that this ruin is of a nature to fix of itself the locality of Babylon, even to the exclusion of those on the eastern side of the river; and if the ancients had actually assigned a position to the tower irreconcilable with the Birs, it would be more reasonable to suppose that some error had crept into their accounts than to reject this most remarkable of all the ruins."

It is stated by ancient writers in the most positive and circumstantial manner, that the palace, with its grand appendage of hanging gardens, was situate upon or very near the river, whence, indeed, the gardens were artificially watered. Now, modern Babylon presents near the river no ruins of any magnitude except those of the Amran, Kasr, and Mujelibé. It seems, therefore, unquestionable that some of these must be the remains of those immense structures. "In the Kasr we have remains of a pile, sumptuous in its material, of the finest furnace-baked brick, and magnificent for its extent, occupying a central position among the conspicuous ruins on the eastern bank, and inclosed on three sides by immense embankments answering to the description left us by Herodotus of the strong interior wall which surrounded the palace"—(Dr Traill in *Edin. Phil. Journal*, vol. xix.) The Mujelibé is by Mr Rich supposed to be the hanging gardens, and this is the generally received opinion, although some would give the preference to Amran, from its lying nearer the river. The opinion of Mr Rich seems to be strengthened by the piers discovered here by Mr Layard, and from no traces of masonry having as yet been found in the mound of Amran. The Amran and the embankment may probably have formed part of the defences of the city towards the river. It has been supposed that Diodorus is incorrect in stating that there were two palaces, especially as he is not supported by Herodotus or any other ancient authority; and as he wrote only from hearsay, that he might have been deceived by varying accounts of one palace, and thus led to form the idea that there were two. The striking similarity in his two descriptions as to situation, plan, and ornament, somewhat favours this conjecture. It is possible, however, that Sir R. K. Porter may be right in his supposition that he had found the site of the Lesser Palace. It thus seems extremely probable that the palace and the hanging gardens were situated on the eastern side of the Euphrates, and the tower of Belus on the western; that the Birs Nimroud was included within the walls of the ancient city, and is the remains of the tower of Belus, and that the Kasr represents the palace; while the Mujelibé not improbably corresponds to the hanging gardens.—See Rich's *First and Second Memoirs on the Ruins of Babylon*, 1815 and 1818; Major Rennell, *On the Topography of Ancient Babylon*, in *Archæologia*, vol. xviii.; Sir R. K. Porter's *Travels*, London, 1822; "*Remains of Babylon*," in *Edin. Review*, vol. xlviii.; Mignan's *Travels in Chaldæa*, Lond. 1829; Buckingham's *Travels in Mesopotamia;* Ainsworth's *Researches in Babylonia*, Lond. 1838; Keppell's *Personal Narrative;* Dr Traill, *On Ruins of Babylon*, in *Edin. Phil. Journal*, vol. xix.; *Nineveh and Persepolis*, by Vaux, Lond. 1850; Layard's *Nineveh and Babylon*, London, 1853. (D.K.)

Babylonia. BABYLONIA, or CHALDÆA, a country and kingdom of Asia, the capital of which was Babylon. The country was bounded on the N. by the desert part of Mesopotamia, on the E. by the Tigris, on the S. by the Persian Gulf, and on the W. by the Arabian desert. The confines of the kingdom, however, were at times much more extensive.

Passing over the early portion of Babylonian history, which is obscure and doubtful, we shall limit ourselves to a short acount of the events which terminated in the subversion of the kingdom.

A war which had begun between the Medes, Persians, and Babylonians, in the reign of Neriglissar, the father of Nabonadius, had been carried on with very bad fortune on the side of the Babylonians. Cyrus, who commanded the Median and Persian army, having subdued the several nations inhabiting the great continent from the Ægean Sea to the Euphrates, bent his march towards Babylon. Nabonadius, hearing of his march, immediately advanced against him with an army. In the engagement which ensued, the Babylonians were defeated; and the king, retreating to his metropolis, was blocked up and closely besieged by Cyrus. The reduction of this city was no easy enterprise. The walls were of a prodigious height, the number of men employed to defend them was great, and the place was stored with all sorts of provisions for twenty years. Cyrus, despairing of being able to take such a city by storm, caused a line of circumvallation to be drawn quite round it, with a large and deep ditch; reckoning that if all communication with the

Babylonia. country were cut off, the besieged would be obliged to surrender through famine. That his troops might not be too much fatigued, he divided his army into twelve bodies, appointing each body its month to guard the trenches; while the besieged, trusting to their high walls and magazines, insulted him from the ramparts, and ridiculed all his preparations as so much unprofitable labour.

After Cyrus had spent two whole years before Babylon, without making any progress in the siege, he at last thought of the following stratagem, which put him in possession of it. He was informed that a great annual solemnity was to be held at Babylon, and that the inhabitants on that occasion were accustomed to spend the whole night in drinking and debauchery. This he therefore thought a proper time for surprising them; and accordingly sent a strong detachment to the head of the canal leading to the large lake, with orders, at a certain time, to break down the great bank which was between the lake and canal, and to turn the whole current into the lake. At the same time he stationed one body of troops at the place where the river entered the city, and another where it came out; ordering them to march in by the bed of the river as soon as they should find it fordable. Towards the evening he opened the head of the trenches on both sides of the river above the city, that the water might discharge itself into them; by which means, and the breaking down of the great dam, the river was soon drained. The troops then entered the channel, the one body commanded by Gobryas, the other by Gadates; and finding the gates all left open in consequence of the disorders of that riotous night, they penetrated into the very heart of the city without opposition, and meeting, according to agreement, at the palace, they surprised the guards and cut them to pieces. Those who were in the palace opened the gates to know the cause of this confusion, when the Persians rushed in, took the palace, and killed the king, who came out to meet them sword in hand. Thus an end was put to the Babylonian empire; and Cyrus took possession of Babylon for one called in Scripture Darius the Mede, most probably Cyaxares II., uncle to Cyrus. From this time Babylonia never formed a distinct kingdom, but has always followed the fortune of those great conquerors who at different times have appeared in Asia. It is now subject to the Turks, under the name of Irak Arabi.

Of the country, manners, customs, and institutions of the Babylonians, a good account, chiefly gathered from Herodotus, has been given by M. Sabbathier in his *Manners, Customs, and Usages of Ancient Nations* (Stockdale's English translation, 2 vols. 8vo. 1775).

"As all the nations under the dominion of Cyrus, beside the ordinary tributes, were obliged to maintain him and his army, the monarch and his troops were supported by all Asia. The country of Babylon alone was obliged to maintain him four months of the year; its fertility, therefore, yielded a third of the produce of Asia. The government of this country, which the Persians termed *satrapy*, was richer and more extensive than any of the rest. It maintained for the king, besides the war-horses, a stud of 800 stallions and 16,000 mares. So great a number of Indian dogs were likewise bred in this province for the king, that four of its cities kept those animals; and in return, they were exempted from all taxes and tributes.

"It rained very seldom in this country, according to Herodotus. The earth was watered by the river, which was here diffused by human industry, as the Nile is over Egypt by nature; for all the country of Babylon was divided by canals, the greatest of which was navigable, and flowed from S. to N., from the Euphrates to the Tigris. In short, it was one of the finest countries for corn in the world; but for producing trees, the fig-tree, the vine, and the olive, it was not famous. It was so luxuriant in grain, that it commonly yielded a hundred times more than what was sown; and in good years it yielded three hundred times more than it received. The leaves of its wheat and barley were four inches broad. 'Though I know,' says Herodotus, 'that the millet and the sesame of that country grow to the size of trees, I will not describe them particularly, Babylonia. lest those who have not been in Babylonia should think my account fabulous.'

"They had no oil but what they made from Indian corn. The country abounded with palm-trees, which grew spontaneously; and most of them bore fruit, of which the inhabitants made bread, wine, and honey. They cultivated these trees and their fig-trees in the same manner. Some of them, as of other trees, the Greeks called *male* ones. They tied the fruit of the male to the trees which bore dates; that the musquitto, leaving the male, might cause the date to ripen, by penetrating it; for without that assistance it did not come to maturity. Musquittos bred in the male palms as in the wild fig-trees.

"But we must not here omit to give an account of the peculiar and surprising construction of their boats of skins, in which they sailed along the river to Babylon. These boats were invented by the Armenians, whose country lay north from Babylonia. They made them with poles of willow, which they bent, and covered with skins; the bare side of the skins they put outwards; and they made them so tight that they resembled boards. The boats had neither prow nor stern, but were of a round form like a buckler. They put straw on the bottom. Two men, each with an oar, rowed them down the river, laden with different wares, but chiefly with palm wine. Of these boats some were very large and some very small: the largest carried the weight of 500 talents. There was room for an ass in one of their small boats; they put many into a large one. When they had unloaded, after their arrival at Babylon, they sold the poles of their boats and the straw, and loading their asses with the skins, returned to Armenia; for they could not sail up the river, its current was so rapid. For this reason they made their boats of skins instead of wood; and on their return to Armenia with their asses, they applied the skins to their former use.

"As to their dress, they wore a linen shirt, which came down to their feet. Over it they wore a woollen robe; their outer garment was a white vest. Their shoes resembled those of the Thebans. They let their hair grow. On their heads they wore a turban. They rubbed their bodies all over with fragrant liquors. Each man had a ring on his finger, and an elegant cane in his hand, with an apple at the top, or a rose, a lily, or an eagle, or some other figure; for they were not suffered to use canes without devices.

"With regard to their policy, Herodotus thinks that their best law was one which the Heneti, an Illyrian people, likewise observed in every town and village. When the girls were marriageable, they were ordered to meet in a certain place, where the young men likewise assembled. They were then sold by the public crier: but he first sold the most beautiful one. When he had sold her at an immense price, he put up others to sale, according to their degrees of beauty. The rich Babylonians were emulous to carry off the finest women, who were sold to the highest bidders. But as the young men who were poor could not aspire to have fine women, they were content to take the ugliest with the money which was given them; for when the crier had sold the handsomest, he ordered the ugliest of all the women to be brought, and asked if any one was willing to take her with a small sum of money. Thus she became the wife of him who was most easily satisfied; and thus the finest women were sold, and from the money which they brought, small fortunes were given to the ugliest, and to those who had any bodily infirmity. A father could not marry his daughter as he pleased; nor was he who bought her allowed to take her home, without giving security that he would marry her. But, after the sale, if the parties were not agreeable to each other, the law enjoined that the purchase-money should be restored. The inhabitants of any of their towns were permitted to marry wives at these auctions. Such were the early customs of the Babylonians.

"But they afterwards made a law, which prohibited the inhabitants of different towns from intermarrying, and by which husbands were punished for treating their wives ill. When they had become poor by the ruin of their metropolis, fathers used to prostitute their daughters for gain. There was a sensible custom among the Babylonians, worthy to be related. They brought their sick into the forum, to consult those who passed on their diseases; for they had no physicians. They asked those who approached the sick, if they had ever had the

Babylonian || Bacchanalia.

same distemper; if they knew any one who had had it, and how he was cured. Hence, in this country, every one who saw a sick person was obliged to go to him and inquire into his distemper.

"They embalmed their dead with honey, and their mourning was like that of the Egyptians.

"There were three Babylonian tribes who lived only upon fish, and who prepared them in the following manner: they dried them in the sun, and then beat them in a mortar to a kind of flour, which, after they had sifted it through linen, they baked into rolls.

"The Babylonians at first worshipped only the sun and the moon; but they soon multiplied their divinities. They deified Baal, Bel, or Belus, one of their kings, and Merodach-Baladan. They also worshipped Venus under the name of *Mylitta*. She and Belus were the principal deities of the Babylonians. They counted their day from sunrise to sunrise. They solemnized five days of the year with great magnificence, and almost the same ceremonies with which the Romans celebrated their Saturnalia.

"The Babylonians were very much addicted to judicial astrology. Their priests, who openly professed that art, were obliged to commit to writing all the events of the lives of their illustrious men; and on a fancied connection between those events and the motions of the heavenly bodies the principles of their art were founded. They pretended that some of their books, in which their historical transactions and revolutions were accurately compared with the courses of the stars, were thousands of years old. This assertion of their judicial astrologers we may reasonably dispute; but that their astronomers had made a long series of observations is incontestably true. It is certain that some of these were extant in the days of Aristotle, and that they were older than the empire of the Babylonians." See ASTRONOMY, *History*.

BABYLONIAN, BABYLONIUS, is used by some ancient writers to signify astrologer, or anything relating to astrology. Hence *Babylonia cura* means the art of casting nativities; and *numeri Babylonii*, the computation of astrologers. See above.

BABYLONICA TEXTA, a rich sort of weavings or hangings, so called from the city of Babylon, where the art of interweaving divers colours in hangings or tapestry was first practised. Hence also Babylonic garments, Babylonic skins, Babylonic carpets, housings, &c.

BACCALAUREATE, the degree of bachelor of arts. See UNIVERSITIES.

BACCARAT, a town of France, capital of a canton in the department of Meurthe, 15 miles S.E. of Luneville. It is celebrated for its glass works, the most extensive in France, and which employ upwards of 1000 workmen. Pop. 2794.

BACCHÆ, Βάκχαι, in *Antiquity*, the female companions of Bacchus, who are said to have followed him in his Eastern expedition. It was likewise the name given to the priestesses of Bacchus, who celebrated the *orgia* or mysteries of that god, and are sometimes designated by the names, Mænades, Thyiades, &c.

BACCHANALIA, festivals or orgies in honour of Bacchus, which were introduced by the Greeks of Southern Italy into Etruria and Rome. These festivals, which had been celebrated among the Greeks with great merriment, degenerated among the Romans into practices of hideous licentiousness and immorality, which were generally carried on at night and in secret. In the year B.C. 186 their existence was discovered by the Roman magistrates, and strict inquiries were instituted. The numerous crimes committed at these nocturnal orgies induced the senate to issue an order forbidding the celebration of the Bacchanalia both at Rome and in Italy. This order (*Senatus consultum de Bacchanalibus*), which is mentioned by Livy and Cicero, was discovered, in 1640, at Bari in Southern Italy, engraved upon a brazen table, from which it has frequently been copied, as in Drakenborch's edition of Livy, in Donaldson's *Varronianus*, and elsewhere.

The Greeks called the festivals of Bacchus *Dionysia Lenæa, Anthesteria*, which were celebrated at different seasons of the year, and at which the dramatic poets produced their new tragedies and comedies in the Dionysiac theatre in Athens. See Dr Schmitz's article *Dionysia* in Smith's *Dictionary of Greek and Roman Antiquities*. (L. S.)

Bacchiglione || Bacchus

BACCHIGLIONE, a river in the Venetian territory, which, rising in the mountains eastward of Trent, passes by Vicenza and Padua, and falls into the lagune of Venice below Este, after a course of 90 miles. It is navigable for large boats as far as Vicenza. It gave name to a province of Napoleon's Italian kingdom.

BACCHIUS (Βακχεῖος), surnamed the Old; a Greek author whose place and time of birth are unknown. He wrote an *Introduction to the Art of Music*, in the form of questions and answers, apparently intended for the use of schools. Its title, Εἰσαγωγὴ τέχνης μουσικῆς, might lead one to suppose that it contains some explanations of the art of composing or performing music; but it treats merely of sounds, intervals, systems, &c. Meibomius published the first part of Bacchius' work, with a Latin translation and notes, in his *Antiquæ Musicæ Auctores*, Amstel. 1652; but unaccountably omitted the second part, although he had a copy of it. In the royal library of Paris there exists a MS. copy of that second part, but it has not yet been published, except through a bad French translation of the whole work, given by Mersenne in his *Harmonie Universelle*, 1627. (G. F. G.)

BACCHUS (Βάκχος), the god of wine and revelry, more generally called Dionysus by the Greeks, was, according to the common tradition, the son of Jupiter and Semele the daughter of Cadmus and Hermione. When Semele was pregnant, Juno, in the disguise of a friend, persuaded her to urge the fatal request that her lover, in order to assure her of his divinity, would come to her embraces invested with the attributes of majesty. Jupiter, who had sworn by Styx to grant whatever she might ask, was obliged to comply; when the mortal Semele, unable to endure the fiery splendours of the god, was reduced to ashes. The infant Bacchus was snatched from the flames by Mercury, or by the nymph Dirce, and sealed up in his father's thigh until the full period of birth; whence he has received the epithet of Bimatris. Semele, under the name of Thyone, was immediately translated to heaven; or, as some report, she remained in Hades till brought thence by Bacchus. According to Ovid, the young Bacchus was brought up by his aunt Ino, and afterwards intrusted to the care of the nymphs of Mount Nysa. Others say that he was educated at Naxos by the nymphs Philia, Coronis, and Cleis. Pausanias relates a tradition of a more dramatic cast:—that when Cadmus discovered the amour of his daughter, he exposed her with her infant to the perils of the deep in a coffer or chest, which was carried by the waves to the coast of Brasiæ in Peloponnesus, where Semele was found dead, but the child still living. These various traditions appear to refer to different personages. Cicero enumerates five Dionysi: 1. The son of Jupiter and Semele; 2. the son of Nilus; 3. The son of Caprius or Cabirus; 4. The son of Jupiter and the Moon; 5. The son of Nisus and Thyone (*De Nat. Deor.* iii. 23). Bacchus is often confounded with the Egyptian Osiris, or the sun, whose worship appears to have been introduced into Greece by the Orphici; and when Bacchus is represented seated on a globe bespangled with stars, he must be regarded as identified with that deity. Tradition represents Bacchus as having assisted the gods in their war against the giants, in which he was cut to pieces; but this story evidently relates to Osiris, who was killed by his brother Typhon. When Bacchus was grown up he was afflicted by Juno with madness, in which condition he wandered over many parts of the earth. There is also a tradition that while he lay asleep in the isle of Naxos he was carried off by some Tyrrhenian mariners, whom he transformed into dol-

Bacchus.

phins, but spared the pilot because he had opposed their design. (See Acœtes.) In his celebrated expedition to India, he is represented sitting in a chariot drawn by a lion and tiger, with a panther's skin flung about his shoulders. His attendants were Pan, Silenus, and the Satyrs, besides a motley multitude including numerous Bacchantic women, who are variously styled Lenæ, Mænades, Thyades, Mimallones, Clodones, and Bassaræ or Bassarides. Armed with the thyrsus, and crowned with vine and ivy leaves, they danced around him with cups in their hands, shouting "Evohe! Bacche!" "Evohe! Eleleu!" to the sound of Phrygian flutes, drums, and cymbals. His progress was triumphant, and generally without bloodshed; for men gratefully acknowledged the divinity of the hero who taught them the cultivation of the vine and instructed them in the useful arts. He was relentless, however, towards those who opposed his authority; and on that account he inflicted dreadful punishments on Damascus, on Lycurgus the son of Dryas king of Thrace, and others.

Bacchus is generally represented as young, handsome, and beardless, with an air of luxurious languor and effeminacy, and long flowing hair, holding in his hand a thyrsus, and crowned with vine or ivy leaves. Sometimes he has the appearance of age and decrepitude, as indicating the effects of intemperance: at other times he is seen as an infant in the arms of his foster-father Silenus, or riding on the shoulders of Pan, or on a goat, and accompanied by goats and satyrs. The horns with which he is sometimes represented are probably the symbol of victory or dominion, according to the Egyptian idea; but these are generally short, and concealed almost entirely by the hair. The phallus, which had a conspicuous place in the processions of Bacchus, was introduced from Egypt by Melampus. (See Herodot. ii. 49.) His several appellations of Liber, Bromius, Evan, Thyonæus, Bassareus, Psilas, &c., were derived either from circumstances connected with his personal history, from the places where he was worshipped, or from the ceremonies observed at his festivals. These festivals, which were very numerous, were called Orgia, Dionysia, Bacchanalia, &c. The orgies were celebrated by night, and those held on Mount Cithæron were especially noted for extravagance and licentiousness. The Dionysia at Athens were celebrated with extraordinary splendour. The rites of Bacchus were often attended with the grossest debauchery; and to such a pitch was this depravity carried at Rome, that it was found necessary to suppress the orgies by a decree of the senate. The vine, ivy, laurel, yew, fig-tree, and fir, were sacred to Bacchus; as were also the tiger, panther, ass, dolphin, magpie, and serpent; the last, as emblematic of immortality, being common to several of the gods. The ram was sacrificed to him, as was also the goat, on account of its destructiveness to vines. (See Ascolia.) It is said that in very early times this deity was propitiated with the blood of human victims; and even Themistocles had the barbarity to sacrifice three noble Persian youths on an altar which he erected to Bacchus Omestes on board his galley. (Plutarch, *Themist.*) Bacchus had numerous children by Ariadne, whom he espoused in the island of Naxos, after her desertion by Theseus. (See Ariadne.) The most interesting circumstance in connection with the worship of this deity is that of the dithyrambics and mummeries performed at the celebration of his mysteries, which were undoubtedly the first rude prototypes of scenic or theatrical representations, as eventually developed in the comedies of Cratinus, Eupolis, and Aristophanes. Tragedy also arose out of the worship of Bacchus. The worshippers, clad in the skins of goats and fawns, imitated the poetical fictions concerning the god; personating Silenus, Pan, the nymphs and satyrs, and arrayed in grotesque dresses, they smeared their faces with the lees of wine, and diverted themselves and others with their antic gestures and comic sallies.

The Greek word τραγῳδία, *tragedy*, is generally admitted to have been derived from the name of the victim, τράγος, *a goat*, which was sacrificed on these occasions, accompanied with the singing of an ode or hymn, ᾠδή.

Bacchylides || Baccio.

The origin of Bacchus and of his name have given rise to a diversity of opinions. The name has been deduced from ἰάχω, and from βοάω, because of the noise which prevailed at the celebration of his rites. Diodorus mentions three deities of this name: 1. The conqueror of India, who is known as the bearded Bacchus; 2. The horned Bacchus, son of Jupiter and Proserpine; 3. The son of Semele, called the Bacchus of Thebes. The ingenious Rudbeck conjectures that Bacchus was a Scythian or Thracian hero named Bagge, whom tradition represents as the conqueror of the Eastern world; and this name he derives from *bagge, book, i.e.* a goat or ram, metaphorically taken for *dux*. (*Atlantic.* ii. p. 146.) Ovid, indeed, makes Bacchus set out from the Hebrus, a river of Thrace:—

Ibat arenoso satyris comitatus ab Hebro.—*Fast.* iii. 737.

The worship of this deity appears to have been of Eastern origin. The name Dionysus (Διόνυσος) is apparently a compound of Διὸς and Νύσα, *i.e.* the deity from Nysa, which was the name of a mountain and city between the rivers Choaspes and Cophes; yet it should be observed that this name was borne by several other places in different parts of the world. (T. S. T—L.)

BACCHYLIDES, Βακχυλίδης, a famous Greek lyric poet, born at Iulis in Ceos, was the nephew of Simonides, and flourished about 470 years before Christ. He resided long at the court of Hiero of Syracuse with Simonides and Pindar, and wrote odes, hymns, and epigrams, of which some fragments are published in the first volume of Brunck's *Analecta*; by Neue, *Bacchylidis Cei Fragm.*; and by Bergk, *Poëtæ Lyrici Græci.*

BACCIO, or Baccius, Andrea, a celebrated physician of the sixteenth century, born at St Elpideo. He practised physic at Rome with great reputation, and was first physician to Pope Sixtus V. The most scarce and valuable of his works are the following:—1. *De Thermis*; 2. *De Naturali Vinorum Historia, de Vinis Italiæ, et de Conviviis Antiquorum*; 3. *De Venenis et Antidotis*; 4. *De Gemmis ac Lapidibus Pretiosis.*

Baccio *della Porta*, called *Bartolomeo di S. Marco*, a celebrated historical and portrait painter, was born at Savignano, near Florence, in 1469, and died in 1517. He was a disciple of Cosimo Roselli; but his principal knowledge of the art was derived from Lionardo da Vinci. He understood the true principles of design better than most masters of his time; and as he was a considerable master of perspective, Raphael had recourse to him after quitting the school of Perugino, and under his direction studied the art of managing and uniting colours, as well as the rules of perspective. Some years after the departure of Raphael from Florence, Baccio visited Rome, where he derived much benefit from the study of the antique, and of the works of Raphael, which were then the admiration of the whole world. His improvement was manifested in a picture of St Sebastian, which he finished on his return to Florence. This was so well designed, so naturally and beautifully coloured, and so strongly expressive of suffering and agony, that it was found necessary to remove it from the place where it had been exhibited in the chapel of a convent, in consequence of the too powerful impression it had made on the imaginations of many women who beheld it. Baccio was very laborious, and made nature his perpetual study; his designs were distinguished for correctness and purity, his figures had a great deal of grace, and his colouring was admirable. He is usually accounted the inventor of the useful contrivance called the *lay figure*. There is a capital picture of the Ascension, by Baccio, in the Florentine collection.

Bach || Bachian.

BACH, JOHANN SEBASTIAN, a most original and learned composer of music, was born at Eisenach, March 21, 1685, and died at Leipzig, July 30, 1750. His works were very numerous, but many of them have been lost, and many others still remain in manuscript; although, fortunately, a number of his best works have been printed. His published works alone prove his powers of invention and construction to have been prodigious. His compositions consist chiefly of sacred music, and pieces for the organ and harpsichord. He composed no dramatic music. Many persons believe that Gluck was the first great German composer of recitatives; but this error is made evident by Bach's *Grosse Passionsmusik*, published in score, at Berlin, in 1830. In knowledge of instrumentation and instrumental effects, he was far in advance of his contemporaries. As a fugue writer and an extempore composer, he was unequalled; while as an organ and harpsichord player he had no rival but Handel. What he wrote was to please himself and not the public, whose favour he never courted. He was twice married, and had eleven sons and nine daughters. All his sons became professional musicians, but only three or four of them distinguished themselves as composers. (G. F. G.)

BACH, *Carl Philip Emanuel*, the second son of Johann Sebastian Bach, was by far the most remarkable of the eleven brothers, not only for his peculiar genius and originality, but also for the great influence which his compositions exercised on the forms and style of later instrumental music. His style, full of novelty and elegance, was that which Haydn and Mozart studied attentively, and carried to perfection by giving it greater breadth of development. He was born at Weimar on the 14th of March 1714, and died at Hamburg on the 14th of December 1788. His compositions, vocal and instrumental, are numerous. Many of them are still unpublished. (G. F. G.)

BACHELOR, a common term for a man not married, or who is yet in a state of celibacy. The Roman censors frequently imposed fines on bachelors. Dionysius of Halicarnassus mentions an old constitution, by which all persons of full age were obliged to marry. But the most celebrated law of this kind was that made under Augustus, called the *Lex Julia de Maritandis Ordinibus*, by which bachelors were made incapable of taking legacies or inheritances by will, unless from their near relations. By the laws of Lycurgus bachelors were branded with infamy, and excluded from all offices civil and military, and even from the public entertainments. At certain feasts they were exposed to public derision, and led round the market-place. In the canon law we find injunctions on bachelors, either to marry, or to turn monks and profess chastity in earnest.

BACHELOR was anciently applied to those who had attained to knighthood, but wanted the number of vassals sufficient to entitle them to have their banner carried before them in the field of battle; or who, being of the order of bannerets, were not yet of age to display their own banner, and consequently obliged to march to battle under the banner of another. Bachelor was also a title given to young cavaliers, who having made their first campaign, received the military girdle accordingly; and it further served to distinguish him who had overcome an adversary in a tournament the first time he had ever engaged.

Knights-BACHELORS, the most ancient, but the lowest, order of knights in England, known by the name of *knights* only. They are styled *knights-bachelors*, either, according to some, as denoting their degree, *quasi* "*bas chevaliers*;" or, according to others, because this title does not descend to their posterity. Knights are called in Latin *equites aurati*, from their wearing gilt spurs.

BACHELORS *of Arts*, *of Divinity*, *of Laws*, and *of Medicine*, are persons who have taken the first degree in these respective faculties. See UNIVERSITIES.

BACHIAN, one of the Molucca islands, about fifty-four miles in length by twenty in breadth, and separated by a narrow strait from the island of Gilolo. It yields gold dust, sago, fruits, and cloves. The inhabitants are Malay Mahometans. Long. 127. 33. E. Lat. 1. 0. S.

Bacillaria || Back-gammon.

BACILLARIA, one of Ehrenberg's families of infusoria, containing 30 genera or more. The siliceous bucklers of those minute animals form whole beds of the *polishing-slate* of Bohemia; and are contained in astonishing numbers in the cretaceous formations of England, Germany, Italy, Greece, and North America. See ANIMALCULE.

BACKER, or BAKKER, *Jacob*, portrait and historical painter, was born at Harlingen in 1609, but spent the greater part of his life at Amsterdam. His portraits are executed with boldness, spirit, and grace. His incredible expedition in painting was testified by a half-length portrait of a lady, adorned with rich drapery and jewels, which he began and finished in one day. Of his historical subjects the picture of Cimon and Iphigenia is worthy of mention. He died in 1651.

BACKERGUNGE, one of the lower provinces of the presidency of Bengal, situate in the delta of the Ganges, and containing an area of 3794 square miles, with a population of 733,800. The tract throughout is low, level, and intersected by numerous rivers, the principal of which are the Ganges and the Meghna. For the most part the soil is alluvial, but notwithstanding the inundations to which the district is subject, the climate is more healthy than in most parts of Bengal, the several channels serving as drains to carry off the stagnant water immediately after the cessation of the rains. Generally speaking the country is well cultivated, and the crops of rice are rich in the extreme. The town of Backergunge was formerly the principal place of the province, but the seat of the civil establishment was some time since transferred to Burrisol, a town 128 miles east of Calcutta, in Lat. 22. 43. Long. 90. 23. (E. T.)

BACKGAMMON, an ingenious game played with dice upon a table by two persons. The table is divided into two parts, upon which there are twenty-four black and white spaces, called *points*. Each player has fifteen men, black and white, to distinguish them, and they are disposed of in the following manner: Supposing the game to be played in the right-hand table, two are placed upon the ace point in the adversary's table, five upon the six point in the opposite table, three upon the cinque point in the hithermost table, and five on the six point in the right-hand table. The grand object in this game is for each player to bring the men round into his right-hand table, by throwing with a pair of dice those throws that contribute towards it, and at the same time to prevent his adversary doing the like. The first best throw upon the dice is esteemed aces, because it stops the six point in the outer table, and secures the cinque in the thrower's table; so that the adversary's two men upon the thrower's ace point cannot get out with either quatre, cinque, or six. This throw is an advantage often given to the antagonist by the superior player. When he carries his men home in order to lose no point, he is to carry the most distant man to his adversary's bar point, that being the first stage he is to place it on; the next is six points farther, viz. in the place where the adversary's five men are first placed out of his tables; and he must go on in this method till all his men are brought home except two, when by losing a point he may often save the gammon, by throwing two fours or two fives. When a hit is only played for, he should endeavour to gain either his own or adversary's cinque point; and if that fail by his being hit by the adversary, and he find him farther advanced than himself, in that case he must throw more men into the adversary's tables, which is done in this manner: He must put a man upon his cinque or bar point; and if the adversary neglect to hit it, he may then gain a forward game instead of a back game. But if the adversary hit him, he should play for a back game; and then the greater number of men

Back-gammon.

which are taken up makes his game the better, because by these means he will preserve his game at home. He should then endeavour to gain both his adversary's ace and trois points, or his ace and deuce points, and take care to keep three men upon the adversary's ace point, that in case the latter hit him from thence, that point may remain still secure to himself. A back game should not be played for at the beginning of a set, because it would be a great disadvantage, the player running the risk of a gammon to win a single hit. The subsequent calculations will show the odds of entering a single man upon any certain number of points. Upon two dice there are thirty-six chances, and upon these chances the following points, viz.

	Points.
2 Aces	4
2 Deuces	8
2 Trois	12
2 Fours	16
2 Fives	20
2 Sixes	24
6 and 5 twice	22
6 and 4 twice	20
6 and 3 twice	18
6 and 2 twice	16
6 and 1 twice	14
5 and 4 twice	18
5 and 3 twice	16
5 and 2 twice	14
5 and 1 twice	12
4 and 3 twice	14
4 and 2 twice	1
4 and 1 twice	10
3 and 2 twice	10
3 and 1 twice	8
2 and 1 twice	6

Divide by 36)294(8

This proves, that upon an average the player has a right to 8 points each throw 6

The chances upon two dice calculated for backgammon are as follow:—

2 Sixes	1
2 Fives	1
2 Fours	1
2 Trois	1
2 Deuces	1
†2 Aces	1
6 and 5 twice	2
6 and 4 twice	2
6 and 3 twice	2
6 and 2 twice	2
†6 and 1 twice	2
5 and 4 twice	2
5 and 3 twice	2
5 and 2 twice	2
†5 and 1 twice	2
4 and 3 twice	2
4 and 2 twice	2
†4 and 1 twice	2
3 and 2 twice	2
†3 and 1 twice	2
†2 and 1 twice	2
	36

As it may seem difficult to find out by this table of thirty-six chances what are the odds of being hit upon a certain or flat die, let the following method be pursued. The player may observe in the table that the chances marked thus † are,

† 2 aces	1
† 6 and 1 twice	2
† 5 and 1 twice	2
† 4 and 1 twice	2
† 3 and 1 twice	2
† 2 and 1 twice	2
Total,	—11
When deducted from	36
There remains	25

From which it appears that it is 25 to 11 against hitting an ace upon a certain or flat die. And this method holds good with respect to any other flat die. For example, what are the odds of entering a man upon 1, 2, 3, 4, or 5 points? Answer.

To enter it upon	for	against	for	agt.
1 point is	11	to 25 or about	4	to 9
2	20	... 16	5	... 4
3	27	... 9	3	... 1
4	32	... 4	8	... 1
5	35	... 1	35	... 1

The following table shows the odds of hitting with any chance in the reach of a single die:—

To hit upon	for	against	for	agt.
1 is	11	to 25 or about	4	to 9
2 ...	12	... 24	1	... 2
3 ...	14	... 22	2	... 3
4 ...	15	... 21	5	... 7
5 ...	15	... 21	5	... 7
6 ...	17	... 19	8½	... 9½

The odds of hitting with double dice are as follow:— Back-gammon.

To hit upon	for	against	for	agt.
7 is	6	to 30 or about	1	to 5
8 ...	6	... 30	1	... 5
9 ...	5	... 31	1	... 6
10 ...	3	... 33	1	... 11
11 ...	2	... 34	1	... 17
12 ...	1	... 36	1	... 35

How to find out the odds of being hit upon a six by the table of thirty-six chances.

2 Sixes	1
2 Trois	1
2 Deuces	1
6 and 5 twice	2
6 and 4 twice	2
6 and 3 twice	2
6 and 2 twice	2
6 and 1 twice	2
5 and 1 twice	2
4 and 2 twice	2
	—17
Which deducted from	36
There remains	19

By which it appears to be 19 to 17 against being upon a six.

The odds on the hits.

2 love is about	5 to 2
2 to 1 is	2 to 1
1 love is	3 to 2

If a player has taken up two of the adversary's men, and happen to have two, three, or more points made in his own tables, he should spread his men, that he may either take a new point in his tables, or be ready to hit the man which the adversary may happen to enter. If he find, upon the adversary's entering, that the game is upon a par, or that the advantage is on his own side, he should take the adversary's man up whenever he can, it being 25 to 11 that he is not hit; except when he is playing for a single hit only, because then, if playing the throw otherwise gives him a better chance for it, he ought to do it.

It being five to one against his being hit with double dice, he should never be deterred from taking up any one man of the adversary's.

If he has taken up one of the adversary's men, and happen to have five points in his own tables, yet is forced to leave a blot out of his tables, he should endeavour to leave it upon doublets in preference to any other chance, because in that case the odds are 35 to 1 that he is not hit; whereas it is only 17 to 1 that he is hit upon any other chance.

When the adversary is very forward, a player should never move a man from his own quatre, trois, or deuce points, thinking to bear that man from the point where he put it, as nothing but high doublets can give him any chance for the hit. Instead of playing an ace or a deuce from any of those points, he should play them from his own six or highest points, so that, throwing two fives or two fours, his six and cinque points being eased, would be a considerable advantage to him; whereas if they had been loaded he would have been obliged to play otherwise.

It is the interest of the adversary to take up the player as soon as he enters. The blot should be left upon the adversary's lowest point; that is to say, upon his deuce point rather than upon his trois point, or upon his trois point rather than his quatre point, or upon his quatre point preferably to his cinque point, for a reason before mentioned. All the men the adversary plays upon his trois or his deuce point are deemed lost, being greatly out of play; so that those men not having it in their power to make his cinque point, and his game being crowded in one place and open in another, the adversary must be greatly annoyed by the player.

Back-gammon.

If the player have two of the adversary's men in his tables, he has a better chance for a hit than if he had more, provided his game is more forward than that of his antagonist; for if he had three or more of the adversary's men in his tables, he would stand a worse chance to be hit.

When a player is running to save the gammon, if he should have two men upon his ace point and several men abroad, although he should lose a point or two in putting his men into his tables, it is his interest to leave a man upon the adversary's ace point, because it will prevent his adversary from bearing his men to the greatest advantage, and at the same time the player will have a chance of the adversary's making a blot, which he may chance to hit. However, if a player find upon a throw that he has a probability or saving his gammon, he should never wait for a blot, as the odds are greatly against his hitting it, but at once embrace that opportunity to escape.

Suppose the adversary has so many men abroad as to require three throws to put them into his tables, and at the same time that the player's tables are made up, and that he has taken up one of the adversary's men; in this case it is about an equal wager that the adversary is gammoned; for in all probability the player has borne two men before he opens his tables, and when he bears the third man he will be obliged to open his six or cinque point. It is then probable that the adversary is obliged to throw twice before he enters his men in the player's tables, twice more before he puts that man into his own tables, and three throws more to put the men which are abroad into his own tables; in all seven throws. Now the player having twelve men to bear, he may be forced to make an ace or a deuce twice before he can bear all his men, and consequently will require seven throws in bearing them; so that, upon the whole, it is about equal whether the adversary is gammoned or not.

Suppose a player has three men upon his adversary's ace point and five points in his own tables, and that the adversary has all his men in his tables, three upon each of his five highest points; has the player a probability of gammoning his adversary or not?

	Points.
For bearing three men from his 6th point is	18
From his 5th point	15
From his 4th point	12
From his 3d point	9
From his 2d point	6
In all,	—60
Bringing his three men from the adversary's ace point to his six point in his own tables, being 18 points each, and making together	54
There must remain	6

From which it is plain that the player has much the best of the probability of the gammon; exclusive of one or more blots which the adversary is liable to make in bearing his men, and supposing at the same time the throws to be upon an equality. But suppose two blots are left, either of which cannot be hit but by double dice; one must be hit by throwing eight, and the other by throwing nine; so that the adversary has only one die to hit either of them. What, then, are the odds of hitting either of them?

The chances of two dice being in all	36
The chances to hit 8 or 6 and 2 twice	2
5 and 3 twice	2
2 deuces	1
2 fours	1
The chances to hit 9 or 6 and 3 twice	2
5 and 4 twice	2
2 trois	1
For hitting in all	11
Chances for not hitting remain	25

So that the odds are 25 to 11 against hitting either of these blots.

Backhuysen || Bacon.

This method may be taken to find out the odds of hitting three, four, or five blots upon double dice, or blots made upon double and single dice at the same time. After knowing how many chances there are to hit any of these blots, they must be added all together, and then subtracted from the number 36, which are the chances of the two dice.

The laws of backgammon are as follow: 1. When a man is taken from any point, it must be played; when two men are taken from it, they also must be played. 2. A man is not supposed to be played till it is placed upon a point and quitted. 3. If a player have only fourteen men in play, there is no penalty inflicted, because by his playing with a lesser number than he is entitled to, he plays to a disadvantage for want of the deficient man to make up his tables. 4. If he bear any number of men before he has entered a man taken up, and which of course he was obliged to enter, such men so borne must be entered again in the adversary's tables as well as the man taken up. 5. If he have mistaken his throw and played it, and his adversary have thrown, it is not in the choice of either of the players to alter it, unless they both agree so to do.

BACKHUYSEN, Ludolf, an eminent painter of the Dutch school, born at Embden in Hanover in 1631; died in 1709. He was brought up as a merchant at Amsterdam, but early discovered a genius for painting. Such was his zeal for the art, that he frequently exposed himself on the sea in an open boat, in order to study the effects of tempests on that element. His sea-pieces are greatly esteemed.

BACK-RENT, in Scotland, is rent paid by a tenant after reaping the crop, in contradistinction to *fore-rent*, or rent payable previous to the reaping of the first crop; which is settled in either case by the terms of the lease.

BACK-STAFF, or Davis's Quadrant, an instrument invented by Captain John Davis, about the year 1590, for taking the sun's altitude at sea; but now superseded by Hadley's quadrant. It consisted of two concentric arcs and three vanes, the arc of the longer radius being 30 degrees, and that of the shorter 60 degrees, thus making altogether 90 degrees, or a quadrant. It derived its name from the observer's standing with his back to the sun.

BACON, Francis, Viscount St Albans, and Baron Verulam. This illustrious man was born in London, on the 22d day of January 1561. His father, Sir Nicholas Bacon, a courtier, a lawyer, and a man of erudition, stood high in the favour of Queen Elizabeth, and was lord-keeper during twenty years of her reign. Anne, the second wife of Sir Nicholas, and the philosopher's mother, was the daughter of Sir Anthony Cooke, Edward the Sixth's tutor, and was herself distinguished among the learned females of the time. One of her sisters became the wife of Elizabeth's celebrated treasurer, Lord Burleigh. Delicate in health, and devoted to sedentary employment, Francis Bacon exhibited in early boyhood the dawning of those powers whose versatility afterwards became not less remarkable than their strength. As a child he delighted the queen with his precocious gravity and readiness of speech; and before he had completed his twelfth year we see him investigating the cause of a singular echo in a conduit, and endeavouring to penetrate the mystery of a juggler who performed in his father's house. At the age of thirteen he was matriculated at Trinity College, Cambridge, of which Whitgift was then master; but his residence at the university lasted scarcely three years, and his writings contain many expressions of dissatisfaction with the current system of academical education. In his sixteenth year he was sent abroad, and lived for some time at Paris, under the charge of the English ambassador, Sir Amias Paulett; after which he visited the French provinces, and added to his literary and philosophical studies an acquaintance with foreign policy and statistics, the fruit of which soon appeared in his tract upon the State of Europe. In February 1580, his father died, and he immediately returned to England.

Bacon. Sir Nicholas left but a scanty fortune; and his son Francis, the youngest of a large family, found himself obliged, in his twentieth year, to devise the means of earning a livelihood. It might have been thought that friends could not have been wanting to one who, besides his own acknowledged merit, had it in his power to urge the long and honourable services of his father, while his uncle was the prime minister of the kingdom. Of the patronage which thus seemed to be at his command, Bacon attempted to avail himself, desiring to obtain such a public employment as might enable him to unite political activity in some degree with literary study. But his suit was received neglectfully by the queen, and harshly repulsed by his kinsman. Although all the causes of this conduct may not be discoverable, a few lie at the surface. The lord-keeper had, in the later years of his life, lost the royal favour. Burleigh, besides his notorious contempt for men of letters, had to provide for sons of his own, to whom their accomplished cousin might have proved a dangerous rival. From the Cecils, indeed, Bacon never derived any efficient aid, till he had forced his way upwards in spite of them; and there are evident traces of jealousy and dislike in the mode in which he was treated both by the old treasurer, and by his second son, Robert.

Obliged therefore to betake himself to the law, Bacon was admitted at Gray's Inn, where he spent several years obscurely in the study of his profession, but with increasing practice at the bar. The friendship of his fellow lawyers, earned by his amiable disposition and his activity in the affairs of the society, bestowed on him offices in his inn of court; but his kinsmen were still cold and haughty. Lord Burleigh continued to write him letters of reproof; and Robert Cecil, already a rising statesman, sneered at speculative intellects, and insinuated their unfitness for the business of life. In 1590, when Bacon was in his thirtieth year, he was visited for the first time with court-favour, receiving then an honorary appointment as queen's counsel extraordinary; and to this was added a grant of the reversion of a clerkship in the star-chamber, which did not become vacant for eighteen years. But the lawyer's heart was not in his task. His brilliant professional success, and the awakening friendship of his relations, merely suggested to him renewed attempts to escape from the drudgery of the bar. His views are nobly expressed in a letter which he addressed to the lord-treasurer the year after his appointment.[1] We linger with melancholy pleasure over these abortive efforts made by one of the finest and most capacious of intellects to extricate itself from that labyrinth of worldly turmoil, in which its owner was destined to purchase rank and splendour at the expense of moral degradation and final ruin.

We are henceforth to behold Bacon actively engaged in political life, as well as in the duties of his profession. Two parties then divided the court, equally remarkable in different ways on account of those who headed them. Burleigh was the chief of the queen's old counsellors, on whom, amidst all her caprices, she always had the prudence to rely for the real business of the state: the young and gay, those who aspired to be ranked as the personal friends or adorers of the withered sovereign of hearts, were led by the high-spirited and imprudent Earl of Essex. To the party of this nobleman Bacon decidedly attached himself, and soon indeed shared with his own elder brother Anthony, the earl's most private confidence. Valuable advisers were they to their rash patron; and a valuable servant of the nation did Francis Bacon bid fair to become, when, in November 1592, he entered parliament as one of the knights of the shire for Middlesex. His first speech, in February following, contained an urgent pleading for improvements in the law; in another address, delivered in March, he resisted, with exceeding boldness as well as force of reason, the immediate levying of an unpopular subsidy to which the House had already consented. The young lawyer's exposition of unpleasant truths gave deep offence to the queen. His uncle and the lord-keeper were both commissioned to convey to him the assurance of the royal displeasure; and the two humble, nay, crouching letters of apology, still extant, in which he entreated those ministers to procure his pardon, did not forebode much independence in his subsequent conduct. We do not, indeed, again hear Bacon named as a champion of popular rights. Bacon.

In the year 1594, Sir Edward Coke being made attorney-general, the solicitorship became vacant; and Bacon's application for the office was strenuously supported by Essex. But all efforts were in vain. The powerful kinsmen were colder than ever towards one who had chosen another patron. The lord-keeper, Puckering, acted in a manner which drew on him a spirited rebuke from the candidate. The queen hesitated, coquetted, told Essex that his friend, though witty, eloquent, and in some branches learned, was a showy lawyer rather than a profound one. After a delay of many months, the place was given to a plodding serjeant; and Bacon's generous patron, vexed at the disappointment of his hopes, sought to console both him and himself by a gift equally munificent and delicate. Bacon received from him an estate at Twickenham, worth about eighteen hundred pounds. The present, in all likelihood, came very seasonably; for he appears to have been already involved in those pecuniary embarrassments from which he was never afterwards completely able to extricate himself. He was obliged to sell the land which Essex had given him; two years later he was arrested in the street for a debt of three hundred pounds; and among the Lord Chancellor Ellesmere's papers, recently published, there is a curious acknowledgment, granted in 1604, for a pledge in security of an advance of fifty pounds to him. These reasons offer the only apology for the addresses which, about the time of his arrest, he paid to a wealthy and shrewish widow, who, fortunately for him, preferred his professional brother and personal enemy, Sir Edward Coke. In the meantime, his legal reputation continued to increase, and his parliamentary exertions were unremitted, though altogether free from that independence which had once characterized them. We thus trace Bacon down to his thirty-

[1] "I wax now somewhat ancient: one-and-thirty years is a great deal of sand in the hour-glass. My health, I thank God, I find confirmed, and I do not fear that action shall impair it; because I account my ordinary course of study and meditation to be more painful than most parts of action are. I ever bear a mind, in some middle place that I could discharge, to serve her majesty; not as a man born under Sol that loveth honour, nor under Jupiter that loveth business, for the contemplative planet carrieth me away wholly; but as a man born under an excellent sovereign, that deserveth the dedication of all men's abilities. . . . Again, the meanness of my estate doth somewhat move me; for, though I cannot accuse myself that I am either prodigal or slothful, yet my health is not to spend, nor my course to get. Lastly, I confess that I have as vast contemplative ends, as I have moderate civil ends; *for I have taken all knowledge to be my province;* and, if I could purge it of two sorts of rovers,—whereof the one with frivolous disputations, confutations, and verbosities, the other with blind experiments, and auricular traditions and impostures, have committed so many spoils,—I hope I should bring in industrious observations, grounded conclusions, and profitable inventions and discoveries; the best state of that province. This, whether it be curiosity, or vain-glory, or nature, or (if one take it more favourably) philanthropia, is so fixed in my mind, as it cannot be removed. . . . *And if your lordship will not carry me on,* I will not do as Anaxagoras did, who reduced himself with contemplation into voluntary poverty: but *this I will do,—I will sell the inheritance that I have, and purchase some lease of quick revenue, or some office of gain, that shall be executed by deputy; and so give over all care of service, and become some sorry bookmaker, or a true pioneer in that mine of truth, which, he said, lay so deep.*"—(Cabula, p. 18. Bacon's Works, vol. xii. p. 6, 7. Montagu's edit.)

Bacon. ninth year, pausing only to remark, that two years earlier, that is, in 1597, his celebrated Essays were first published. Although merely the skeleton of what they afterwards became, these compositions gained high reputation for their author, not only at home, but also on the continent.

After this, the first step in Bacon's literary career, we approach what is the most painful task of his biographer, a dark page of his history, over which no ingenuity has ever been able to throw a veil thick enough to disguise its foulness. We have seen him the friend, the adviser, the grateful vassal of Essex; we are now to behold him deserting his benefactor, assisting to destroy him, standing forth in the face of the world as his enemy and accuser. The philosopher's latest biographer has pronounced his conduct in this matter to be honourable and praiseworthy; and to his pages we must refer those who are curious to canvass arguments of which we are ourselves unable to discover the force. Bacon, unfortunately for himself, had lately risen much in royal favour, and been greatly trusted and employed. Accordingly, in the first stages of Essex's decline, he had to act a double part,—now offering to his patron advices which were but seldom followed, now seeking excuses to pacify the queen's rising displeasure. His natural inclination for temporizing, the success which had hitherto attended his cautious policy, the honest wish to serve his generous friend,—all these reasons may have concurred in tempting him to embark in the dangerous channel. But the sunken rocks soon encompassed him, and shipwreck was unavoidable. Alienation either from Elizabeth or from Essex speedily appeared to be the necessary result of the position into which the parties were coming. Bacon had not the courage to take the nobler part, and place himself by the side of his falling friend, at the probable expense of all his worldly prospects. Suspicion and estrangement soon took the place of affectionate confidence; and the trust reposed in him by the queen was purchased by the bitter consciousness that Essex regarded him as treacherous and hostile. A more degrading task was yet to come The first trial of the earl, in reference to his conduct in Ireland, was determined upon; and Bacon's enemies asserted that he offered himself to act as one of the counsel for the prosecution. In that memoir in defence of his conduct which he wrote in the next reign, and which proves satisfactorily nothing but his own humiliating consciousness of guilt, he states as to this matter what was doubtless the truth. It had been resolved that the proceedings against the rash earl should not be carried out to his destruction, but should only disarm and discourage him; and, a hint being conveyed to Bacon that the queen had not determined whether he should be employed professionally in the affair or not, he thought proper to address to her "two or three words of compliment," intimating that if she would dispense with his services he would consider it as one of her greatest favours, but that otherwise he knew his duty, and would not allow any private obligations to interfere with what he owed to her majesty. All this was, he adds, "a respect no man that had his wits could have omitted." Bacon, in short, still wished to serve two masters; but he had now placed himself at the mercy of those from whom he had no forbearance to expect. The queen, suspicious and moody, was jealous of his attachment to Essex, and bent on compelling him to do her service unreservedly: her advisers, or some of them, were glad to have the odium of the earl's destruction shared with them by one so distinguished, who had, likewise, been the victim's friend. It was intimated that Bacon's services could not be dispensed with; but he tells us, (and he probably repeats only what his masters tried to make him believe), that it was resolved his share in the prosecution should be confined to matters which could not do his unfortunate patron any serious harm. Essex's private censure by the privy-council followed; and, while he was committed to custody-at-large, Bacon incurred, by his appearance against him, an obloquy of which his letters show him to have been painfully sensible. In a few months the earl's open rebellion took place; he was seized, and put upon his trial in February 1601, along with Lord Southampton; and on this occasion, when his life was at stake, Bacon again appeared as one of the counsel for the prosecution, and delivered a speech of which there is extant an imperfect account. The language is harsh, but less so than addresses of the kind used to be in those days. The topics are oratorical, and, as it has been justly remarked, are less calculated for ensuring conviction (which indeed was certain) than for placing the conduct of the prisoner in an odious light, and hardening the queen's heart against him; and, although it would be rash to judge of the real temper of the harangue without knowing more of its contents, yet what we possess contains much that cannot possibly be explained so as to do credit to the speaker. We know, likewise, how the object of the attack received it. At one place Essex interrupted his treacherous friend, and called upon him to say, as a witness, whether he had not, in their confidential intercourse, admitted the truth of those excuses which he now affected to treat as frivolous and false. Essex was convicted; and between his sentence and execution, Bacon admits in his exculpatory memoir that he made no attempt to save him; seeing the queen but once, as he says, and on that occasion venturing to do nothing further than pronouncing a few common-places on the blessed uses of mercy. But not even here was the disgrace to end, in which the timid man of the world had steeped himself. The act which had cost Elizabeth's own heart so much, had also made her unpopular; a defence of the royal policy in regard to Essex was thought necessary, and the pen that drew it up, under the direction of the queen's advisers, was, we are grieved to find, no other than Bacon's. The "Declaration of the Practices and Treasons attempted and committed by Robert Earl of Essex," was printed, and is extant: "a performance," says a late writer, "in defence of which, in the succeeding reign, Bacon had not a word to say; a performance abounding in expressions which no generous enemy would have employed respecting a man who had so dearly expiated his offences." With this humiliating act of service we may consider Bacon's public life under Elizabeth as closed.

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The reign of her successor was, from its commencement, a more auspicious era for men of letters and philosophy, with whom James, amidst all his imbecility and cold-heartedness, was not by any means ill fitted to sympathise. Bacon's learning was no longer open to sneers and contempt; his uncle was dead; his hunchback cousin, Robert Cecil, who soon became Earl of Salisbury, was kept in check by his hereditary prudence; and Coke, who had insulted our philosophic lawyer grossly, as he insulted every one who was defenceless and within his reach, was in a few years removed to the head of the court of common pleas. From the first hour of James's reign, Bacon lost no opportunity of recommending himself to favour; but the first mark of it which he received, was one of which he neither was nor could have been proud, and which, nevertheless, he thought proper to solicit. When the king called upon all persons possessing forty pounds a year in land to be knighted, or to compound for a dispensation from the honour, one effect of this scheme for filling the royal coffers was, that three members of Bacon's mess at Gray's Inn appeared among the new knights. That love of external distinctions which was the fatal weakness of his nature, was called into play, and the philosopher was disconcerted by the titles of his companions, beside whom he sat untitled. At the same time, likewise, he had, in his own words, "found out an alderman's daughter, a handsome maiden, to his liking;" and the alderman's daughter was likely to be more easily won if her admirer could offer her

Bacon. a showy accession of rank. Accordingly, Bacon wrote to his cousin Cecil, stating his desire to obtain, for these reasons, "this divulged and almost prostituted title of knighthood." The request was granted, but was immediately followed by another. Bacon, heartily ashamed of the company in which he was to appear, entreated that he might be knighted alone; "that," as he says, "the manner might be such as might grace one, since the matter will not." This petition was refused; and, on the day of the coronation, Francis Bacon was one of three hundred who received the empty honour. Soon afterwards, being forty-two years old, he was married to the alderman's daughter, Alice Barnham, who brought him a considerable fortune, but seems, in the latter part of his life at all events, to have contributed little to his domestic happiness.

These details are in themselves trifles; but they are strange illustrations of the mixed character of one who, while thus soliciting honours of which he was half-ashamed, and eager for public distinctions, which, though more solid, were likewise more dangerous, was not only respected and distinguished as a lawyer and a statesman, as an orator, a scholar, and an author, but was occupied, during his few hours of leisure, in completing the most valuable system of philosophy that had ever been expounded in modern Europe. Smaller compositions, submitted to his friends, showed from time to time the progress of the great work which he had marked out as the business of his life; and among these was the treatise on the Advancement of Learning, published in 1605, in its author's forty-fifth year. Political tracts alternated with these philosophical speculations.

In the mean time his public reputation, and his favour with the king, increased and kept pace with each other. In parliament he was actively useful in forwarding favourite and really good measures of the court, such as the union of England and Scotland, and the proposed consolidation of the laws of the countries. Nor was he less usefully employed in taking a prominent part in the select committee of the house upon grievances: and in his skilful hands, the report became all that the rulers could have wished, without exciting any general feeling against the framers. In 1604, he was made king's counsel in ordinary, with a salary of forty pounds, to which was added a pension of sixty pounds. In 1607, upon Coke's promotion to the bench, Bacon was appointed solicitor-general; and he became attorney-general in 1612. His treatises concerning improvements in the law, and the principles of legislation, are more creditable testimonies to the value of his official services than some others of his acts; such as the scheme, first tried in the session of 1614, for securing majorities in the House of Commons by organised corruption, the invention of which has been recently traced to him, although in his place in parliament he ridiculed those who asserted that such a project had ever been formed. Bacon was likewise officially the prosecutor of Oliver St. John, of Owen and Talbot, and of the old clergyman Peacham, who was examined in the Tower under torture, the founder of modern philosophy being present, and putting the questions. In Peacham's case there was even an attempt, actively promoted by Bacon, for securing a conviction by previous conference with the judges; a plot which, though at length successful, was defeated for a time by the sturdy resistance of Coke, a tyrant to his inferiors, but a staunch opponent of encroachments upon judicial independence. Bacon's last remarkable appearance as attorney-general, was in the noted trial of the earl and countess of Somerset and their accomplices, for the murder of Sir Thomas Overbury; and, whatever the foul secret may have been, which was involved in that fiendish intrigue, Bacon's letters to the king leave little reason for doubting that he at least was in possession of it. His conduct in this matter however gained him great and deserved credit.

The fall of Somerset was followed by the rise of the new favourite Villiers, who had already profited by his intimacy with the attorney-general, and by the sound advices with which the cautious statesman endeavoured to fortify his youth and inexperience. The worthless Buckingham, destined in a few years to be the instrument of retribution for Bacon's past desertion of Essex, did not for some time forget obligations, of which he was probably wise enough to desire a continuance. In 1616, Bacon having been sworn of the privy council, relinquished the bar, but retained his chamber practice. In the spring of 1617, the Lord Chancellor Ellesmere resigned the seals, which were immediately delivered to Bacon, with the title of lord-keeper. In January of the succeeding year he was made lord high chancellor of England, and in July was raised to the peerage as Baron of Verulam. His higher title of Viscount St. Albans was not conferred on him till 1621. Without neglecting his political duties, he proceeded zealously to the judicial functions of his office, in which arrears of business had accumulated through the infirmities of his aged predecessor. "This day," wrote he to Buckingham in June 1617, "I have made even with the business of the kingdom for common justice; not one cause unheard; the lawyers drawn dry of all the motions they were to make; not one petition unanswered. And this, I think, could not be said in our age before. Thus I speak, not out of ostentation, but out of gladness, when I have done my duty. I know men think I cannot continue, if I should thus oppress myself with business; but that account is made. The duties of life are more than life: and if I die now, I shall die before the world be weary of me." And the man who wrote in this solemn moral strain, the man whose writings throughout are an echo of the same lofty expression of the sense of duty, was also the man who, in less than four years after his elevation to the seat of justice, was to be hurled from it in disgrace, branded as a bribed and dishonest man. "At York House," says Mr. Montagu, "on the 22d of January 1621, he celebrated his sixtieth birthday, surrounded by his admirers and friends, among whom was Ben Jonson, who composed a poem in honour of the day.

> Hail, happy genius of this ancient pile!
> How comes it all things so about thee smile—
> The fire, the wine, the men—and in the midst
> Thou stand'st, as if some mystery thou didst?

"Had the poet been a prophet, he would have described the good genius of the mansion not exulting, but dejected, humble, and about to depart for ever."

He had now arrived at the conviction that his worship of the powers of this world had made it impossible for him to consummate the great sacrifice, which, during his lifetime, he had hoped to lay upon the altar of philosophy. Aged sixty years, and immersed in difficult and anxious business, he felt that his great Restoration of Science, his Instauratio Magna, could not be completed; and he therefore hastened to give to the world an outline of its plan, coupled with a filling up of one section of the outline. "I number my days," wrote he, "and would have it saved." The Novum Organum, the result of this determination, was published in October 1620; and the fame which it earned for its author throughout Europe, was in its rising splendour when his fall took place.

The tempest which was soon to overturn the throne was already lowering on the horizon; and its earliest mutterings were heard in the important parliament which met on the 30th of January 1621. With most of the complaints, whose investigation the king and Buckingham feared so much, we have here little to do: but two gross abuses there were, in which the lord chancellor was personally implicated. He had passed the infamous patents of monopoly, of which the worst were those held by Sir Giles Mompesson, (Massinger's Overreach,) and by Sir Francis Michell, and shared by Buckingham's brothers and dependents: and he had allowed himself to be influenced in his judicial sentences by *re-*

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commendations of the favourite. The first of these faults admitted of palliation, the second was susceptible of none; but both were real and heavy offences. Yet neither of them was made an article of charge against Bacon. He was attacked upon a different ground. Buckingham, by the advice of his new counsellor Williams, then dean of Westminster, abandoned the monopolists to their fate, contenting himself with sending his own brothers out of the country, and with afterwards publicly denying that he had any hand in assisting their escape. But the storm was not allayed. In March, the parliamentary committee appointed to inquire into the existence of abuses in the courts of justice, reported that abuses did exist, and that the person against whom they were alleged, was the lord chancellor himself. Two cases were specified, of suitors named Aubrey and Egerton, of whom the one had given the chancellor L.100, the other L.400, and against whom he had decided, notwithstanding these presents. Two days after this report was presented, Lord St. Albans presided in the House of Lords for the last time. New accusations accumulated against him; and, alarmed in mind, and sick in body, he retired from the house, and addressed to the peers a letter, praying for a suspension of their opinion, until he should have undergone a fair trial. In no long time the charges against him amounted to twenty-three; and Williams, again called to the councils of Buckingham and his master, advised that no risks should be incurred upon his account. A prorogation of parliament ensued, during which an interview took place between the king and the chancellor; and James, instead of encouraging his accused servant in the resolution he had expressed of defending himself, recommended "that he should submit himself to the House of Peers, and that upon his princely word he would then restore him again, if they in their honours should not be sensible of his merits." On the 24th of April there was presented to the Lords, by the Prince of Wales, a supplication and submission of the lord chancellor, in which the most important passage is the following: "It resteth, therefore, that, without fig-leaves, I do ingenuously confess and acknowledge that, having understood the particulars of the charge, not formally from the house, but enough to inform my conscience and memory, I find matter sufficient and full, both to move me to desert my defence, and to move your lordships to condemn and censure me. Neither will I trouble your lordships by singling those particulars, which I think may fall off.

Quid te exempta juvat spinis de pluribus una?

Neither will I prompt your lordships to observe upon the proofs, where they come not home, or the scruples touching the credits of the witnesses: neither will I represent unto your lordships how far a defence might, in diverse things, extenuate the offence, in respect of the time or manner of the gift, or the like circumstances; but only leave these things to spring out of your own noble thoughts, and observations of the evidence and examinations themselves, and charitably to wind about the particulars of the charge here and there, as God shall put in your minds; and so submit myself wholly to your piety and grace. . . . . And, therefore, my humble suit to your lordships is, that my penitent submission may be my sentence, and the loss of the seal my punishment; and that your lordships will spare any further sentence, but recommend me to his majesty's grace and pardon for all that is past." But not even thus was the humiliation complete. The house resolved that the submission was not specific, nor unequivocal enough to be satisfactory; and that he should be required to furnish categorical answers to the several articles of charge, which, accordingly, were sent to him, being numbered under twenty-three heads. The specific answers which he returned were prefaced and followed by these declarations: "Upon advised consideration of the charge, descending into my own conscience, and calling my memory to account, so far as I am able, I do plainly and ingenuously confess that I am guilty of corruption, and do renounce all defence, and put myself upon the grace and mercy of your lordships. . . . . This declaration I have made to your lordships with a sincere mind; humbly craving that, if there should be any mistakes, your lordships would impute it to want of memory, and not to any desire of mine to obscure truth, or palliate anything. For I do again confess, that in the points charged upon me, although they should be taken as myself have declared them, there is a great deal of corruption and neglect, for which I am heartily and penitently sorrow, and submit myself to the judgment, grace, and mercy of the court.—For extenuation, I will use none, concerning the matters themselves: only it may please your lordships, out of your nobleness, to cast your eyes of compassion upon my person and estate. I was never noted for an avaricious man, and the apostle saith, that covetousness is the root of all evil. I hope also that your lordships do the rather find me in the state of grace; for that, in all these particulars, there are few or none that are not almost two years old, whereas those that have an habit of corruption do commonly wax worse and worse; so that it hath pleased God to prepare me, by precedent degrees of amendment, to my present penitency. And for my estate, it is so mean and poor, as my care is now chiefly to satisfy my debts."

This declaration being read, a deputation of the lords was appointed to wait on the unfortunate man in the chamber where he sat deserted and alone, and to demand whether it were his own hand that was subscribed to it. Among them was Shakspeare's friend Lord Southampton, who had been condemned to death along with Essex. Bacon replied to them, "It is my act, my hand, my heart. I beseech your lordships, be merciful unto a broken reed." Again the fallen judge prayed the king to intercede for him; and again the king, his haughty son, and their thankless favourite, refused to interfere. On the 3d of May 1621, the lords pronounced a sentence which, stamping him at all events with indelible disgrace, was terrible even in the punishment which it actually inflicted. Bacon, found guilty upon his own confession, was sentenced to a fine of forty thousand pounds, and to confinement in the Tower during the king's pleasure; he was pronounced incapable of public employments, and of sitting in parliament; and prohibited from coming within the verge of the court. His judges indeed knew that the harsher part of the sentence would not be executed. Accordingly, though committed immediately to the Tower, he was released after two days' imprison ment; and the fine was remitted in the course of the au tumn, although it is a fact dishonourable (in the circumstances) to his enemy and successor Bishop Williams, that the pardon was stayed at the seal, till the king in person ordered it to be passed.

From the whole tenor of this afflicting history, it is plain that Bacon's memory cannot be cleared from very heavy imputations. Indeed, the case against him may be stated, if we push it to the utmost, in an alternative form which admits of no honourable solution. Convicted of corruption, as he was, upon his own confession, we must either believe the confession, and pronounce him a corrupt judge, or we must disbelieve it, and pronounce him a liar. Most of his biographers adopt the former alternative. Mr. Montagu's elaborate defence is really founded on something which is not very far distant from the latter. And, humiliating as either supposition is, we have, for our own part, no hesitation in believing that the truth lies nearest to that theory which imputes to the unhappy chancellor insincerity and cowardice rather than wilful corruption. We cannot indeed go so far as his enthusiastic biographer, who insists that the acts charged and confessed, were in themselves, if not quite free from moral blame, yet palliated, not only by general usage,

Bacon. but by intentions strictly honest;—that he was sacrificed by the king and the king's minion, although, if he had stood a trial, he could have obtained a full acquittal. This, we must venture to think, is a position which, if maintained to its whole extent, cannot be even plausibly defended. Neither, as we must also believe, is justice done by that other view, which has been stated more recently with such force and eloquence, that the case was one of gross bribery, gross and glaring even when compared with the ordinary course of corruption in these times; a case so bad, that the court, anxious, for their own sakes, to save the culprit, dared not to utter a word in extenuation.[1]

The fact which possesses the greatest importance for the elucidation of this unfortunate story, is that which has been founded on so elaborately by Mr. Montagu, and lately illustrated further by another writer for a different purpose.[2] The custom of giving presents was then general, not to say universal, in England. It extended much farther than the *épices* of the French parliaments; for the gifts were not fixed in amount, nor, though always expected, were they recognised as lawful perquisites. The advisers of the crown received presents from those who asked for favours: the sovereign received presents from those who approached the throne on occasions of pomp and festivity. Both these improprieties were not only universal but unchallenged. Further, judges received presents; and under certain conditions,—when, for instance, the giver had not been, and was not likely to be, a suitor in the judge's court, or even when, though he had been a suitor, the cause was ended,—this dangerous abuse was scarcely less common than the other, and scarcely regarded in a more unfavourable light. That it was wrong, all men felt; but we fear there were few indeed, who, like Sir Thomas More, refused absolutely to profit by it. High as Coke himself stood for honesty, and well as he deserved praise for this (almost his only redeeming virtue), we doubt whether his judicial character could have emerged quite untainted from a scrutiny led by common informers, discarded servants, and disappointed litigants, like that to which his unfortunate rival was subjected. Pure Bacon was not; purer than he, several of his contemporaries probably were; but we believe him to have been merely one of the offenders, and very far indeed from being the worst, in an age when corruption and profligacy, senatorial, judicial, and administrative, were almost at the acme of that excess which an indignant nation speedily rose to exterminate and to avenge.

A comparison of the charges in detail, and of the evidence adduced, with Bacon's articulate answers, as to the candour of which there is no reason to doubt, would really exhibit little or nothing which, after fair allowances are made for imperfect information and other causes of obscurity, would afford a distinct contradiction to the chancellor's own solemn averment, made in a letter to the king at an early stage of the investigation. "For the briberies and gifts wherewith I am charged, when the book of hearts shall be opened, I hope I shall not be found to have the troubled fountain of a corrupt heart, in a depraved habit of taking rewards to pervert justice; howsoever I may be frail, and partake of the abuses of the times." While he lay in the Tower, he addressed to Buckingham a letter containing these expressions: "However I have acknowledged that the sentence is just, and for reformation sake fit, I have been a trusty, and honest, and Christ-loving friend to your lordship, and the justest chancellor that hath been in the five changes since my father's time." This last sentence, indeed, when carefully weighed, will be found to contain more of truth than the writer himself perhaps intended. A judge not altogether unjust he may have been, if we compare him with his contemporaries; but he was also a trusty, and trusting, and servile friend of the royal favourite, and of other men in power. Bacon. He was a lover of the pomp of the world, to an extent highly dangerous for one who had but little private fortune, insufficient official remuneration, and habits which disqualified him for exercising a strict superintendence over the expenses of his household, or the conduct of his dependents generally. His emoluments as chancellor did not amount to three thousand pounds a-year; and, immediately on his appointment, he had used vain endeavours to have the office put on a more independent footing. His servants habitually betrayed both him and the suitors; but there can be no doubt that, continually embarrassed in circumstances, he himself was only too glad to receive the customary gifts when they could be taken with any semblance of propriety. As to his confession, while we believe it to be true in every particular instance, we believe it also in its general admission of corruption; but we likewise believe that the general admission ought to have been qualified by certain references, which would have established the truth of a remark made by Bacon in his hour of deepest suffering, that "they upon whom the wall fell were not the greatest offenders in Israel." And this, as we conceive it, was the danger which the court were so eager to avert, the danger which filled the king and Buckingham with such dismay. This was their reason for insisting that Bacon should sacrifice his own character, and abandon that line of defence which might not improbably have precipitated the revolution. Upon this assumption, their conduct throughout is intelligible and consistent; and, although one is reluctant to believe it, the assumption is not contradicted by any thing in the chancellor's character. Lofty as may still have been his abstract notions of morality, his practical views were darkened and debased by his long servitude to public office in a corrupt age. The stain which, as he well knew, the sentence of the parliament would affix upon his name, may have seemed a light thing to one who was aware how the same brand might have been justly imprinted on almost every eminent name in the kingdom. And again, neither Bacon nor his master, nor those others who were the royal advisers, were able to comprehend, in this instance, any more than elsewhere, the spirit which had already gone abroad. They did not anticipate the severity of the sentence pronounced by the House of Lords; still less did they anticipate (Bacon at least did not, nor perhaps did Williams) the universal indignation which was aroused by the fact that the highest judge in the realm had been displaced for bribery. The court gained its immediate purpose, in removing to a subsequent time the fatal struggle; but there soon arrived the fulfilment of Bacon's prophecy, that the successful attack on him would be but an encouragement and strengthening to those who aimed at the throne itself.

After his release from the Tower, Bacon, although strangely anxious to continue in London, was obliged to retire to his paternal seat of Gorhambury, near St. Albans. There he immediately commenced his History of Henry the Seventh, a work displaying but too unequivocal proofs of the dejected lassitude which had crept upon his mind. Early in next year he offered himself unsuccessfully for the provostship of Eton College, and proceeded with other literary undertakings. These included the completion of the celebrated treatise, "De Augmentis," an improvement of the older work on the Advancement of Learning. This was the last philosophical treatise which he published; although the few remaining years of his life were incessantly devoted to study and composition, and gave birth to the New Atlantis, the Sylva Sylvarum, and other works of less consequence.

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[1] Montagu's Life of Bacon, *Works*, vol. xvi. part 1. pp. 313–377, *note*. *Edinburgh Review*, vol. lxv. p. 50–63 (Mr Macaulay).
[2] *Edinburgh Review*, No. 143, p. 38, 39. *Life of Raleigh* (Professor Napier).

Bacon.

Shortly before the king's death, he remitted the whole of the sentence on Bacon, who, however, did not again sit in parliament. His health was already broken; and in December of that year, 1625, he made his will, in which, although his affairs were really in extreme confusion, he writes as if he considered himself a wealthy man. In the spring of 1626, on his way from Gray's Inn to Gorhambury, he exposed himself to a sudden chill, by performing in a cottage an experiment which had suggested itself to him, regarding the fitness of snow or ice as a substitute for salt in preserving dead flesh. Unable to travel home, he was carried to the earl of Arundel's house at Highgate, where, after seven days' illness, he died early in the morning of Easter Sunday, the 9th of April, in the sixty-sixth year of his age. In obedience to his will, he was buried in the same grave with his mother, in St. Michael's church, near St. Albans.

It is sad beyond expression to turn to those reflections which are suggested by the life of this great man, however leniently one may be disposed to regard his weaknesses. He who founded the philosophy of modern Europe, he who brought down philosophy from heaven to earth, disentangling it from airy abstractions, and anchoring it on practical truths,—he who aided science alike by his improvements on its procedure, and his enlarged views of its end and aim, indicating observation of individual truths as the only sure guide to universal conclusions, and practical utility as the only quality which makes such conclusions worth the labour they cost,—he who did all this, was destined to furnish, by his own pitiable example, a pregnant illustration of the great principles which his writings taught. A slave to the world and its vanities, he was betrayed by the evil genius whom he served. Unable to subject reason, and passion, and imagination, to the stern control of the moral sense, he expiated, by a life of discomfort and dependence, ending in an old age of sorrow and disgrace, the sin of having misapprehended the mighty rule, which alone can save the empire of the mind from becoming a scene like ancient chaos.

Bacon's philosophy has been analysed in other parts of this work, and on his literary character we have left ourselves no space to enlarge. We can only remark the powerful effect which his singular versatility of talents exercised over the dissemination of his scientific views. "The reputation which Bacon had acquired from his Essays," says a late writer, "a work early translated into various foreign languages,—his splendid talents as an orator,—and his prominent place in public life,—were circumstances strongly calculated to attract the curiosity of the learned world to his philosophical writings." And these writings in themselves partake admirably of the character belonging to their author's works of a different class. Philosophy has seldom made herself more attractive; never has she made herself equally so in communicating lessons of such sterling value. If the works of this wonderful man were worthless as repositories of scientific thought and knowledge, they would still demand reverential study. A masterly eloquence, a union of diversified qualities of style in the highest sense of the word, distinguished even the earlier among them, and entitled those which were produced in the writer's maturer years, to rank, notwithstanding the faults they share with all prose compositions of their time, as monuments nowhere excelled in the compass of English literature.[1] (W. S.)

Bacon, *John*, who may be considered as the founder of the British school of sculpture, was born Nov. 24. 1740. He was the son of Thomas Bacon, cloth-worker in Southwark, whose forefathers possessed a considerable estate in Somersetshire.

Bacon.

At the age of fourteen he was bound apprentice in Mr Crispe's manufactory of porcelain at Lambeth, where he was at first employed in painting the small ornamental pieces of china, but soon attained the distinction of being modeller to the work. The produce of his labour was devoted by him, from his earliest years, towards the support of his parents. While thus engaged, he had an opportunity of seeing the models executed by different sculptors of eminence, which were sent to be burned at an adjoining pottery. An observation of these productions appears to have immediately determined the direction of his genius; and his progress in the imitation of them was no less rapid than his propensity to the pursuit was strong. His ardour and unremitting diligence are best proved by the fact, that the highest premiums given by the Society for the Encouragement of Arts in those particular classes in which he was a competitor, were adjudged to him nine times between the years 1763 and 1776. During his apprenticeship he improved the method of working statues in artificial stone, an art which he afterwards carried to perfection.

Bacon first attempted working in marble about the year 1763, and, during the course of his early efforts in this art, was led, by the resources of his genius, to improve the method of transferring the form of the model to the marble (technically called *getting out the points*), by the invention of a more perfect instrument for this purpose, and which has since been adopted by many sculptors both in this and other countries.[2] The advantages which this instrument possesses above those formerly employed are, its greater certainty and exactness, that it takes a correct measurement in every direction, is contained in so small a compass as not to encumber the workman, and is transferable either to the model or the marble, as may be required, without the necessity of a separate instrument for each.

In the year 1769 the first gold medal given by the Royal Academy was adjudged to Bacon, and in 1770 he was associated by that body. His first work in sculpture was a bust of His Majesty George III., intended for Christ Church College. It is said, that of sixteen different competitions in which he engaged with other artists, he was unsuccessful in one case only. His knowledge of the classic style was for a time called in question; and on occasion of the doubts which were raised on this point, he is reported to have modelled his head of Jupiter Tonans, as the most satisfactory method of repelling the charge. The objection probably originated from the circumstance, that in some of his principal works the figures were represented in the costume of modern times, of which his statue of Justice Blackstone at All Souls College, Oxford, and that of Howard in St Paul's Cathedral, are remarkable examples. But his genius was not subjected to the trammels of this or of any one style exclusively. Many of his emblematical figures are designed after the purest models, and in a taste altogether classical. Among several of this character, the monument to Mrs Draper, in the cathedral of Bristol, is exquisitely simple. In his later productions, likewise, particularly those of a monumental kind, he introduced frequent examples of the ancient style; as in the well-known monument to the Earl of Chatham in Westminster Abbey, that to Lord Robert Manners, and others which might be mentioned. "Another marble, scarcely finished at the time of his death," says Dallaway, in his *Anecdotes of the Arts in England*, "will secure him a lasting fame for originality and classical taste. It is the cenotaph lately erected in Westminster Abbey to the poet Mason. A muse, holding his profile on a medallion, reclines on an antique altar, on

[1] Montagu's Life of Bacon, *Works*, vol. xvi. parts 1 and 2, 1834. *Edinburgh Review*, vol. lxv. No. 132, article I. Stewart and Playfair, in the Preliminary Dissertations to this Encyclopædia. Napier on the Scope and Influence of the Philosophical Writings of Lord Bacon; in the *Transactions of the Royal Society of Edinburgh*, vol. viii. part 2. 1818.

[2] The invention of this pointing machine has sometimes been erroneously ascribed to the French sculptor Hudon.

Bacon. which are sculptured, in relief, a lyre, the tragic masque, and laurel wreath; all of the most correct form, as seen on ancient sarcophagi of the pure ages."

On the 4th of August 1799, Bacon was suddenly attacked with inflammation, which occasioned his death in little more than two days, in the 59th year of his age. He left a widow, his second wife, and a family of six sons and three daughters.

Of his merit as a statuary, the universal and established reputation of his works has afforded decisive proof. The various productions of this artist which adorn St Paul's Cathedral, Christ Church and Pembroke Colleges, Oxford, the Abbey Church at Bath, and Bristol Cathedral, give ample testimony to his powers; above all, those great and prominent works among the monuments in Westminster Abbey.

But it was not as an artist only that Bacon was esteemed; he was no less distinguished by the firmness of his mind, and the uprightness of his private character. His principles were deeply founded, and the virtues which he strove to attain were measured by a standard more unbending than the mere dictates of feeling or of a cultivated taste. He was an avowed believer in the truths of the Christian religion; and in him this belief exhibited its corresponding effects, by producing a consistent influence upon his whole character and conduct. With great simplicity of manners, he was in all things devoid of ostentation. Of the general powers of his mind, and particularly of his acute and just perception in matters of taste connected with his art, a very favourable opinion will be formed by those who peruse the article SCULPTURE which he contributed to Dr Rees' edition of Chambers's *Dictionary*.

See *Memoir of the late John Bacon, R.A.*, by the Rev. Richard Cecil. London, 1811. (J. G—D.)

BACON, *Sir Nicholas*, lord keeper of the great seal in the reign of Queen Elizabeth, was born at Chislehurst in Kent in 1510, and educated at the university of Cambridge; after which he travelled in France, and made some stay at Paris. On his return he settled in Gray's Inn, and applied himself with such assiduity to the study of the law, that he quickly distinguished himself; and, on the dissolution of the monastery of St Edmund's Bury in Suffolk, he had a grant from King Henry VIII., in the thirty-sixth year of his reign, of several manors. In the thirty-eighth of the same king he was promoted to the office of attorney in the court of wards, which was a place both of honour and profit. In this office he was continued by King Edward VI.; and in 1552 he was elected treasurer of Gray's Inn. His great moderation and consummate prudence preserved him through the dangerous reign of Queen Mary. Very early in the reign of Elizabeth he was knighted; and on the 22d of December 1558, he succeeded Nicholas Heath, archbishop of York, as keeper of the great seal of England, with the title of Lord Keeper; and he was also made one of the queen's privy council. He had a considerable share in the settling of religion; and, as a statesman, he was remarkable for a clear head and wise counsels. But his great parts and high preferment were far from raising him in his own estimation, as appears from the modest answer he gave Queen Elizabeth when she told him his house at Redgrave was too little for him: "Not so, madam," returned he; "but your majesty has made me too great for my house." After having held the great seal more than twenty years, this able statesman and faithful counsellor was suddenly removed from the scene of his labours. He had been under the hands of his barber, and, thinking the weather warm, had ordered a window before him to be thrown open; but he fell asleep as the current of fresh air was blowing in upon him, and awakened some time after extremely distempered. He was immediately removed into his bed-chamber, and died a few days after, on the 26th of February 1579, equally lamented by the queen and her subjects. He was buried in St Paul's, where a monument was erected to his memory. This was destroyed by the great fire of London in 1666. Granger observes that he was the first lord keeper who ranked as lord chancellor; and that he had much of that penetrating genius, solidity, judgment, persuasive eloquence, and comprehensive knowledge of law and equity, which afterwards shone forth with so great splendour in his illustrious son.

Bacon ‖ Baconthorp.

BACON, *Roger*, a Franciscan friar of great genius and learning, was born near Ilchester in Somersetshire in the year 1214. He began his studies at Oxford, but in what school or college is uncertain. Thence he removed to the university of Paris, which in those times was esteemed the centre of literature. Here, we are told, he made such rapid progress in the sciences, that he was esteemed the glory of that university, and was much honoured by several of his countrymen, particularly by his friend and patron, Robert Greathead, afterwards bishop of Lincoln. About the year 1240 he returned to Oxford, and, assuming the Franciscan habit, prosecuted his favourite study of experimental philosophy with unremitting ardour and assiduity. In this pursuit, in experiments, instruments, and scarce books, he tells us he spent, in the space of twenty years, no less than 2000 livres, which, it seems, was given him by some of the heads of the university to enable him to continue his interesting inquiries. But such extraordinary talents, and astonishing progress in sciences which, in that ignorant age, were totally unknown to the rest of mankind, whilst they raised the admiration of the more intelligent few, failed not to excite the envy and malice of his illiterate fraternity, who found no difficulty in possessing the vulgar with the notion that Bacon dealt in the magic art. Under this pretence he was restrained from reading his lectures; his writings were confined to his convent; and, finally, in 1278, he was himself imprisoned in his cell. At this time he was sixty-four years of age. Nevertheless, being permitted the use of his books, he persevered in the rational pursuit of knowledge, corrected his former labours, and wrote several curious essays. When he had been ten years in confinement, Jerome de Ascoli being elected pope, Bacon solicited his holiness for release, but did not immediately succeed in his object. However, towards the latter end of that pope's reign he obtained his liberty, and spent the remainder of his life in the college of his order, where he died, according to Anthony à Wood, in 1292, and was buried in the Franciscan church. Bale and others have enumerated a large list of works as written by Bacon, and existing in manuscript in various collections. Several of his tracts were published in the work entitled *Epistolæ Fratris Rogeri Baconis de Secretis Operibus Artis et Naturæ, et de Nullitate Magiæ*. Paris, 1542, 4to; Basil, 1593, 8vo. His *Opus Majus*, which forms a sort of digest of his preceding writings, was first published in 1733, in a handsome folio volume by Dr Jebb. Some of his chemical tracts may be found in the *Thesaurus Chemicus*, published at Frankfort in 1603 and 1620. By an attentive perusal of his works the reader will find that Roger Bacon was a great linguist and a skilful grammarian; that he was well versed in the theory and practice of perspective; that he understood the use of convex and concave glasses, the camera obscura, burning-glasses, &c.; that he was conversant in geography and astronomy; that he knew the great error in the calendar, assigned the cause, and proposed the remedy; that he understood chronology well; that he was in all probability the inventor of gunpowder; that he possessed considerable knowledge in the medical art; and that he was an able mathematician, logician, and theologist.

BACONTHORP, JOHN, called *the Resolute Doctor*, a learned monk, born towards the end of the 13th century, at Baconthorp, a village in Norfolk. After spending the early

Bactria || Badajos.

part of his life in the convent of Blakeney, near Walsingham, he removed to Oxford, and from thence to Paris, where he obtained great reputation for his learning, and was esteemed the principal of the Averroists. In 1329 he returned to England, and was chosen twelfth provincial of the English Carmelites. In 1333 he was sent for to Rome, where, we are told, he first maintained the pope's sovereign authority in cases of divorce; but this opinion he is understood to have afterwards retracted. He died in London in 1346. He wrote, 1. *Commentaria, seu Quæstiones super quatuor libros Sententiarum;* and, 2. *Compendium Legis Christi, et quodlibeta;* both of which passed through several editions.

BACTRIA, or BACTRIANA (now Bokhara), an ancient kingdom of Asia, bounded on the W. by Margiana, N. by the river Oxus, E. by Asiatic Scythia, and S. by the Paropamisan, range. This country was very fertile, and inhabited by a numerous and warlike race. It became a Persian province about the time of Cyrus, and afterwards figured in the wars of Alexander, being celebrated for its cavalry. It formed part of the kingdom of the Seleucidæ; but about B.C. 256, Theodotus, who was the governor, threw off the Grecian yoke, and Bactria remained independent till about B.C. 126, when it was conquered by the Parthians. Its capital was Bactra or Zariaspa, corresponding to the modern town of Balk. The history of Bactria began to be illustrated by Colonel Tod's discovery of Bactrian coins (*Royal Asiatic Soc. Trans.* 1824); since which time various travellers have completed the series, such as now found in the Parisian and London Museums. See BOKHARA, BALK.

BACTRIS, an American genus of low palms, found in equinoctial regions, in the neighbourhood of rivers, or in marshy grounds. Martins describes 17 species. The leaves spring from all parts of the stem.

BACULARIUS, in writers of the middle age, an ecclesiastical apparitor or verger, who carries a staff, *baculus*, in his hand, as an ensign of his office.

BACULE (French, *Bascule*), in *Fortification*, a kind of portcullis or gate, made like a pit-fall with a counterpoise, and supported by two large stakes. It is usually erected before the corpade guard, not far from the gate of a place.

BADAJOS, a province of Spain, forming, by the division of 1833, the southern half of the old province of Estremadura, or what is generally called Lower Estremadura. It is bounded on the N. by Caceres, E. by Ciudad Real, S. and S.E. by Cordova, Sevilla, and Huelva, and W. by Portugal, embracing an area of 596 square leagues. It contains 15 *partidos*, 162 *ayuntamientos*, 4 cities, 123 towns, and 45 villages; pop. in 1849, 336,136. See ESTREMADURA.

BADAJOS, a fortified city of Spain, the capital of the above province, and the see of a bishop. It is situated about 5 miles from the Portuguese frontier, on a slight elevation near the left bank of the Guadiana. The height is crowned by the ruins of a Moorish castle. A strong wall and bastions, with a broad moat and outworks, and forts on the surrounding heights, make the city a place of great strength. The river is crossed by a magnificent granite bridge, originally built in 1460, repaired in 1597, and rebuilt in 1833. The city is well built, and contains an arsenal, a cathedral, 6 churches, and several hospitals and schools. Its 5 monasteries are all secularized; one is occupied as infantry barracks; and of its 8 nunneries 4 are closed. Badajos from its importance as a frontier garrison has been the scene of numerous sieges. The last and most severe was in 1812, when it was stormed by the British troops under Wellington, and carried with dreadful loss. It had been surrendered in the previous year to Soult by the treachery of Imaz the commander of the garrison. The legitimate trade and manufactures of Badajos are inconsiderable; but much contraband traffic is carried on with Portugal. Pop. 11,480.

Badajos is the *Pax Augusta* of the Romans, corrupted by the Moors into *Paxagousa*, *Baxagus*, *Badaxos*.

Badakshan || Baden.

BADAKSHAN, or BUDUSCHAN, a mountainous district, situated to the N. of the great Himalaya ridge, which bounds Hindustan on the N. It is about twenty days' journey E.S.E. of Bokhara, and nearly S. of Kokaun. It comprehends the higher valley of the Amoo, which is here called the Jihon or the Jaxartes, together with all the other valleys of its tributary streams, and all the mountains connected with them as far nearly as the sources of that river. The district of Badakshan rises gradually to its level from the lower and northern part of the province of Balk, which occupies the left bank further down the river. This country is described as mountainous and well wooded, and the people as uncivilized, and even savage in their manners. They live in villages surrounded with gardens, and situated in the little glens and recesses of the hills. The mountainous districts of this province are famed for some of the richest mines of lapis lazuli and of rubies that are known. The former is found in veins, sometimes of considerable thickness, in a gray matrix; and masses of this stone are occasionally procured capable of being wrought into large slabs. They are carried to Bokhara for sale, and thence to Russia. The rubies are found imbedded in a white earth, in large masses of crystal. Some large and coarse crystals are also found, as well as emeralds, according to the information of Fraser. The chief town is Fyzabad, which is said to be not more than 150 miles from Balk. There is another town of the same name as the province, and of considerable importance. Mr Fraser could gain little authentic information concerning the people of this remote country, their habits, or the nature of their government. They are, however, rigid and intolerant Mahometans, among whom it would be dangerous for any European to reside. (Fraser's *Journey into Khorassan.* Elphinstone's *Cabul.*)

BADALOCCIO, SISTO, a painter and engraver, born at Parma about the end of the 16th century. He was of the school of A. Caracci, by whom he was highly esteemed for design. His principal engravings are the series known as *The Bible* of Raffaello.—(Lanzi, *Storia Pittor.*)

BADALONA (*Bætulo* of the Romans), a town of Spain, in the province of Barcelona, pleasantly situated on the seacoast, 10 miles N.E. of Barcelona. It is remarkable as the landing place of the Archduke Charles of Austria and the Earl of Peterborough, in the war of the succession in 1704. Pop. 5000, mostly seamen and fishermen.

Boundaries

BADEN, GRAND DUCHY OF, is situated in the S.W. of Germany, between Lat. 47. 32. and 49. 52. N.; and Long. 7. 27. and 9. 50. E. It is bounded on the N. by Bavaria and Hesse-Darmstadt; W. by Rhenish Bavaria and France; S. by Switzerland; and E. by Wirtemberg and the principality of Hohenzollern. At the commencement of the present century, Baden was only a margraviate with an area little exceeding 1300 square miles, and a population of 210,000. Since then it has from time to time acquired additional territory, so that its area now amounts to upwards of 5900 square miles, and its population to nearly a million and a half.

History.

The margraves of Baden belonged to the Zähringen family, the founder of which was Berthold, landgrave of Breisgau, who flourished about the middle of the 11th century. Berthold's third son, Hermann, acquired Baden by marriage; and his grandson, Hermann II., fixed his residence at Baden, and took the title of margrave. Margrave Christopher I. was succeeded on his death in 1527 by his three sons, one of whom however died soon after, and the margraviate was divided among the two survivors, who thus formed the two lines of Baden-Baden and Baden-Durlach. The line of Baden-Baden became extinct by the death of Augustus George in 1771, and its possessions were united with Baden-Durlach under Charles Frederick. By the treaty of Luneville con-

Baden. cluded in 1801, Baden acquired a considerable addition of territory, which was farther increased in 1803 when the margrave received the title of elector. The treaty of Presburg, in 1805, still farther increased his domains, by the addition of Breisgau, so that Baden had then an area of 3455 square miles, with 670,000 inhabitants. On the dissolution of the German empire, and his joining the confederation of the Rhine, in 1806, the elector received the title of Grand Duke, and 1950 square miles of additional territory. Some smaller additions at subsequent periods have increased Baden to its present extent.

Population In 1832 it was divided into 4 circles, 74 bailiwicks, and 1595 communes. By the census of 1849, the population was 1,362,774; of whom 905,143 were Roman Catholics, 432,184 Protestants, and 23,547 Jews. The following table gives the extent and population of each of the four circles according to the census of 1852:—

Circles.	Square Miles.	Bailiwicks.	Communes.	Pop. in 1852.
Lake,	1303	15	376	199,075
Upper Rhine,	1654	18	448	349,205
Middle Rhine,	1633	21	389	462,085
Lower Rhine,	1314	20	382	346,578
	5904	74	1595	1,356,943

Baden contains 115 cities, 45 market towns, 1634 villages, and 533 hamlets. The capital of the duchy is Carlsruhe: Pop. 23,217.

Physical features. Baden is principally of a mountainous or hilly character, interspersed with fertile and pleasant valleys. On the western side of this country, and extending along the Rhine, is a very fertile stripe of land, from which the rest of the country rises towards the east. In the southern and eastern parts is the Black Forest (Schwarzwald), extending northwards as far as the Neckar, north of which is the Odenwald range, sometimes considered as a part of the Schwarzwald, but considerably less elevated. The highest peaks of the Black Forest are the Feldberg and the Belchen, which attain respectively the height of 4650 and 4397 feet: the Katzenbückel, the highest point of the Odenwald, is only 2180 feet high. Lying between the Rhine and the Treisam is the *Kaiserstuhl*, an independent volcanic group, nearly 10 miles in length and five in breadth, the highest point of which is 1760 feet.

This country is watered by numerous rivers and streams: of these, the principal is the Rhine, which is the recipient of almost all the rest, and forms the boundary of the duchy on the S. and W. Among its other rivers are the Mayn, Tauber, Neckar, Murg, Kinzig, Wutach, Pfinz, and Elz. The Danube too takes its rise here. Baden has also a number of lakes, as the Mummel Wilder, Nonnenmattweiher, Titti, Eichener, Schluch, &c. A part of Lake Constance belongs to Baden.

Climate. The climate of Baden varies considerably with the elevation, but is everywhere very salubrious. In the plains and valleys it is mild and agreeable, but in the higher parts it is cold and moist, with snow during a great part of the year; and the transition from winter to summer is often very sudden.

Agriculture. The inhabitants are chiefly engaged in agricultural and pastoral pursuits, for which their country affords many advantages. In the valleys and plains the soil is particularly fertile and productive, yielding most luxuriant crops of wheat, maize, barley, beans, potatoes, flax, hemp, and tobacco; and even in the mountainous parts, rye, wheat, and oats are extensively cultivated. There is also a considerable extent of pasture land, and a great part is covered with woods. The vineyards are extensive, producing various kinds of excellent wine, and the gardens and orchards supply abundance of fruits of the finest description, especially almonds, chestnuts, and walnuts. The distribution of the surface of the duchy is as follows:—

Baden.

	Morgens.	Per cent.
Arable	1,476,626	or 34·8
Meadow	406,613	9·6
Pasture	225,759	5·3
Vineyards	68,064	1·6
Gardens	37,507	0·9
Woods and Forests	1,296,861	30·5
Quarries, Gravel and Clay Pits	102	0·0
Waste land	21,214	0·5
Buildings, Roads, and Waters	711,594	16·8
	4,244,340	100·0

Manufactures. The manufactures of Baden were formerly very insignificant, but latterly they have been much improved. They are, however, chiefly confined to iron and hardware goods, and the spinning and weaving of cotton. The inhabitants of the Black Forest have long been celebrated for their dexterity in the manufacture of wooden ornaments and toys, watches, clocks, musical boxes, organs, &c. There are extensive government salt-works at Durrheim and Rappenau, and iron-works at Albbrugg and other places. The mines of Oberwert and Kandern produce excellent iron. Silver, gold, and copper are also among its mineral productions, as well as alum, vitriol, sulphur, and coal. Gold washing, formerly extensively carried on along the Rhine, is now little practised. The mineral springs of Baden are very numerous, and have acquired great celebrity.

Minerals.

Commerce. The exports of Baden are very considerable, and exceed a million sterling per annum, consisting chiefly of its agricultural and industrial products. It has about 75 leagues of railways, the principal of which is that traversing almost the entire length of the country, from Mannheim to Basle in Switzerland, and of which 62 leagues are in Baden.

Education. The educational institutions of Baden are numerous and flourishing. There are two universities, the Protestant one at Heidelberg, founded in 1386, and the Catholic one at Freiburg, founded in 1457. The attendance at the former in 1849 was 543, at the latter 368. There are also 6 lyceums, 5 gymnasiums, 4 normal schools, 19 higher and 7 Latin schools, besides about 2000 common schools established throughout the country. There is an institution in Pforzheim for the deaf and dumb, and one in Freiburg for the blind. A polytechnic school was established about 18 years ago at Carlsruhe, and is now perhaps the most efficient institution of the kind in Germany. It has a staff of 41 teachers, and about 330 students. The preparatory course extends over three years, and includes French, German, English, general history, mathematics, drawing, modelling, chemistry, mineralogy and geology, mechanics, &c. The special courses are engineering, architecture, forestry, chemistry, mechanics, commerce, and post-office service; and extend over from one to four years.

Government. The government is a hereditary monarchy, vested in the grand duke, who enjoys the executive and judicial powers, but is assisted in the legislative by two chambers, the one of peers, and the other of deputies. The chamber of peers consists of 36 members, 8 of whom are chosen by the grand duke, and one by each of the two universities; the remaining members are, the Roman Catholic archbishop of Freiburg, a Protestant prelate, and the principal nobility. The chamber of deputies has 64 members, elected by all the males who have attained their twenty-fifth year. Each member must be at least 30 years of age, and is elected for 8 years; one-fourth of the members going out every two years.

Baden occupies the seventh rank in the Germanic confederation, and furnishes a contingent of 10,000 men to the federal army. It has three votes in the full diet, and one in the minor assembly. By the approved budget of 1852 and 1853, the clear united revenue for these years was fixed at 19,536,497 florins (L.1,628,041), and the expenditure at 19,545,723 florins (L.1,628,810). The public debt in 1852 was 60,894,107 florins (L.5,074,509), of which

Revenue.

Baden || Badia y Leblich.

32,609,791 florins (L.2,717,482) was a loan contracted for the construction of railways in the country.

BADEN, or BADEN-BADEN, a town and celebrated watering-place of Germany, in the circle of Middle Rhine and Grand Duchy of Baden. It stands on the Oos, in a valley of the Black Forest, 18 miles S.W. of Carlsruhe; and it is connected by a branch with the Mannheim and Basle railway. Baden during the months of July and August is frequented by great numbers of visitors from all parts of Europe, so that its resident population, which is only about 6000, is frequently augmented to three times that number. There are thirteen hot springs, varying in temperature from 37° to 54° R., = 115° to 156° F.; and the water is conveyed through the town in pipes to supply the different baths. The superiority of its situation, its extensive pleasure-grounds, gardens, and promenades, render Baden one of the first watering-places in Germany. It was for six centuries the residence of the margraves of Baden. The "old castle" occupying the summit of a hill above the town, was the earliest residence of the reigning house; and the "new castle" (so called by comparison), situated close to the town, is remarkable for its subterranean dungeons. Baden has a library and reading-room, theatre, assembly rooms, and the other accessaries of a fashionable watering-place. The parish church contains monuments of several of the margraves. The springs of Baden were known to the Romans under the name of *Aurelia Aquensis*, and fragments of ancient sculpture are still to be seen there. In 1847 remains of Roman vapour baths, well preserved, were discovered just beneath the new castle.

BADEN, a small town of Switzerland, in the canton of Aargau, on the Limmat, 14 miles N.W. of Zurich. It is much resorted to, principally by the Swiss, on account of its hot medicinal springs. The treaty of 1714 between France and Germany was concluded here. Pop. 2500.

BADEN, a small city in the Austrian province of the Lower Ens, in the circle of Wiener Wald. It is about twelve miles from Vienna, and is the most fashionable summer resort of the inhabitants of that capital. The situation is highly romantic, and the prospects in its vicinity are picturesque and beautiful. It has many warm baths, which are much resorted to by invalids. Accommodations and amusements are here as amply furnished to the visitors as at the other German spas. Baden suffered much by a fire in 1812, but has since been very elegantly rebuilt. The Archduke Charles has a residence at this place, which is a favourite retirement of the imperial family. The stationary population amounts to 4000. Baden stands on the rapid river Schwachat, whose water-falls greatly enhance its natural beauties.

BADENOCH, a district of Inverness-shire in Scotland. (See INVERNESS-SHIRE.)

BADENS, FRANCIS, an historical and portrait painter, born at Antwerp in 1571; died in 1603. He was distinguished by the warmth of his colouring, for which he has been surnamed *the Italian*.

BADEN-WEILER, a village in the Grand Duchy of Baden, and circle of Upper Rhine, celebrated for its alkaline thermal springs and baths. Remains of Roman baths still exist here.

BADGER. See MAMMALIA, *Index*.

BADIA Y LEBLICH, DOMINGO, a celebrated Spanish traveller, better known under his assumed name of Ali Bey, was born in Biscay in the year 1776. After receiving a very liberal education, he made himself master of the Arabic language, and the usages of the Mussulmans, with a view to facilitate his Oriental travels. He was employed by the French government as a political agent in the East; and after submitting to the rite of circumcision, he assumed the Mussulman costume, in which disguise he visited Egypt, Arabia, and Syria, and was received as a person of high rank wherever he appeared He returned to Europe; but again visiting the East, he died at Aleppo in 1819, it is said by poison. His travels appeared in 1814, under the title of *Voyage d'Ali Bey en Asie et en Afrique*, &c., in 3 vols. 8vo, and they have been translated into English.

Badile || Baeza.

BADILE, ANTONIO, an historical and portrait painter, born at Verona in 1480. He was confessedly an eminent artist; but he derived greater honour from having had two such disciples as Paolo Veronese and Baptista Zelotti, than from the excellence of his own compositions. He died in 1560.

BADIUS, JODOCUS or JOSSE, sometimes called BADIUS ASCENSIUS, from the village of Asche near Brussels, where he was born in 1462, was an eminent printer at Paris, whose establishment was celebrated under the name of *Prelum Ascensianum*. He illustrated with notes several of the classics which he printed, and was himself the author of numerous pieces, amongst which are a life of Thomas à Kempis, and a satire on the follies of women, entitled *Navicula Stultarum Mulierum*. He died in 1535.

BAENA, a town and *partido* in the province of Cordova in Spain. The town, 8 leagues S.E. of Cordova, is picturesquely situated on the slope of a hill crowned with a castle, near the river Marbello. It has four parish churches and three schools, one of which, a female college, with an attendance of 167 pupils (1847), has a high reputation in the province. The education, which is conducted by Sisters of Charity, does not go beyond reading, writing, arithmetic, and religious instruction. Grain and oil are the principal articles of commerce. Pop. 12,944. The site of the Roman town (*Baniana* or *Biniana*) can still be traced, and various antiquities are to be met with. A subterranean vault was discovered in 1833, containing twelve cinerary urns with inscriptions commemorating various members of the Pompeian family.

BÆTICA, a province of ancient Spain, so called from the famed river Bætis, now Guadalquivir. It was bounded on the W. and N.W. by Lusitania, on the S. by the Mediterranean and Sinus Gaditanus, and on the E. and N.E. by Tarraconensis.

BÆTYLIA (*βαίτυλια*, *βαίτυλοι*), anointed stones, worshipped by the Phœnicians and other barbarous nations. They were commonly of a black colour, and consecrated to some god, as Saturn, Jupiter, the sun. Some are of opinion that the true original of these idols is to be derived from the pillar of stone which Jacob erected at Bethel, and which was afterwards worshipped by the Jews. These *bætylia* were the objects of much veneration among the ancient heathens. Many of their idols were in fact no other; and no sort was more common in Eastern countries than that of erect oblong stones, hence termed by the Greeks *κιόνες*, *pillars*. Dædalus separated the mass into two feet, whence he is said to have made *walking statues*. In some parts of Egypt they were planted on both sides of the highways. In the temple of Elagabalus in Syria, there was one said to have fallen from heaven; and in Phrygia there was a black stone, also considered an aerolite; which the Romans sent for, and received with much ceremony, Scipio Nasica being at the head of the embassy.

BAEZA (ancient *Beatia*), a city and *partido* in the province of Jaen in Spain. The city, which is well built, stands on a considerable elevation, about 3 miles from the right bank of the Guadalquivir. Lat. 37. 59. N. Long. 3. 28. W. It has a cathedral and several fine public buildings, among which the most worthy of notice are the university, the oratorio of St Philip Neri, the marble fountain with Caryatides in the Plaza de la Constitucion, the gates "de Cordoba y Ubeda," and the arch of Baeza. The latter are among the remains of its old fortifications, which were of great strength. There is little trade or manufacture here. The principal productions of the neighbourhood are grain and oil. The red dye made from the native cochineal was

Baffa ‖ Baghdad.

once celebrated; but this, as well as other branches of industry, has fallen greatly in importance. In the time of the Moors, Baeza was a flourishing city of 50,000 inhabitants. Present pop. about 11,000.

BAFFA, a town in the island of Cyprus, with a fort built near the site of the ancient Paphos, of which some ruins yet remain, particularly fragments of columns, which probably belonged to a temple of Venus. Long. 32. 20. E. Lat. 34. 50. N. See PAPHOS.

BAFFIN, WILLIAM, an able and enterprising English seaman, born in 1584. His descriptions of part of the bay which bears his name have been found remarkably accurate by later navigators. His voyages to those regions were performed in 1612, 1613, 1615, and 1616, while he was only a subordinate; but he gave the accounts of the discoveries. In 1618 he was mate in a voyage to Surat and Mocha; but in 1621 he was killed, while attempting, in conjunction with a Persian force, to expel the Portuguese from Ormuz. —(Purchas's *Pilgrimage.*)

BAFFIN'S BAY, a large inland sea separating Greenland from the N.E. coast of America, and extending from 68° to 78° N. Lat., and from 52° to 80° W. Long. It was first explored in 1616 by the English navigator Baffin. It is connected by Davis's Strait with the Atlantic, and by Lancaster Sound and Barrow's Strait with the Arctic Ocean. The coasts are generally high and precipitous, and are deeply indented with gulfs. During the greater part of the year this sea is frozen, and is only navigable from the beginning of June to the end of September. It is annually visited by vessels engaged in the whale and seal fishery.

BAFRA, a town of Asia Minor, pashalic of Sivas, on the right bank of the Kizil Ermak, 13 miles from its mouth in the Black Sea. It has a fine bridge and two mosques, and some trade in rice and tobacco. Pop. about 3000.

BAGHDAD, a city of Asia, formerly the capital of the empire of the khalif, and long renowned for its commerce and its wealth. It is situated on an extensive and desert plain, with scarcely a tree or village throughout its whole extent; and, though it is intersected by the Tigris, it stands mostly on its eastern bank, close to the water's edge. Old Baghdad on the W. is now considered only as a suburb to the larger and more modern city on the eastern shore. It has, however, numerous and extensive streets, well furnished with shops, and is protected by strong walls, with three gates opening towards Hillah on the Euphrates and Kazameen. Beyond these recent bulwarks, vestiges of ancient buildings, spreading in various directions, are visible in the plain, which is strewed with fragments of brick, tiles, and rubbish. A burying-ground has extended itself over a large tract of land formerly occupied by the streets of the city; and here is the tomb of Zobeida, the favourite wife of Haroun el Raschid, built of brick, of a high octagonal shape, and surmounted by a lofty superstructure in the form of a cone. The two towns of Old and New Baghdad are connected by a bridge of thirty pontoons. The form of the new city is that of an irregular oblong, about 1500 paces in length by 800 in breadth; and a brick wall, 1500 paces in length and about five miles in circuit, incloses the town on both sides of the river. This wall, which is built of brick, has been constructed and repaired at different periods; and, as in most other works of the same nature in Mahometan countries, the oldest portion is the best, and the more modern the worst part of the fabric. At the principal angles are large round towers, with smaller towers intervening at short distances; and on these large towers batteries are planted, with about fifty brass cannon of different calibre, badly mounted. In two of these angular towers, Mr Buckingham remarked that the workmanship is equal to any ancient masonry that he had ever seen. The wall has three gates, one on the S.E., one on the N.E., and a third on the N.W. of the city; and it is surrounded by a dry ditch of considerable depth. The town has been built without the slightest regard to regularity. The streets are even more intricate and winding than those in most other Eastern towns; and, with the exception of the bazaars and some open squares, the interior is little else than a labyrinth of alleys and passages. The streets are unpaved, and in many places so narrow that two horsemen can scarcely pass each other; and as it is seldom that the houses have windows facing the great public thoroughfares, and the doors are small and mean, they present on both sides the gloomy appearance of dead walls. All the buildings, both public and private, are constructed of furnace-burnt bricks, of a yellowish-red colour, taken chiefly from the ruins of other edifices, as their rounded angles evidently show. A house is generally laid out in ranges of apartments opening into a square interior court, and furnished with subterranean rooms called *serdaubs*, into which the inhabitants retreat during the day for shelter from the intense heats of summer; and with terraced roofs, on which they take their evening meal, and sleep in the open air. In the months of June, July, and August, the thermometer at break of day generally stands at 112° of Fahrenheit; at noon it rises to 119°, and a little before two o'clock to 122°; at sunset it is about 117°; and at midnight 114°. In some seasons it rises even higher; and at these times the inhabitants during the day take refuge in the subterranean apartments, where they endeavour, by every possible device, to mitigate the intolerable heat. The interiors of the houses of the rich are splendidly furnished, and ornamented in the ceilings with a sort of chequered work, which has a handsome appearance. A great portion of the ground within the walls of the town is unoccupied by buildings, especially in the north-eastern quarter; and even in the more populous parts of the city, near the river, a considerable space between the houses is occupied by gardens, which produce pomegranates, grapes, figs, olives, and dates, in great abundance; so that the city when seen from a distance, has the appearance of rising out of the midst of trees.

Baghdad.

The public buildings in Baghdad are chiefly the mosques, the khans or caravanserais, and the serai or palace of the pasha. This latter building, which is situated in the north-western quarter of the town, not far from the Tigris, is distinguished rather for extent than grandeur. It is a comparatively modern structure, built at different periods, and forming a large and confused pile, without proportion, beauty, or strength. There are no remains of the ancient palace of the khalifs.

In all Mahometan cities the mosques are conspicuous objects. The number in Baghdad is above 100; but of these not more than thirty are distinguished by their particular minarets or steeples, the rest being merely chapels and venerated places of prayer. The most ancient of these mosques was erected in the year of the Hegira 633, or 1235 of the Christian era, by the Khalif Mostanser. All that remains of the original building is the minaret, and a small portion of the outer walls; the former a short, heavy erection, of the most ungraceful proportions, built of bricks of various colours, diagonally crossed. The jamah or mosque of Merjameeah, not far distant from the former, though the body of it is modern, has some remains of old and very rich arabesque work on its surface. The door is formed by a lofty arch of the pointed form, bordered on both sides by rich bands exquisitely sculptured, and having numerous inscriptions. The mosque of Khassakey is chiefly distinguished by the niche for prayer, which, instead of a simple and unadorned recess, is crowned by a Roman arch, with square pedestals, spirally fluted shafts, a rich capital of flowers, and a fine fan or shell-top in the Roman style. Around the arch is a sculptured frieze; and down the centre, at the back of the niche, is a broad band, richly sculptured with

Baghdad. vases, flowers, &c., in the very best style of workmanship; the whole executed on a white marble ground. The mosque of the vizier, near the Tigris, has a fine dome and lofty minaret; and the great mosque in the square of El Maidan is also a noble building. The others do not merit any particular notice. The domes of Baghdad are mostly high, and disproportionately narrow. They are richly ornamented with glazed tiles and painting, the colours chiefly green and white, which, being reflected from a polished surface, impart more of liveliness than magnificence to the aspect of these buildings. But, in the opinion of Mr Buckingham, they are not to be compared to the rich and stately domes of Egypt, as the minarets, although they have the same bright assemblage of colours, are far from being equal "to the plain and grave dignity of some of the Turkish towers at Diarbekir, Aleppo, and Damascus, or to the lighter elegance of many of those in the larger towns on the banks of the Nile."[1]

There are about thirty khans or caravanserais in Baghdad, all of inferior construction to those in the other large towns of Turkey. The bazaars, which are numerous, are mostly formed of long, straight, and tolerably wide avenues. The one most recently built is the largest and the best; still it has an air of meanness about it that is not common in the bazaars of large Turkish cities. It is long, wide, and lofty, and well filled with dealers and wares of all sorts. Several of these bazaars are vaulted over with brick-work; but the greater number are merely covered with flat beams which support a roof of straw, dried leaves, or branches of trees and grass. There are about fifty baths in Baghdad, which are also very inferior in their accommodations to those in the other large towns of Mesopotamia.

Baghdad is about 500 miles from the mouth of the Tigris, following its course, and about 400 from Bassora; and with this latter place it carries on a constant communication by means of boats, of from twenty to fifty tons burden, though the river is navigable for larger vessels. With a northerly wind these boats will make the passage to Bassora in seven or eight days; in calms, when they have merely the aid of the current, the passage occupies from ten to fifteen days. Sir R. K. Porter mentions that the stream of the Tigris runs at the rate of seven knots an hour. This, however, is probably during floods, since, with such a powerful current, a boat could not occupy ten or fifteen days on its passage from Baghdad to Bassora. In coming up the stream, thirty or forty days are consumed before reaching Baghdad. The smaller craft, used for bringing supplies of provisions and fruit to the city, are circular boats of basket-work, covered with skins, the same that have been employed from the remotest antiquity. The communication with Bassora used formerly to be carried on by the way of Hillah on the Euphrates; but the banks of this river are now in possession of a tribe of Arabs, who detain and plunder all vessels sailing down the river, and frequently murder the crews. The Euphrates and the Tigris are liable to spring floods; and the streams of both rivers being joined, inundate the desert plain on which Baghdad stands, when the city appears like an island in the midst of the sea. The inhabitants are supplied with water from the Tigris, which is brought to their houses in goats' skins; the convenience of water-works, cisterns, and pipes, being entirely unknown.

Baghdad has declined from its ancient importance. It was formerly a great emporium of Eastern commerce; and it still receives, by way of Bassora, from Bengal, the manufactures and produce of India, which are distributed over Arabia, Syria, Kurdistan, Armenia, and Asia Minor. At the same time the inland trade from Persia and the East has declined. The productions and manufactures of Persia which were intended for the Syrian, Armenian, and Turkish markets, and were sent to Baghdad as a central depôt, now reach Constantinople by the more direct route of Erzerum and Tocat. Wealth appears to be deficient among all classes, and Baghdad has many symptoms of a decayed city. Baghdad.

The population is a mixture of nations from various quarters of the East. The chief officers of government, whether civil or military, are of the families of Constantinopolitan Turks, though they are mostly natives of the city; the merchants and traders are almost all of Arabian descent; while the lower classes consist of Turks, Arabs, Persians, and Indians. There are some Jews and Christians, who still remain distinct from the other classes; while the strangers in the town are Kurds, Persians, and Desert Arabs in considerable numbers. The dress of the Baghdad Turks is not nearly so gay or splendid as that of their northern countrymen; and the costume of the Baghdad residents is, upon the whole, unusually plain in comparison with that of other Asiatics. As every nation retains its own peculiar dress, it may be easily conceived what an amusing variety of costume must be seen in the streets of Baghdad. The dress of the females is as mean as that used in the poorest villages of Mesopotamia; women of all classes being enveloped in a blue checked cloth, such as is worn by the lowest orders in Egypt, and having their faces covered by hideous veils of black horse-hair.

Baghdad is governed by a pasha, assisted by a council. The pasha receives his appointment from the sultan of Constantinople; which, however, has to be ratified by the public voice, not ascertained by votes, but expressed in the tumultuous acclamations of the populace. The pasha is chosen from a body of Georgian Mamelukes, maintained by importations from Georgia, which are said to increase every year. Among this body are distributed all the lucrative offices, as well as all the military commands. The pasha has a force of 2000 horsemen, 10 pieces of artillery, and a body-guard consisting of 1000 men. On particular emergencies he can call for the service of some Arab tribes of the Desert, who are bound to this duty in return for provisions supplied by the pasha. The pashas of Kurdistan also aid him with 5000 or 6000 horse in case of need; so that on a short notice he can collect a force of 20,000 or 30,000 undisciplined troops for the defence of the city. He is generally considered as quite independent of the sultan of Constantinople. His revenue arises from a custom-duty on all merchandise entering Baghdad; and he seldom resorts to forced exactions for the supply of his treasury. The moderation and justice pursued by the government has the effect of giving great activity to commerce, and general satisfaction to all engaged in it. The police, however, is extremely defective, and murders frequently take place at the gates of the palace and of the great mosque, without any attempt being made to bring the criminals to justice. Mr Buckingham mentions that one murder was committed in open day, in the street, before a hundred witnesses, not one of whom thought of interfering; it being, according to the maxims of the Arabs, an affair of blood, which it belonged to the relatives of the slain to revenge, or the pasha to investigate, and which they had no business to meddle with. Robberies are also frequently committed with impunity. The English and French maintain each a consul at Baghdad. The late Mr Rich, whose amiable qualities furnished a theme of praise to every traveller, was appointed to that situation by the East India Company, with a large establishment, and was considered the most powerful man in Baghdad next to the pasha.

Baghdad was founded by Al Mansour, second khalif of the race of Abbas, in the 145th year of the Hegira (A.D. 767). It was adorned with many noble and stately edifices by the magnificence of the renowned Haroun el Raschid, who also built on the eastern side of the river, connecting

[1] Buckingham's *Travels in Mesopotamia*, vol. ii. chap. vii.

Baghdad.

the two quarters of the town by a bridge of boats. Under the auspices of Zobeida, the wife of that prince, and Jaffer Barmecide, his favourite, the city may be said to have attained its greatest splendour. It continued to flourish and increase, and to be the seat of elegance and learning, until the 656th year of the Hegira (A.D. 1277), when Hulakoo the Tartar, the grandson of Genghis Khan, took it by storm, and extinguished the dynasty of the Abbassides. The Tartars retained possession of Baghdad till about the year 1400 of our era, when it was taken by Tamerlane, from whom the sultan Ahmed Ben Avis fled, and finding refuge with the Greek emperor, contrived afterwards to repossess himself of the city, whence he was finally expelled by Kara Yusef in 1417. In 1477 his descendants were driven out by Usum Cassim, who reigned 39 years in Baghdad, when Shah Ismael the First, the founder of the royal house of Sefé, made himself master of it. From that time it continued for a long period an object of contention between the Turks and Persians. It was taken by Soliman the Magnificent, and retaken by Shah Abbas the Great; and it was afterwards besieged by Amurath the Fourth, with an army of 300,000 men. After an obstinate resistance, it was forced to surrender, A.D. 1638; when, in defiance of the terms of capitulation, most of the inhabitants were massacred by torch-light. Since that period it has remained under a nominal subjection to the Turks. Achmet, the greatest of the pashas of Baghdad, and the first who rendered the pashalic independent of the porte, defended the town with such courage against Nadir Shah, that the invader was compelled to raise the siege, after suffering great loss. Baghdad, according to Colonel Chesney, had 110,000 inhabitants previously to the great plague of 1830; but now, in 1853, Mr Layard estimates its population under 50,000. Long. 44. 24. E. Lat. 33. 21. N. (Buckingham's *Travels in Mesopotamia;* Sir R. K. Porter's *Travels in Georgia, Persia, Armenia, and Ancient Babylonia;* Kinneir's *Geographical Memoir of the Persian Empire;* Chesney's *Expedition.*) (D. B—N.)

BAGHDAD is also a Turkish pashalic or government of Asia, and is computed to have an area of above 100,000 square miles. It stretches in a N.W. direction, from the mouth of the Shat-el-Arab at Bassora, to Merdin, situated near the source of the Tigris; and from the confines of Persia, W. to the banks of the Khabour, which separates it from the pashalic of Diarbekir. Its general boundaries are the Euphrates and the Arabian desert of Nedjed to the W. and S., Kusistan and Mount Zagros to the E., the pashalic of Diarbekir to the N.W., and Armenia with the territories of the Kurdish chief of Julamerick to the N. This great tract comprehends ancient Babylonia, and the greatest part of Assyria Proper. The first includes the space inclosed by the Tigris and the Euphrates, which is also known under the general appellation of Mesopotamia; and the second, that which is beyond the Tigris, commonly called Lower Kurdistan. This tract of country is an extensive and very fertile plain, and is watered by the Tigris and the Euphrates, which at Baghdad approach within 25 miles of each other, and afford an inexhaustible supply of the finest water. Only some parts of these fertile districts, however, are cultivated, as the population consists in many places of wandering Arabs, who are adverse to agriculture, and who, in their vagrant life of idleness and rapine, neglect all the natural advantages of a fertile country. The most productive portion of the pashalic is on the banks of the Shat-el-Arab, in the neighbourhood of Bassora. This tract, for upwards of 30 miles below that city, is well cultivated, and yields vast quantities of dates, wheat, barley, and various kinds of fruits. The banks of the Euphrates produce abundant crops of dry grain. Higher up the Euphrates, the country which is possessed by the Arabs is a low marshy tract, formed by the expansion of the Euphrates, and is famed for plentiful crops of rice. Among the mountainous districts of the Upper Euphrates the country is highly picturesque and beautiful; it is watered by the river Mygdonius, and is in a tolerable state of cultivation. It produces in abundance the finest fruits, such as grapes, olives, figs, pomegranates, which are esteemed the most delicious in the East; apples, pears, apricots of an inferior quality; and the finest dates, on which the inhabitants, as in other parts of Asia, depend in many cases for subsistence. The domestic animals are, the horse, for which the country has long been famed, the ass, camel, dromedary, buffalo, and mule. Of the wild animals, the lion, the hyena, the jackal, the wolf, and the wild boar, are also common; and antelopes are seen in great numbers. Hares are plentiful, but foxes are seldom seen. All sorts of poultry are bred excepting the turkey. On the cultivated lands, and on the borders of the rivers, the black partridge is met with in great numbers. Snipes and almost every species of wild fowl may be found in the marshes, and pelicans on the banks of the Euphrates and Tigris. In addition to these two rivers, the country is watered by the Khabour or Chaboras, formed by the junction of several small streams about ten miles to the S.W. of Merdin; by the Mygdonius, which joins the Khabour; and by the Hermes, a tributary of the Mygdonius.

Baghermi ‖ Bagneres-de-Bigorre.

In ancient times the plain of Mesopotamia was occupied by the great and wealthy cities of Nineveh, Babylon, Seleucia, Ctesiphon, &c., and was in a high state of cultivation. It was intersected by many well-constructed canals and other works, which, in dispersing over the country the superfluous waters of the Tigris and Euphrates, proved extremely useful to agriculture. These works are now all ruined, and not a vestige remains of many of the canals; while the course of others can only be faintly traced in their imperfect remains. One canal, however, still exists: it connects the Euphrates and the Tigris exactly half-way between Bassora and Baghdad, and is navigable in spring for large boats.

BAGHERMI. See AFRICA.

BAGLIVI, GIORGIO, an illustrious Italian physician, descended of a poor persecuted Armenian family, was born at Ragusa in 1669, and assumed the name of his adoptive father, Pietro Angelo Baglivi, a wealthy physician of Lecce. He studied successively at the universities of Salerno, Padua, and Bologna; and after travelling over Italy, he went in 1692 to Rome, where, through the influence of the celebrated Malpighi, he was elected professor of anatomy in the college of Sapienza. He died at Rome in 1707, at the early age of thirty-eight. A collection of his pieces, which are all in the Latin language, was published in 4to in 1704, and has been several times reprinted in the same form. An edition in 2 vols. 8vo was published in 1788. Baglivi's work, *De Fibra Motrice*, is the foundation of that theory of medicine which by Hoffmann and Cullen was substituted for the Humoral Pathology.

BAGMUTTY, a river of Hindustan, which has its source in the hills to the N. of Catmandoo, the capital of Nepaul, whence it flows in a southerly direction, and joins the Ganges, after a course of 285 miles, in Lat. 25. 23. Long. 86. 34.; about eight miles below the town of Monghyr, but on the opposite side of the river.

BAGNARA, a city of the province of Calabria Ulteriore II., in the kingdom of Naples, on the Gulf of Gioja. It suffered by the earthquake in 1783, when, out of 4938 persons, 3324 perished. It now contains 3000 inhabitants, who carry on a considerable trade in silk, oil, wine, and fish.

BAGNERES-DE-BIGORRE, the capital of the arrondissement of Bagneres, department of Hautes-Pyrenees, is situated on the left bank of the Adour, 13 miles S.E. of Tarbes. This is the principal watering-place in France, and is much admired for its picturesque situation and the beauty of its environs, particularly the valley of Campan,

Bagneres-de-Luchon || Bagpipe.

which abounds with beautiful gardens and handsome villas. The town is remarkably neat and clean, and many of the houses are built or ornamented with marble. Its thermal springs and baths are numerous and varied, and are very efficacious in debility of the digestive organs and other maladies. Their temperature is from 90° to 135° Fahr. The season commences in May, and terminates about the end of October, during which time the population is nearly doubled. Permanent pop. (1852) 8335. The arrondissement of Bagneres contains 10 cantons and 194 communes; pop. 95,413.

BAGNERES-DE-LUCHON, a small well-built town of France, department of Haute-Garonne, pleasantly situated in the valley of the Luchon, at the foot of the Pyrenees. It is celebrated for its sulphurous thermal springs, which vary in temperature from 88° to 152° Fahr. The principal edifice is a handsome bath establishment, erected in 1807. The waters are employed with success in a variety of chronic and cutaneous affections. Pop. about 2500.

BAGNOLES, a village of France, department of Orne, in a valley 13 miles S.E. of Domfront. It is much frequented for its mineral springs and baths, and has been much improved and embellished by handsome buildings and fine promenades. Military baths were erected here in 1822, capable of accommodating 200 invalids.

BAGNOLS, a town of Lower Languedoc, now the department of Gard, in France. It has a handsome square, adorned with a fountain, the waters of which are conveyed by a canal to the lands in the vicinity. Pop. in 1846, 3803.

BAGPIPE, a musical instrument of unknown antiquity. It was used among the ancient Mysians and Pannonians, the latter a Celtic people; and is still employed by the modern Sclavonians. The ancient Scandinavians also used it. An antique gem, of which Dr Burney procured a drawing, represents Apollo as walking with a lyre in his hands, and a bagpipe slung at his back. The bagpipe was well known to the ancient Romans, and we learn from Suetonius that Nero, among his various musical accomplishments, was a bagpipe-player. To this day the bagpipe is a common instrument in the southern parts of Italy, especially Calabria; and its modern use in Spain appears from the Spanish proverb regarding the bagpiper of Bujalance, in Andalucia, and from the allusion to the bagpipes of Zamora in chap. 62, part 2, of *Don Quixote*. Some of the mountain tribes of Hindustan are said to have a large and powerful bagpipe. Curious representations of ancient bagpipers are given in plates 33 and 34 of Gerbert's work, *De Cantu et Musica Sacra*. Court bagpipers in England are mentioned as early as the fourth year of Edward II., *i.e.* 1310. Dr Petrie, the eminent Irish antiquary, says that the bagpipe is often mentioned in Irish poems varying in date between the tenth and sixth centuries. Some Irish writers assert that the great bagpipe—the same as that of the Scottish Highlands—was used very early as a war instrument in Ireland; but the oldest representation of it which they have been able to point out is that given in *The Image of Irelande, by John Derricke. Imprinted at London by Jhon Daie*, 1581. 4*to*. The woodcut there shows a bearded and half-naked Irish piper playing upon an enormous bagpipe, with two drones and chanter. He holds the bag—as big as his own body—pressed against his stomach. Sixty years ago, several kinds of bagpipe were used in Scotland and the north of England; but we now seldom hear any others than the small Irish bagpipe, blown with bellows, and the great Highland bagpipe, or its smaller congener, which is used at dances, chiefly in the Highlands. The great Highland bagpipe is a very loud instrument, famous for its martial influence upon Highland soldiers in battle.[1] It consists of a large wind-bag made of greased leather covered with woollen cloth; a mouth-tube, valved, by which the bag is inflated with the player's breath; three reed drones, and a reed chanter with finger-holes, on which the tunes are played. Of the three drones, one is long and two are short. The longest is tuned to A, an octave below the lowest A of the chanter, and the two shorter drones are tuned each an octave above the A of the longest drone; or, in other words, in unison with the lowest A of the chanter. The scale of the chanter has a compass of nine notes, all natural, extending from G on the second line of the treble stave, up to A in alt. In the music performed upon this instrument, the players introduce among the simple notes of the tune a great number of rapid notes of peculiar embellishment, which they term *warblers*. No exact idea of these *warblers* can be formed except by hearing a first-rate player upon the Highland bagpipe. We may remark that the profusion of ornament in the music of the Highlanders reminds us of the observations made by several musical travellers upon the airs performed by various Oriental players and singers—Greek, Arab, Egyptian, Hindu, &c.—all of whom employed so many peculiar ornaments as to disguise entirely the real theme or melody, whatsoever that might be, and to produce an effect more resembling the warbling of birds than anything else generally known to Europeans.

Bahamas.

The ancient Egyptians, Greeks, and Romans, used single, double, and triple tubes, the sound of which was produced by a double reed, like that of an oboe, or of the chanter or the drone of a bagpipe, &c. The reed (γλωττὶς) was moveable, and was carried about by the the player in a box called by the Greeks γλωττοκομεῖον, *i.e.* a *tongue-case*. Demades, the Athenian orator, compared his countrymen to these reed-pipes, "good for nothing without their tongues." These tubes, called ἀυλοὶ, were blown by the mouth of the player, as seen in ancient sculptures and paintings; and required so strong a breath to sound them, that the performer bandaged up his lips and cheeks with a φορβεία, or περιστόμιον, the Roman *capistrum*, a leathern muzzle or headstall. It seems very probable that the bagpipe derives its origin from these double and triple reed-pipes, by the after addition to them of a wind-bag made of the skin of a goat or kid, together with a valved *porte-vent*, in order to relieve the strain on the lungs and cheeks of the player. In some parts of Russia, double flutes (or reed-pipes) are used among the peasantry. A paper published by George Burdett, Esq., in 1845, gives an account of a very ancient and curious instrument now peculiar to the northern parts of the island of Sardinia, and called the *lannedda*. It consisted of three reed-pipes of unequal length and thickness, and pierced with several holes, and was played upon by a vigorous Sardinian peasant eighty years of age, in a hut among the mountains about ten miles from the town of Terranova. The pipes were tuned by shifting small pieces of wax up and down outside of the holes The longest and thickest pipe was a drone, and had only one hole. The player placed the reed-ends of all these three pipes in his mouth, and sounded them all at the same time. The sound reminded Mr Burdett of that of a bagpipe. It is, he says, a very exhausting instrument, and often kills the performers at an early age. This old peasant was the last of the race of *lannedda* players. The exertion required to play upon it has caused a modification of the *lannedda* in the southern parts of the island, by adding to the pipes a common mouth-piece, like that of the double-flageolet, which greatly lessens the fatigue of the performer. (G. F. G.)

BAHAMAS, or LUCAYAS, a chain of islands stretching in a north-westerly direction from the N. coast of St Domingo to that of East Florida, and lying between Lat. 21. and 27. 30. N. and Long. 70. 30. and 79. 5. W. The group is composed of about twenty inhabited islands, and an immense number of islets and rocks. The principal islands or this group are New Providence, containing the capital, Nassau; Harbour Island; Abaco; Eleuthera; Heneagua, or

[1] See *Wood's Songs of Scotland*, vol. i. pp. 97–137, and vol. iii. p. 51.

Bahamas. Inagua; Mayaguana; St Salvador; Andros Island; Great Bahama; Ragged Island; Rum Cay; Exuma; Long Island; Crooked Island; Long Cay; Watling's Island; the Caicos, the Turks, and the Berry Islands.

Most of these islands are situated on those remarkable flats called the Great and Little Bahama Banks, and some out of soundings in the ocean. The Great Bahama Bank is about 300 miles in length from N.W. to S.E., and 100 in breadth; and the Little Bahama is about 130 miles long. The islands have, in general, a very flat appearance, and many of them consist of mere bleak and barren rocks. The soil in those that are under cultivation is thin, and generally light and sandy, but interspersed with occasional patches of rich mould. The substratum, so far as has been ascertained, consists of calcareous rocks, composed of coral, shells, madrepores, and marine deposits hardened into solid masses. The surface stratum is a combination of debris of the rock, exuviæ, and decayed vegetable matter. Though destitute of running streams, they possess numerous springs; and by digging wells down to the level of the sea, fresh water is obtained. The productions of the soil comprehend all the varieties of a tropical climate. Provisions—such as maize, yams, sweet potatoes, &c.; and fruits, as oranges, lemons, pine-apples, cocoa nuts, &c.—are produced in abundance. There are also several species of valuable trees, as mahogany, fustic, lignum vitæ, cedars, pines, &c. Oxen, sheep, horses, poultry, and a great variety of live stock are reared; and wild hogs and agoutis are found in the woods. There are many varieties of birds, and the shores and creeks abound in turtle and excellent fish of various kinds. In the most southerly islands are salt ponds of great value.

St Salvador, one of the islands composing this chain, was the first land discovered by Columbus on his memorable voyage in 1492. At that period the Bahamas were inhabited by a mild and peaceable race of Indians, who, seduced by the arts of the Spaniards, were afterwards consigned to perpetual bondage in the mines of St Domingo, or sent to labour as divers in the pearl fisheries of Cumana. From this period the islands continued devoid of inhabitants until 1629, when New Providence was settled by the English, and held till 1641, at which time the Spaniards expelled them, but made no attempts to settle there themselves. It was again colonized by England in 1666, and again ravaged by the French and Spaniards in 1703; after which it became a rendezvous for pirates till 1718, when these were extirpated, a regular colonial administration established, and the seat of government fixed in this island. In 1781 the Bahamas were surrendered to the Spaniards; but at the conclusion of the war they were once more annexed to the British empire, to which they have ever since belonged. At the close of the American war many of the British royalists sought refuge in these islands, and colonized the principal of them, from which period we may date their gradual though slow cultivation and improvement.

In 1848 the Turks, Caicos, and Mayaguana Islands were separated from the other Bahamas, and formed into a distinct government.

This colony has lately begun to assume a state of greater prosperity than previously. According to the governor's report for the year 1851, the amount of the revenue was L.26,105, and of the expenditure L.25,068; the revenue of the preceding year being L.25,591, and the expenditure L.29,451. The unfavourable financial state of the colony in 1850 was occasioned by the repeal of the export duty on fruit, the exemption of ships engaged in the salt trade from tonnage-duty, and the diminished productiveness of a new tariff. The separation of the Turks Islands—the most productive of the salt islands, and which brought a comparatively large revenue to the Bahama government—considerably affected the finances. For some years previous to that time, the income had considerably exceeded the expenditure. The governor, in his closing speech to the Bahama legislature in March 1852, said that he did not despair of seeing the day, before finally quitting the government, when the revenue will be found nearly if not quite as large as it was before the separation of the Turks from the Bahama Islands. The value of sponge exported in 1850 was, in round numbers, L.5700; and in 1851, L.14,000; that of fruit, which in 1849 was L.8000, had increased in 1851 to L.12,600; and that of salt in 1851 was L.16,500. The salt-producing islands are rapidly increasing in importance. There are at present six of these islands, viz., Inagua, Exuma, Long Cay (Crooked Island), Rum Cay, Long Island, and Ragged Island. The number of vessels that cleared out from the several ports of the colony in 1851 was 373, registering 36,914 tons; and 363 entered inwards, of 36,038 tons. There are four lighthouses, viz., a fixed light on Hog Island, at the entrance of the harbour of Nassau; a revolving light, 160 feet above the level of the sea, on the S.E. point of the Island of Abaco; a revolving light, 80 feet high, at Gun Cay; and a fixed light at Cay Sal, 100 feet above the level of the sea. There are nine colonial custom-houses and ports of entry in the government, viz., Nassau, Abaco, Eleuthera, Harbour Island, Little Exuma, Rum Cay, Long Island, Long Cay (Crooked Island), and Ragged Island, principally for the exportation of salt, the chief staple of these islands, except the first three, from which a considerable quantity of fruit (pine-apples, oranges, &c.) is exported to England and the United States.

Bahamas.

The colony is divided into 13 parishes; and the religious bodies are Episcopalian, Presbyterian, Baptist, Anabaptist, and Methodist. There are 9 Episcopal churches, besides 11 chapels; a Presbyterian church, endowed by the legislature; 4 Methodist chapels and several preaching stations; and a capacious Baptist chapel at Nassau. In 1851 L.300 was voted by the legislature to assist in the erection of three Methodist chapels.

The educational system is under a board of management, composed of the governor and four members of the executive council. Besides a number of private schools, there are 21 schools supported by the legislature, with 37 teachers, besides assistant-teachers, pupil-teachers, and monitors. In 1851 the number of scholars was 1857, and the sum expended for educational purposes L.1650. A museum, library, and reading-room, have been established at Nassau, and are partly supported by the legislature. At Nassau there is a public dispensary for supplying medicine and medical advice gratis; and there is also in New Providence an extensive building for the reception of poor and infirm persons, lunatics, and lepers. The number of inmates in 1851 was 62.

The climate is agreeable and salubrious, being tempered by northern breezes from the continent of America. It is well adapted for those suffering from pulmonary and bronchial affections; and Nassau is resorted to by many of the wealthy inhabitants of North America to avoid the severity of the winter there. The salubrity of Nassau in particular has recently been much improved by the draining of the neighbouring swamps. The average temperature from 1st November to 1st May is 76°, and from 1st May to 1st November 84°.

By the census taken in March 1851 the population of the Bahamas was 27,519; of whom 13,747 were males, and 13,772 females. The following are the inhabited islands, with their populations according to that census:—

New Providence	8159	Ragged Island	347
Harbour Island	1840	Andros Island	1030
Eleuthera (including Spanish Wells and Cays)	4610	Great Bahama	922
Rum Cay	858	Berry Islands	236
Crooked Island	1092	Bimini and Gun Cay	150
St Salvador	1828	Watling's Island	384
Exuma	2027	Inagua	530
Long Island	1477	Green Cay	7
Abaco	2011	Cay Sal	11

Bahar.

The number of births during the year 1851 was 1206; of deaths, 576. What is termed the "wrecking system" is a source of considerable profit to a large number of the inhabitants. These "wreckers" are licensed by the government, for the purpose of affording succour to vessels in distress, and rescuing lives and property from stranded ships. They are allowed a salvage on the property they recover; and, according to a recent enactment of the Bahama government, it is declared "that the wrecking vessel engaged in saving lives shall be awarded salvage on the wrecked property in equal proportion with vessels of the same size engaged in saving such property." (*Parliamentary Papers.*)

BAHAR, one of the territorial divisions of Hindustan included with the provinces of Bengal and Orissa in the dewanny or grant conferred upon the East India Company by Shah Alum, emperor of Delhi, in 1765. The province comprises the British districts of Patna, Bahar, and Shahabad, on the right bank of the Ganges, and an equal extent of territory on the left bank, now distributed between the two districts of Sarun and Tirhoot. The area is computed at 22,005 square miles, and its population amounts to 9,672,000. The tract is well watered and highly cultivated. Its principal river is the Ganges, joined on the right side by the Kurumnassa, Sone, Phalgu, and Poompun; and on the left by the Gogra, Gunduck, and Bagmutty. According to Hindu legend, Bahar comprised the dominions of the kings of Magadha, who are stated to have been lords paramount of India, and whose court is represented as one of the most brilliant that ever existed. Their highest point of grandeur is supposed to have been attained about the time of Seleucus Nicator, one of the immediate successors of Alexander the Great. In the sixteenth century, during the reign of the Emperor Akbar, Bahar constituted one of the fifteen grand divisions or viceroyalties into which India was then distributed.

The present British district of the same name is situate in the southern quarter of the province, of which it comprises about one fourth part, both in its extent and the amount of its population; its area being 5694 square miles, and its population being computed at 2,500,000. Though in general level and marshy, the district is in some parts intersected or bounded by ranges of mountains. One of these ridges extending along its southern frontier, has an elevation of 1000 or 1200 feet above the level of the sea. Another range, called by Major Rennell the Caramshaw Hills, rises on the west side of the river Phalgu; and a more considerable series termed the Rajahgriha Hills, having an elevation of 800 or 900 feet, intersects a portion of the district from N.E. to S.W. Rice, wheat, sugar, indigo, cotton, the ordinary grains of the country, and opium, constitute the staple produce. The cultivation of opium is controlled and regulated by the government, no one being allowed to grow the poppy, except on account of the state; and annual engagements are entered into by the cultivators to sow a specified breadth of land with that plant, and to deliver the whole produce, in the form of opium, to the government agents at a fixed price. Europeans have introduced the potato, which is now extensively grown. The manufacturing industry is of importance, and extends to the production of fabrics of cotton, silk, and muslin, blankets, carpets, coarse cutlery, and hardware, leather, ornaments in gold, silver, and glass, saltpetre, soap, and a variety of other articles. Coal has been discovered at the south-western angle of the district at Deori, on the right bank of the River Sone. Hindee, one of the languages derived from the Sanscrit, is the vernacular; but Hindustanee or Oordoo, a language formed from the fusion of Persian and Arabic with Hindee, is commonly spoken by the Mahometan population. Behar, the chief town, is distant from Patna 37 miles, and from Calcutta 255. Lat. 25. 10. Long. 85. 35. (E. T.)

Bahawulpoor || Bahrein.

BAHAWULPOOR, a town in Northern India, the principal place of a native state of the same name, is situate on a branch of the Ghara, forty-five miles above the confluence of that river with the Chenaub. The territory of which this town is the capital, originally formed part of the province of Moultan, and was held in feudal tenure from the Duranee monarch of Kabul. But when Runjeet Singh, the ruler of the Punjaub, brought Moultan under his authority, the Nawaub of Bahawulpoor, alarmed for his own safety, tendered his allegiance to the British. No encouragement was given to the proposal; but under the treaty of 1809 the Sutlej became the boundary of Runjeet's dominions, and Bahawulpoor was thus protected from invasion. Thirty years later, the British government undertook to restore Shah Shujah to the throne of Kabul; and as it then became desirable to fix positively the future relations of Bahawulpoor, it was stipulated that the Nawaub should be released from his allegiance to Kabul, and placed among the allies of the British. Good-will and cordiality towards the British invariably characterized the conduct of the Nawaub, and during the military operations beyond the Indus in 1839, the friendly feeling of the prince was strongly marked in facilitating the passage of the British troops, and in procuring the necessary supplies within his own territories. Upon the conquest of Sinde, the British government marked its sense of the Nawaub's fidelity by gratuitously restoring to him the districts of Subzulcote and Bhoong Bara, which had been wrested from him by the Ameers. On the death of the Nawaub in 1852, a contest for the succession arose between two sons of the deceased ruler. The elder, Hajee Khan, having been disinherited and subjected to imprisonment, his brother, Sadik Khan, consequently obtained the sovereign power in the first instance; but Hajee having made his escape, appeared in arms to assert his claim. Obtaining the support of many of the chiefs and people, and ultimately that of the troops, he succeeded in attaining his object and securing the person of his brother. The British government took no part in the contest, but at its close acquiesced in the recognition of Hajee Khan, interfering only to obtain a competent provision for the unsuccessful competitor, with permission for him to reside within the British territories.

The area of Bahawulpoor has been computed at 20,000 square miles, but a small proportion only of this extent of surface has been hitherto reclaimed from the desert. The fertile tract extends principally along the river line for a distance of about ten miles in breadth from the left or eastern bank, the transition from cultivation to desert being abrupt and striking. Wheat, rice, and various other grains, cotton, sugar, and indigo, form the staple crops. The population is estimated at 600,000. The Nawaub has an annual revenue of L.140,000, and maintains a military force of 13,000 men. The town is in Lat. 29. 24. Long. 71. 47. (E. T.)

BAHIA. See SALVADOR, ST.

BAHIR, a Hebrew term signifying "famous" or "illustrious," but particularly applied to a book of the Jews, treating of the profound mysteries of the Cabala, the most ancient of the rabbinical writings.

BAHREIN, the principal of a cluster of islands on the south-west side of the Persian Gulf, near the Arabian shore. This island, which is about twelve miles from the coast, is one of the finest in the gulf, and is covered with villages and date gardens. The town and fort of Manama, which contains about 800 or 900 houses, carries on a considerable trade with Bassora and other ports in the gulf. Here is a harbour admitting vessels of 200 tons, which trade to Bushire, and with a fair wind make the voyage in fourteen hours. This island has always been famous for its pearl fishery. Its banks produce the finest pearls in the world. They are found in a small mussel which is attached to the bottom by a thin fibre of great length. This is cut by the diver from a depth of three fathoms. These pearls are of two

sorts, white and yellow; and are sent to India, and through Bassora and Baghdad into Asia. The fishery is farmed out by the different chiefs on the coast, who draw a large revenue from this source. It employs annually about 2500 boats, each with from eight to fifteen men. The gains of the divers do not average more than from 40 to 50 Spanish dollars in a season. These islands once belonged to the Portuguese, and afterwards fell under the dominion of an Arabian chief, from whom they were seized by the Persians. They were afterwards taken possession of by the Wahabees. Bahrein is also the name of a province in Arabia. See ARABIA.

BAIÆ, an ancient town of Campania, in Italy, situated between the promontory of Misenum and Puteoli, on the Sinus Baianus, and famous for its warm springs and baths, which served the wealthier Romans for the purposes both of health and pleasure. The variety of these baths, the softness of the climate, and the beauty of the landscape, captivated the minds of the opulent nobles, whose passion for bathing knew no bounds. Hither retired for temporary relaxation the mighty rulers of the world, to recruit their strength and revive their spirits, fatigued with bloody campaigns and civil contests. Their habitations at first were small and modest; but increasing luxury soon added palace to palace with such expedition, that ground could no longer be found for new erections; while enterprising architects, supported by boundless wealth, carried their foundations into the sea, and drove that element back from its ancient limits. From being a place of occasional resort for a season, Baiæ grew up into a regular city, and the confluence of wealthy inhabitants rendered it as much a miracle of art as it had before been of nature. Its great splendour is still attested by innumerable ruins, heaps of marbles, mosaics, stucco, and other precious relics of the past. It flourished in undiminished magnificence till the days of Theodoric the Goth; but the destruction of these enchanted palaces followed quickly upon the irruption of the northern conquerors, who overturned the Roman power, sacked and burned all before them, and destroyed or dispersed the whole race of nobility. When the guardian hand of man was withdrawn, the sea rushed back upon its old domain; moles and buttresses were torn asunder and washed away; and promontories, with the proud towers that once crowned their brows, were undermined and tumbled into the deep. Yet, in its ruined state, and stripped of all its ornaments, Baiæ still presents many striking objects for the admiration of the traveller and the pencil of the artist. Long. 14. 3. E. Lat. 40. 50. N.

BAIBOUT, a town of Asiatic Turkey, in the pashalic of, and 65 miles W.N.W. from Erzroum. This was one of the strongholds of the Genoese, when prosecuting their trade with India. Remains of their fortifications still exist. Pop. about 3000.

BAIER, or BAYER, *Gottlieb Siegfred*, an eminent German philologist and antiquarian, born at Königsberg in 1694. Of his various writings, the principal is that entitled *Musæum Sinicum*, a very curious and able work. He died at St Petersburg in 1738.

BAIKAL, a great lake of Siberia, in the government of Irkutsk, 366 miles in length from S.W. to N.E., and from 20 to 53 miles in breadth. This vast reservoir is 1200 feet above the level of the sea. It is fed by several large rivers, namely, the Upper Angara, Selenga, Barguzin, and others; while the only visible outlet is by the Lower Angara, which is incapable of carrying off anything like the quantity of water which is received. The water is excellent, and extremely clear, so that the bottom can be seen at the depth of 8 fathoms. The depth of the lake varies from 22 to upwards of 300 fathoms. It yields abundance of fish, and there is a profitable fishery of seals on its shores during the whole summer; but the species is not ascertained. The climate is extremely severe: the waters of this great inland sea are frozen over from November, and the ice does not break up till May. This lake facilitates the Russian trade with China, and that between Irkutsk and Dauria. It is navigated by the Russians in summer, and in winter they travel across it on the ice. Steam-vessels were introduced here in 1844. Several hot springs and mineral waters are seen on the margin, and naphtha is sometimes found floating on the surface. It is between 51. 20. and 55. 30. N. Lat. and 103. and 110. E. Long. The island of Olkhon, near its north shore, is 32 miles long, and nearly 10 broad.

BAIL, BALLIUM (from the French *bailler*, which is derived from the Greek *βαλλεῖν*, and signifies to deliver into hands), is used in our common law for the freeing or setting at liberty of one arrested or imprisoned upon any action, either civil or criminal, on surety taken for his appearance at a certain day and place.

BAILEN, a town of Spain, in the province of Jaen, and *partido* of Carolina, six leagues N.N.W. of Jaen. Pop. 4976. This is the ancient Bæcula, where Scipio gained a signal victory over Hasdrubal, B.C. 209, and over Mago and Masinissa, B.C. 206 (Polyb. x. 38, xi. 20; Liv. xxvii. 18–20, xxviii. 13.) In the Epitome of Livy, however, the place is called *Bætula*. Near this also, in 1212, was fought the great battle of Navas de Tolosa, where Alonso VIII. is said to have left 200,000 Moors dead on the field, with the loss of only 25 Christians! Here again, on the 23d of July 1808, the French general Dupont, after a bloody contest of several days, signed the *Capitulation of Bailen*, by which 17,000 men were delivered up to the Spaniards as prisoners of war. This disaster was the first great blow to the French arms in the Peninsula. (Madoz, *Diccionario;* Ukert, vol. x. p. 379.)

BAILEY, or BAILY, *Nathan*, an eminent English philologist and lexicographer, whose *Etymological English Dictionary* may be regarded as the basis of Johnson's unrivalled work. He had a school at Stepney, near London; and was the author of *Dictionarium Domesticum*, and several other works. He died in 1742.

BAILIE, the title of a class of magistrates of the second rank in the burghs of Scotland, corresponding generally, though not in all respects, with the aldermen of England. In the royal burghs they seem to have been originally the stewards or executive officers of the crown; in the inferior burghs, of the barons or feudal superiors. At common law the magistrates of royal and parliamentary burghs are held to possess the same powers within their territory as the sheriff in his county; but the powers of bailies of baronies are now so limited as to be scarcely worth exercising, and have fallen generally into disuse.

BAILIFF, or BAILIE, in a general sense, denotes an officer appointed for the administration of justice in a certain district or bailiwick. The term is formed from the French word *bailif*, that is, *præfectus provinciæ*. The chief magistrates in some towns are called bailiffs or bailies; and sometimes the persons to whom the king's castles are committed are termed bailiffs, as the *bailiff of Dover Castle*.

Of ordinary bailiffs there are several sorts, viz., sheriffs' bailiffs, bailiffs of liberties, &c. Sheriffs' bailiffs, or sheriffs' officers, are either bailiffs of hundreds or special bailiffs. Bailiffs of hundreds are officers appointed over those districts by the sheriffs, to collect fines, to summon juries, to attend the judges and justices at the assizes and quarter-sessions, and also to execute writs and process in the several hundreds. Bailiffs of liberties were those bailiffs appointed by every lord within his liberty, to execute process, and do such offices as the bailiffs-errant were wont to do at large in the county.

BAILII, or BAILLY, *David*, a painter of perspective views and portraits, was the son of Peter Bailii, an artist of some note, and was born at Leyden in 1588. From his father

Bailiwick ‖ Baillie.

ne learned to draw and design. He afterwards studied under Adrian Verburg, and then under Cornelius Vandervoort, with whom he spent about six years. Vandervoort possessed many capital paintings of some great masters, which Bailii, for his own improvement, copied with great care. One perspective view of the interior of a church, by Stenwyck, he finished with such accuracy, that Stenwyck himself could scarcely determine which of the two was the original. After this he travelled in Italy, and spent some years at Rome. In the latter part of his life, he devoted himself to portraits drawn with the pen, which are characterized by great force and roundness. He died in 1638.

BAILIWICK (*bailli*, and the Saxon *wic*, a *village*), that liberty which is exempted from the jurisdiction of the sheriff of the county, and over which liberty the lord thereof appoints his own bailiff, with the like power within his precincts as an under-sheriff exercises under the sheriff of the county. Or it signifies the precinct of a bailiff, or the place within his jurisdiction.

BAILLET, ADRIEN, a very learned French writer and critic, born in June 1649, at the village of Neuville, near Beauvais, in Picardy. His parents were too poor to give him a proper education, which, however, he obtained by the favour of the bishop of Beauvais, who afterwards presented him with a small vicarage. In 1680 he was appointed librarian to M. de Lamoignon, advocate-general to the parliament of Paris, of whose library he made a *Catalogue Raisonné* in thirty-five volumes folio, all written with his own hand. He died in January 1706. In the list of his numerous works, the following are among the most conspicuous :—1. *Histoire de Hollande depuis* 1609 *jusqu' à* 1690, 4 tom. 12mo, a continuation of *Grotius*, and published under the name of Neuville. 2. *Les Vies des Saints*, 3 tom. fol. 3. *Des Enfants devenus célèbres par leurs Etudes et par leurs Ecrits*, 2 tom. 12mo. 4. *Vie de Descartes*, 2 tom. 4to. 5. *Jugemens des Savants sur les principaux Ouvrages des Auteurs*, 9 tom. 12mo. The last is the most celebrated and the most useful of all the works of this learned and indefatigable writer. The edition of it published in 1722 by M. de la Monnoye, in seven volumes quarto, contains the *Anti-Baillet* of M. Menage, besides notes ; but the edition published at Amsterdam in 1725 is more esteemed.

BAILLEUL, an ancient town of France, department Du Nord, near the Belgian frontier. It was formerly a place of great strength. Pop. 5988. Lat. 50. 45. N. Long. 2. 44. E.

BAILLIE, JOANNA. This very amiable and accomplished lady was born at Bothwell, on the banks of the Clyde, in 1762. A niece of William and John Hunter, and a sister of Dr Matthew Baillie, she shared the talents of this distinguished family, and increased its honours by a pure and elevated poetry, which has added another wreath to the laurels of her country. She appears early to have cultivated her poetic taste, but did not come before the public as a poet until 1798, when she produced a volume of *Plays on the Passions*, which at once established her powers in delineating character, and exhibited originality of invention. The public was not slow in acknowledging her genius, and hailed with satisfaction the appearance of a second volume, on the same plan, in 1802.

Though the design of each play was chiefly to illustrate a single motive of action, Miss Baillie showed tact in giving variety to her compositions, and especially excelled in the delicate discrimination of the peculiarities of female characters. Although her plays were intended rather for the closet than the stage, the enthusiastic admiration of the two greatest tragedians of our age, Mrs Siddons and John Kemble, introduced *De Montfort* successfully on the English stage ; and another of her plays, *The Family Legend*, was a favourite piece in the theatre of Edinburgh, where it was introduced by a prologue by Walter Scott, and followed by an epilogue by Mackenzie, the author of *The Man of Feeling*. The subjects of her plays are not historical, but are ideal combinations of character, given with a dignity and force that stamp them as the conceptions of a pure and vigorous mind. Though of unostentatious and retiring habits, her friendship was eagerly sought and cultivated by some of the most distinguished literary characters of the age ; and Scott has thus happily expressed his admiration of Joanna Baillie :— Baillie.

> " When she the bold enchantress came
> With fearless hand and heart on flame,
> From the pale willow snatch'd the treasure,
> And swept it with a kindred measure ;
> Till Avon's swans, while rung the grove
> With Montfort's hate, and Basil's love,
> Awakening at the inspired strain,
> Deem'd their own Shakspeare liv'd again."

Her principal productions are *De Montfort*, *The Family Legend*, *Count Basil*, *Henriquez*, and *Separation*. We have already stated the favourable circumstances that introduced the first two on the stage ; the last two have also since been acted. Another volume containing her minor poems, in which are some good specimens of humorous song, showing her talent for lighter compositions, has more lately been given to the public. A collective edition of her works, in one volume, was published at London in 1851.

Miss Baillie's modest retreat at Hampstead was long a favourite resort of those individuals whom she honoured with her friendship ; and till within a short period of her death, she was able to receive her friends, and even to correspond with a select few. There this accomplished and estimable woman closed her long career, on the 23d of February 1851. (T. S. T.)

BAILLIE, *Dr Matthew*, was the son of the Rev. James Baillie, who was successively the clergyman of the parishes of Shotts, Bothwell, and Hamilton, in Lanarkshire, and afterwards professor of divinity in the University of Glasgow. The acknowledged influence of the female parent in forming the character of her offspring may be here admitted. His wife was Dorothea, the intellectual sister of the celebrated William and John Hunter ; their son, Matthew, became one of the most distinguished anatomists and physicians of the age ; and their daughter, Joanna Baillie, added fresh lustre to the poetic genius of Scotland.

The subject of this notice was born in the manse of Shotts in 1761, and was for several years a student in the University of Glasgow, where he became a pupil of Dr Reid in moral philosophy. His professional career was determined by the advice of his maternal uncle, Dr William Hunter, who undertook to superintend his education. On his father's death, a Glasgow exhibition to Balliol College, Oxford, was obtained for him, and he remained a year in that celebrated seat of learning before he removed to London, where he enjoyed the advantages of his uncle's personal direction of his studies. In two years more he assisted Dr Hunter in his anatomical lectures as his assistant and demonstrator, visiting Oxford occasionally, so as to keep his terms to qualify for the degree of bachelor of medicine. Dr Hunter, at his death, bequeathed the use of his magnificent collections to his nephew, together with the lecture-rooms in Windmill Street, an annuity of L.100 a-year, and a small family estate in Scotland ; which last was resigned by Baillie to his other uncle, John Hunter, whom he considered as the natural heir.

Within two years after Dr Hunter's death, his nephew became the principal teacher in that celebrated school of anatomy ; and in 1787, although only a bachelor of medicine, he was appointed physician to St George's Hospital, where he soon distinguished himself by the precision and accuracy of his diagnosis, and the sagacity of his treatment of dis-

Baillie. ease, which speedily introduced him to respectable private practice.

In 1789 he married Sophia, daughter of the eminent accoucheur Dr Denman; a connection which favoured his introduction to practice among the first circles in London, for which, however, he was still more indebted to his talents, his high character, and his unassuming manners. The fine collections of his two uncles became his careful study; and to render them more useful to the public, he gave to the world, in 1795, the result of his examination of them, and of his own experience, in his *Morbid Anatomy*, a most valuable work, which was speedily translated into French, Italian, and German, the latter by no less distinguished an anatomist than Soemmering. After this, Oxford did itself honour by enrolling Matthew Baillie among its doctors of medicine; and he became a Fellow of the Royal College of Physicians.

Dr Baillie was eminently distinguished by his profound knowledge of his profession, his sagacity, his very perspicuous and decided mode of explaining his views of the nature of a disease, his uniform courtesy to his professional brethren, his kindness of manner to his numerous patients, and his delicate attention to the feelings and cases of the poor who applied to him for advice, at a time when the rich and the noble, and even royalty itself, made large demands on his time and medical services. In person Dr Baillie was slender, and rather diminutive; but his mind was expanded, his intellect of the first order; his manners were kind and courteous, and perfectly unassuming; his benevolence extensive and unostentatious; and probably no physician who ever practised in London was more universally respected, or more sincerely regretted, than Dr Matthew Baillie at the period of his decease, which took place on the 23d of September 1823, in the 63d year of his age. The second edition of the *Morbid Anatomy* appeared in 1797; and two years afterwards it was illustrated by a 4to volume of engravings, with excellent descriptions of the plates. Two years after his death, appeared his *Anatomical Lectures and Medical Observations*. The *Works*, 2 vols. 8vo, edited, with a biographical sketch, by Mr Wardrop, contain only the *Morbid Anatomy* and miscellaneous medical papers. (T. S. T.)

BAILLIE, Robert, one of the most learned men among the Scottish presbyterians of the seventeenth century, was born at Glasgow in the year 1599. His father, who is described as a citizen, was a son of Baillie of Jerviston, who belonged to the family of Carphin, a branch of the ancient family of Lamington, in the county of Lanark; his mother was Helen Gibson, connected with the Gibsons of Durie, one of whom was an eminent judge in the supreme court. In the year 1617 he was matriculated in the university of Glasgow, under the name of *Robertus Baillize;* and here it may be remarked that, according to the careless practice of the age, he afterwards exhibited no small variety in the orthography of his surname, writing it Baylie, Baily, Bailie, and Baillie. His studies were partly conducted under the superintendence of John Cameron, a man of great learning and reputation, who had been a professor in the protestant university of Saumur, and who in 1622 was appointed principal of the university of Glasgow. From him Baillie imbibed the doctrine of passive obedience; and, in consequence of this prejudice of education, he only gave a tardy assent to the strenuous measures which were afterwards adopted against Charles the First. Having taken the degree of A. M. he applied himself to the study of divinity, and in due time received ordination from Archbishop Law.

On the 16th of August 1626 he was admitted one of the regents of the university; and, on taking his chair, he delivered an inaugural oration *De Mente agente*. Dr Strang, a man of talents and learning, had been appointed principal a few months before. About the same period, Baillie appears to have prosecuted the study of the oriental languages, in which he is allowed to have attained to no mean proficiency. He was anxious to promote similar studies in the university; and in the year 1629 he delivered an oration *In Laudem Linguæ Hebrææ*. Baillie.

One of the pupils intrusted to his charge was Lord Montgomery, eldest son to the earl of Eglintoun, by whom he was presented to the living of Kilwinning in Ayrshire. His induction must have taken place between 1630 and 1632. With this noble family he continued to live on terms of intimacy; and as he was a person of excellent character, he equally enjoyed the approbation of his own parishioners, and the confidence of his ordinary the archbishop of Glasgow. In 1633 he declined the offer of a living in Edinburgh. Between 1634 and 1636 he was much employed in discussing, by means of private correspondence with his brethren, certain questions respecting Arminianism, and the ceremonies obtruded on the church by the partisans of Laud. In 1638 the presbytery of Irvine elected him a member of the assembly which was held at Glasgow, and which laid the foundation of material changes in church and state. During the ensuing year his countrymen raised a considerable army, which was placed under the command of Alexander Leslie, an old and experienced officer; and Baillie appears to have caught some portion of the military ardour which now prevailed in this cause of religion and liberty. "It would have done you good," he remarks in one of his letters, "to have cast your eyes athort our brave and rich hills as oft as I did, with greater contentment and joy; for I was there among the rest, being chosen preacher by the gentlemen of our shire, who came late with Lord Eglinton. I furnished to half a dozen of good fellows, muskets and pikes, and to my boy a broad sword. I carried myself, as the fashion was, a sword, and a couple of Dutch pistols at my saddle; but, I promise, for the offence of no man, except a robber in the way; for it was our part alone to pray and preach for the encouragement of our countrymen, which I did to my power most chearfully." (*Letters*, vol. i. p. 174.) He afterwards states, "Our soldiers grew in experience of arms, in courage, in favour, daily. Every one encouraged another. The sight of the nobles, and their beloved pastors, daily raised their hearts. The good sermons and prayers, morning and evening, under the roof of heaven, to which their drums did call them for bells; the remonstrances very frequent of the goodness of their cause; of their conduct hitherto, by a hand clearly divine; also Lesly's skill, and prudence, and fortune, made them as resolute for battle as could be wished. We were feared that emulation among our nobles might have done harm, when they should be met in the field; but such was the wisdom and authority of that old, little, crooked soldier, that all, with an incredible submission, from the beginning to the end, gave over themselves to be guided by him, as if he had been great Solyman....Had you lent your ear in the morning, or especially at even, and heard in the tents the sound of some singing psalms, some praying, and some reading Scripture, ye would have been refreshed. True, there was swearing, and cursing, and brawling, in some quarters, whereat we were grieved; but we hoped, if our camp had been a little settled, to have gotten some way for these misorders; for all of any fashion did regret, and all promised to do their best endeavours for helping all abuses. For myself, I never found my mind in better temper than it was all that time since I came from home, till my head was again homeward; for I was as a man who had taken my leave from the world, and was resolved to die in that service without return." This enthusiastic army had advanced to the borders of the kingdom, and had pitched its camp on Dunse Law; the royal forces were

Baillie. within a very short distance; and the adverse parties were on the eve of a general engagement, when the treaty of Berwick, negociated with Charles in person, produced a temporary cessation of open hostilities. But the seeds of dissension were too widely scattered, and had taken too deep root, to be so speedily checked in their growth: the notions of the king, sufficiently arbitrary in themselves, were at variance with the elastic spirit of the age; and his subjects, in both divisions of the island, were gradually impressed with a deep conviction of his insincerity. In the year 1640 the Covenanters again had recourse to arms; and having invaded England, they took the town of Newcastle. Baillie now resumed his attendance in the camp; and before the close of the year he was employed in London, along with other commissioners, in preparing charges against Archbishop Laud, for the innovations which he had obtruded on the church of Scotland. He had very recently published *The Canterburian's Self-Conviction*, which seems to have been industriously circulated, and which arrived at a fourth edition. About this period of his life he composed various other works of a controversial nature, and was regarded as one of the most strenuous defenders of the presbyterian cause.

His merit was now so conspicuous that he was offered a professorship in each of the four universities. Having been appointed one of the professors of divinity at Glasgow, he delivered, on the 6th of July 1642, an inaugural oration *De Hæreticorum Autocatacrisi*. About this period he must have taken the degree of D. D.; for the records of the university describe him as "Doctor et Professor SS. Theologiæ." His colleague David Dickson, who had been appointed in 1640, is described in the same manner; but neither of them assumed the title of doctor in his printed works. Both professors discharged the functions of clergymen in the city; and in such of his publications as bear the author's name, Baillie styles himself minister at Glasgow, or minister of the gospel at Glasgow, without any addition. While he filled this chair, it is to be inferred that his chief employment consisted in teaching the oriental languages. Dr Dickson having been removed to the university of Edinburgh, he was admitted to the higher professorship of divinity on the 17th of January 1651. His labours were various and extensive. He was much engaged in the public affairs of the church, and was a member of all the general assemblies from 1638 to 1653, with the exception of those which were held during his attendance at Westminster. In 1642 the assembly appointed him to visit and preach in the north of Ireland during four months. To the assembly of Westminster, which commenced its sittings in the year 1643, the church of Scotland sent Alexander Henderson, Robert Douglas, Samuel Rutherford, Robert Baillie, and George Gillespie, together with three ruling elders, the Earl of Cassilis, Lord Maitland, and Sir Archibald Johnston of Warriston. Of the proceedings of this ecclesiastical council, Baillie has given an interesting account in his correspondence. His modest opinion of himself, and his high estimate of his colleagues, are equally conspicuous. "These things are so high, and of so great concernment," he remarks in a letter to Robert Blair, "that no living Baillie. man can think Mr Henderson may be away; and to put him to go and return, it were very hard to venture such a jewel, that is so necessary to the well-being both of church and state of all these dominions. Mr Samuel, for the great parts God has given him, and special acquaintance with the question in hand, is very necessary to be here. ...Mr G. Gillespie, however I had a good opinion of his gifts, yet I profess he has much deceived me. Of a truth there is no man whose parts in a publick dispute I do so admire. He has studied so accurately all the points ever yet came to our assembly, he has gotten so ready, so assured, so solid a way of publick debating, that however there be in the assembly divers very excellent men, yet, in my poor judgement, there is not one who speaks more rationally, and to the point, than that brave youth has done ever; so that his absence would be prejudicial to our whole cause, and unpleasant to all here that wishes it well." (*Letters*, vol. i. p. 451.) In 1645 he returned from England, in order to give to the general assembly an account of the proceedings at Westminster; and having resumed his station among the assembled divines, he continued to reside for some time longer in the English metropolis.[1] He now stood very high in the esteem and confidence of his countrymen; and in 1649 he was one of the commissioners sent to Holland for the purpose of inviting Charles II., and of settling the terms of his admission to the government. In the controversy which prevailed among the presbyterians between 1650 and 1660, he adhered to the party of the Resolutioners against that of the Protesters. The commission of the general assembly had adopted two *resolutions*, by which they consented to the repeal of the act for reforming the army, and the act by which certain classes of persons were excluded from places of power and trust, on account of their immoral conduct, or of the opposition which they had evinced towards the cause of civil and religious reform; and the resolutions having been approved by two subsequent assemblies, a formal *protest* against the constitution and proceedings of those assemblies was entered by various ministers and elders.

After the restoration, Patrick Gillespie, who had enjoyed the special favour of Cromwell, was ejected from his office; and on the 23d of January 1661 Baillie was admitted as principal of the university of Glasgow. For this promotion he was indebted to Lauderdale, who had not yet appeared in his true and hideous colours. According to some writers, he might have exchanged his academical office for a bishopric; but he was deeply grieved at the establishment of episcopacy, and would not accept of preferment in the church. When the new archbishop of Glasgow, Andrew Fairfoul, arrived at his metropolitan seat, he did not fail to pay his respects to the learned principal. Baillie admits that "he preached on the Sunday, soberly and well." "The chancellor, my noble kind scholar," he afterwards states, "brought all in to see me in my chamber, where I gave them sack and ale the best of the town. The bishop was very courteous to me. I excused my not using of his styles, and professed my

[1] The following passage occurs in a letter, dated at Glasgow on the 22d of August 1654, and addressed to the famous Dr Fuller: "Haveing lately, and but lately, gone through your Holy Warr and Description of Palestine, I am fallen so in love with your pen, that I am sorie I wes not before acquaint with it, and with your self, when from the 1643 to 1647 I lived at Worcester house, and preached in the Savoy, that then, when I had some credite there, I might have used my best endeavours to have done yow pleasure." (Baillie's *MS. Letters*, vol. iv. p. 423.) Of the pulpit-oratory, and of the general talents of the Scotish divines who visited London, the Earl of Clarendon and Mr Hume have given the same unfavourable account; but on this subject, as well as on many others, their opinion is strongly contested by Mr Brodie. "These famous divines preached as chaplains, by turns, in one of the lecture-rooms; and, as was to have been expected at such a juncture from men of their reputation, capacity, and profound as well as varied erudition, they drew immense crowds. If we may form an estimate of their pulpit-oratory from their works, we may safely pronounce that the English did not discredit themselves by flocking to hear such preachers." (*History of the British Empire*, vol. iii. p. 41.)

Baillie. utter difference from his way, yet behoved to intreat his favour for our affairs of the college; wherein he promised liberally. What he will perform, time will try." (*Letters*, vol. ii. p. 461.) According to another account, the archbishop visited him during his illness, and was accosted in the following terms:—"Mr Andrew, I will not call you my Lord. King Charles would have made me one of these lords; but I do not find in the New Testament that Christ has any lords in his house." In other respects he is said to have treated the prelate very courteously; and it may not be superfluous to remark, that this mode of using the Christian name instead of the surname was not unusual at that period. Baillie died in the month of July 1662, at the age of sixty-three.

His first wife was Lilias Fleming, of the family of Cardarroch, in the parish of Cadder, near Glasgow. Of this marriage there were many children, but only five survived him. 1. Henry, a clergyman, who was never beneficed. His posterity inherited the estate of Carnbroe, which was recently sold by General Baillie. 2. Lilias, married to Eccles of Kildonan in Ayrshire. 3. Helen, married to a bailie of Glasgow, named Colquhoun. 4. Elizabeth, married to Mr Hamilton, a gentleman of Strathbane in the kingdom of Ireland. 5. Mary, married to Walter Buchanan of Orchard. The mother of these children died on the 7th of June 1653, after a lingering illness. She is mentioned by her husband in terms of much respect and affection. On the 1st of October 1656 he married Mrs Wilkie, who was a widow, and the daughter of Dr Strang. The issue of this marriage was Margaret, who became the wife of Walkingshaw of Borrowfield.

Wodrow, the zealous and faithful historian of the persecuted church of Scotland, has formed a very high estimate of Baillie's literary character. "Mr Robert Baillie may most justly be reckoned among the great men of this time, and was an honour to his country, for his profound and universal learning, his exact and solid judgement, that vast variety of languages he understood, to the number of twelve or thirteen, and his writing a Latin style which might have become the Augustan age."[1] This commendation of his Latinity may admit of some abatement; for although he evidently possessed a very familiar knowledge of the language, his Latin style cannot safely be said to reach the standard of ancient purity and elegance. An episcopalian writer, the author of the Appendix to Spotswood, has commemorated Baillie as "a learned and modest man: though he published some very violent writings, yet those flowed rather from the instigation of other persons, than his own inclinations."[2] Mr Brodie, a recent historian of much ability and research, bestows the following commendation on Baillie and his associates. "The clergy, on whom they greatly depended, were profound scholars, and no despicable politicians. Nothing can be more misplaced than the ridicule which has been so profusely levelled at that body. They proved themselves ambitious; but, to be satisfied of their talents, and to admire their knowledge, it is only necessary to peruse their works. The writings of Baillie, even his familiar letters, breathe a manliness of spirit, and evince intelligence and erudition, that must for ever rescue from contempt a class of which he did not conceive himself entitled to rank at the head."[3] Baillie. Baillie had devoted much attention to the study of the oriental languages, and was skilled in Hebrew, Chaldee, Syriac, Samaritan, Arabic, and Ethiopic. In his correspondence with the scholars of the continent, he urged Golius, Buxtorf, and other learned men, to compose elementary works on such of these languages as were not already provided with them. In an unpublished letter, dated at Glasgow on the 27th of August 1656, and addressed to Mr Crawford, a minister of London, he remarks, "The reason of my calling to you at this tyme is my desyre to know the condition of that excellent book, the best to me that ever was printed, Dr Walton's Polyglott Bible." He was solicitous that the learned protestants should undertake an Encyclopædia of arts and sciences; and urged his correspondents not to permit the education of youth, and the composition of books for elementary instruction, to be so generally engrossed by the Jesuits.

Of Baillie's publications, the following is as complete a list as we have been able to furnish.

1. Ladensium Αυτοκαταχρισις, the Canterbvrians Self-Conviction; or, an evident Demonstration of the avowed Arminianisme, Poperie, and Tyrannie of that Faction, by their owne confessions: with a postscript to the personat Jesuite Lysimachus Nicanor,[4] a prime Canterburian. *Written in March, and printed in Aprile*, 1640, 4to.—This book was speedily reprinted at Amsterdam; and a "third edition, augmented by the author, with a large Supplement," was *printed for Nathaniel Bvtter*, 1641, 4to. The additional part was likewise published in a separate form, under the title of "A large Supplement of the Canterbvrian Self-Conviction." *Imprinted* 1641, 4to. A fourth edition of the work bears the title of "The Life of William now Lord Arch-bishop of Canterbvry, examined." Lond. 1643, 4to.

2. A Parallel or briefe Comparison of the Liturgie with the Masse-Book, the Breviarie, the Ceremoniall, and other Romish Ritualls.[5] Lond. 1641, 4to. Reprinted in 1661.

3. Queries anent the Service-Book.

4. An Antidote against Arminianism.

5. The Unlawfulnesse and Danger of limited Episcopacie; whereunto is subjoined a short Reply to the modest Advertiser and calm Examinator of that Treatise: as also the Question of Episcopacie discussed from Scripture and the Fathers. Lond. 1641, 4to.

6. Satan the Leader in chief to all who resist the Reparation of Sion; as it was cleared in a Sermon to the Honourable House of Commons at their late solemn Fast, Febr. 28, 1643. Lond. 1643, 4to.

7. Errours and Induration are the great Sins and the great Judgements of the Time: preached in a Sermon before the Right Honourable House of Peers, in the Abbey-Church at Westminster, July 30, 1645, the day of the monethly Fast. Lond. 1645, 4to.

8. A Dissvasive from the Errours of the Time: wherein the Tenets of the principall Sects, especially of the Independents, are drawn together in one Map, &c. Lond. 1645, 4to. Lond. 1646, 4to.

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[1] *Wodrow's History of the Sufferings of the Church of Scotland*, vol. i. p. 128. Edinb. 1721–2, 2 vols. fol.—See the same author's *Life of James Wodrow, A. M. Professor of Divinity in the University of Glasgow*, p. 30. Edinb. 1828, 12mo.

[2] T. Middleton's *Appendix to the History of the Church of Scotland*, p. 23. Lond. 1677, fol.

[3] Brodie's *Hist. of the British Empire*, vol. ii. p. 506.

[4] The Epistle congratvlatorie of Lysimachus Nicanor, of the Societie of Jesu, to the Covenanters in Scotland; wherein is parallelled our sweet harmony and correspondency in divers materiall points of Doctrine and Practice. *Anno Domini* 1640, 4to.—The author of this Epistle was John Corbet, a Scotish clergyman, who having taken refuge in Ireland, was "hewed in pieces in the very armes of his poore wife." (Baillie's *Historical Vindication*, p. 2.) Some notices of him may be found in Burnet's *Life of Bishop Bedell*, p. 140. Lond. 1685, 8vo.

[5] Some animadversions on this work are subjoined to L. Womock's *Beaten Oyle for the Lamps of the Sanctvarie*. Lond. 1641, 4to.

Baillie.

9. An Historical Vindication of the Government of the Church of Scotland, from the manifold base Calumnies which the most malignant of the Prelats did invent of old, and now lately have been published with great industry in two pamphlets at London; the one intituled *Issachars Burden*, &c., written and published at Oxford by John Maxwell,[1] a Scottish Prelate, &c. Lond. 1646, 4to.

10. Anabaptism, the trve Fovntaine of Independency, Brownisme, Antinomy, Familisme, &c. in a Second Part of the Disswasive from the Errors of the Time. Lond. 1647, 4to.

11. A Review of Doctor Bramble, late Bishop of Londenderry, his Faire Warning against the Scotes Disciplin. Delf, 1649, 4to.—This tract was afterwards incorporated, without being reprinted, in a collection entitled *Three Treatises concerning the Scotish Discipline.* Hagh, 1661, 4to. The other two treatises are Bramhall's Fair Warning and Watson's Second Fair Warning, in answer to Baillie; and the volume likewise includes a virulent epistle by another Scottish writer, Dr Creyghton, afterwards bishop of Bath and Wells. Baillie's Review was reprinted at Edinburgh; and having been translated into Dutch, it was published at Utrecht under the inspection of Gisbert Voet.

12. A Scotch Antidote against the English Infection of Arminianism. Lond. 1652, 12mo.

13. Appendix practica ad Joannis Buxtorfii Epitomen Grammaticæ Hebrææ. Edinb. 1653, 8vo.

14. Catechesis elenctica Errorum qui hodie vexant Ecclesiam; ex nudis sacræ Scripturæ Testimoniis, in brevibus et claris Quæstionibus ac Responsionibus proposita, in gratiam studiosæ Juventutis Academiæ Glasguensis. Lond. 1654, 12mo.

15. A Reply to the Modest Inquirer.—Perhaps relating to the dispute between the Resolutioners and Protesters. This tract, together with numbers 3 and 4, we have not seen. They are all mentioned in Baillie's papers, in the possession of Dr M'Crie.

16. The Disswasive from the Errors of the Time, vindicated from the Exceptions of Mr Cotton and Mr Tombes. Lond. 1655, 4to.

17. Operis Historici et Chronologici libri duo; in quibus Historia sacra et profana compendiose deducitur ex ipsis Fontibus, a Creatione Mundi ad Constantinum Magnum. Amstelodami, 1663, fol.—Some copies have the addition of an index, with a new title bearing the date of 1668.

18. Letters and Journals; containing an impartial Account of public Transactions, civil, ecclesiastical, and military, in England and Scotland, from the beginning of the Civil Wars in 1637, to the year 1662; a period, perhaps, the most remarkable and interesting in the British History: now first published from the manuscripts of Robert Baillie, D. D. Principal of the University of Glasgow. Edinb. 1775, 2 vols. 8vo.—Some copies, bearing the same date, have a different title, which states that the Letters were "carefully transcribed by Robert Aiken." Many of them are addressed to the author's cousin-german William Spang, minister of the Scottish staple at Campvere, and afterwards of the English congregation at Middelburg in Zeeland. It was chiefly from the materials thus communicated that Spang prepared two different publications. The first is entitled "Brevis et fidelis Narratio Motuum in Regno et Ecclesia Scoticana, excerpta ex scriptis utriusque partis scitu dignissimis, per Irenæum Philalethen." Dantisci, 1640, 4to. This work only prosecutes the narrative till the first of October 1638; but he speedily reprinted it, and added a continuation to the year 1640. "Rerum nuper in Regno Scotiæ gestarum Historia." Dantisci, 1641, 8vo.—These letters were published from a copy belonging to Matthew Baillie of Carnbroe, Esq.; and the editor likewise consulted the copy preserved among the archives of the church of Scotland. The copy which belonged to the author's family is now in the possession of Dr M'Crie, to whose kindness we are indebted for the use of it, as well as for several biographical notices. This manuscript consists of four volumes in folio, and is in a tolerably good state of preservation. Baillie's Letters and Journals are of great historical value; and as the editor, besides omitting many detached passages, has suppressed a considerable number of entire letters, we beg leave to suggest, and even to urge, the expediency of a new and complete edition.

Baillie had apparently some concern in the publication of a posthumous work of his learned predecessor Robert Boyd, principal of the university of Glasgow: *In Epistolam Pauli Apostoli ad Ephesios Prælectiones supra cc.* Lond. 1652, fol. Prefixed is a life of the author by Rivet, with whom Boyd had been intimately acquainted; but the preface is subscribed with the initials R. B. A biographical notice, bearing the same signature, is prefixed to the work of his father-in-law Dr Strang, *De Interpretatione et Perfectione Scripturæ.* Roter. 1663, 4to. (D. L.)

BAILLY, JEAN SYLVAIN, a celebrated philosopher and astronomer, was born at Paris on the 15th of September 1736. He was originally intended for the profession of painting, which his family had pursued for several generations, and he even had made some progress in the art. But the bias of his mind leaned too much to literary pursuits, especially to poetry and works of imagination, to permit him to give that application which is necessary to secure success and eminence in any profession.

The friends of Bailly, who had witnessed the early dawn of his genius, saw that it was alike fitted to appear with advantage in the study of polite literature, or to shine in the walks of science; and they recommended the latter chiefly to his attention. His acquaintance with Lacaille, the celebrated geometer, commenced; and this at once decided the object of his studies, which were now almost entirely devoted to scientific investigations. The first of his labours was a calculation of the comet which appeared in the year 1759. In January 1763 he was admitted a member of the Academy of Sciences; and in the same year he published a reduction of the observations made by Lacaille in 1760 and 1761 on the zodiacal stars: an elaborate compilation, and of very extensive utility. His attention was afterwards directed to the consideration of the theory of Jupiter's satellites. Lagrange, who now pro-

[1] John Maxwell, D. D., was the son of Maxwell of Cavons in Nithsdale; and after having been beneficed at Murthlack and in Edinburgh, he became bishop of Ross in the year 1633. He was deposed and excommunicated by the assembly of 1638, and took refuge in England. In 1640 he was appointed bishop of Killala in Ireland; but the rebellion speedily ensued, and after being stript naked and severely wounded, he was again compelled to seek a place of refuge in England, and for some time he attended the king at Oxford. In 1645 he was appointed archbishop of Tuam, and died on the 14th of February 1646. The work which Baillie answered is entitled "The Burthen of Issachar: or, the Tyranical Power and Practises of the Presbyteriall Government in Scotland." *Printed in the yeare* 1646, 4to. Dr Maxwell is the author of another work, which was answered by Rutherford: "*Sacro-sancta Regum Majestas*; or, the sacred and royall Prerogative of Christian Kings." Oxford, 1644, 4to. According to Bishop Burnet, he was "a man of eminent parts, and an excellent preacher; but by his forwardness and aspiring he was the unhappy instrument of that which brought on all the disorders in Scotland." (*Life of Bishop Bedell*, p. 141.) He is mentioned and described in the Life, Diary, and Correspondence of Sir William Dugdale, p. 437. Lond. 1827, 4to.

Bailly. mised to become the first mathematician in Europe, was the formidable rival of Bailly in the competition for this prize question in 1764. The results of his investigations were collected into a treatise, which also contained the history of that part of astronomy, and were published in 1766. In 1771 appeared his interesting and important memoir on the Light of the Satellites, which was marked with a degree of precision and accuracy till that time unknown in the observations of their eclipses.

The studies of Bailly were not entirely limited to the cultivation of abstract science, nor to profound physical speculations; his genius shone with equal lustre in those departments of literature which require a discrimination of character, and no common powers of eloquence, in order to attain excellence. His *Eloges* on Charles V., Corneille, Leibnitz, Molière, Cook, Lacaille, and Gresset, were universally admired as valuable specimens of fine writing, and they added much to his reputation. The distinguished place of secretary of the Academy of Sciences became vacant in 1771; and, supported by the patronage and influence of Buffon, he offered himself a candidate. But, in this instance, he was unsuccessful. Condorcet, then rising into reputation, and supported by the active influence of D'Alembert, was preferred to the office.

In the year 1775 he published at Paris the first volume of his great work, the *History of Astronomy*, containing the history of astronomy from its origin to the foundation of the Alexandrian School; and this was followed by three volumes on the history of modern astronomy, published between 1776 and 1783. This work, which is of inestimable value, is distinguished alike for animated description, luminous narration, and interesting detail. Besides, he published, in 1777, a work entitled *Letters on the Origin of the Sciences, and of the People of Asia;* and this was followed by another series of *Letters on the Atlantis of Plato, and the Ancient History of Asia*, as a continuation of the same work. These volumes were addressed to Voltaire, with whom he had commenced an ingenious correspondence and discussion on this curious subject. The coincidence of his opinions with those of Buffon in points respecting some of the favourite theories of the latter, brought on an intimate acquaintance and close friendship with that celebrated naturalist; which, however, declined and was entirely dissolved, in consequence of the opposition which Bailly made to the election of the Abbé Maury into the French Academy. Bailly had been chosen secretary of the academy in 1784; and in the following year he was admitted into the Academy of Inscriptions and Belles Lettres. This was the only instance, since the time of Fontenelle, of the same person being at once a member of all the three academies.

In the year 1784 he was nominated one of the commission to investigate the nature of the animal magnetism of Mesmer; and he drew up a very elegant report, which was presented to the academy of Sciences. This report, which was soon afterwards translated into English, not only marked the acuteness and discernment of the author, and contained the most satisfactory and decisive evidence with regard to its object, but it may be held up as an excellent model of imitation for those who are engaged in similar investigations. In developing the physical effects produced by moral causes, it is of the greatest value; and it is particularly interesting when we consider the political influence which causes of this nature have exerted on the general opinions of society, and even on the destiny of nations.

In 1787 he published, in one volume 4to, the *History of Indian and Oriental Astronomy;* a work of great erudition and ability, but in which he is thought to have made some erroneous calculations, and to have overrated the antiquity of the Indian observations.

Hitherto we have contemplated Bailly in the shades of retirement, and in the calm undisturbed retreats of philosophy, employing the energy of a vigorous and comprehensive mind in the profound researches of physical truth. We are now to follow him in his political career, and to behold him struggling with the adverse interests of factions, and contending with the unbridled fury of a lawless mob, in defence of the rights of a people whose minds were not prepared to understand, and whose habits were not yet formed to enjoy, the blessings of rational liberty. He was one of the first and most zealous promoters of the revolution in France; and in the part which he acted in this bloody struggle, he has had the good fortune to be well spoken of by opposite factions. He has never been charged with want of integrity or with selfish designs; but apparently actuated by a misguided zeal, and dazzled with the prospect of freedom which the warmth of his imagination held out, he rashly committed himself in a cause which, as he had espoused it with enthusiasm, so he supported it with his utmost exertions. But in that cause he fell a sacrifice to the unrelenting spirit of violence and faction which had been easily roused, but which it was found impossible either to subdue or to regulate. When the states-general of France were assembled in 1789, he was elected a deputy to the *tiers-état*, of which he was afterwards chosen president; and when the national assembly had been constituted, he continued in the chair, and officiated as president at the time the king's proclamation was issued ordering that body to disperse. During the struggle which took place between the national assembly and the court, Bailly was amongst the most forward in asserting those popular rights which were then new in France; and it was he who dictated the famous oath to the members of the *tiers-état*, by which they pledged themselves "to resist tyrants and tyranny, and never to separate till they had obtained a free constitution." On the 14th of July following, the day on which the Bastille was stormed and taken by the people, he was appointed mayor of Paris with universal consent. In this high office he is allowed to have acted with great integrity, courage, and moderation, and to have discharged its arduous and sometimes perilous duties in a manner highly honourable to his character. While he held this conspicuous situation, he was instrumental in promoting the various measures by which the popular party at length prevailed over that of the court; for which, as well as for his conduct in other respects, he obtained a high degree of favour among the people. But the tide of public opinion now swelled beyond all bounds; and no restraint could oppose its violent course. The multitude, newly unshackled from the fetters of despotism, greedy of novelty, fired with enthusiastic and unsettled notions of freedom, and daily panting for change, would brook no opposition. Bailly, who now perhaps saw when it was too late the general disposition of the people to anarchy, still wished the laws to be respected, and hoped by their vigorous execution to restore and maintain tranquillity. He ordered some deputies from the military insurgents of Nancy to be arrested, and firmly opposed the rash proceedings of Marat and Hebert; he became a member of a less promiscuous club than that of the Jacobins; and he exerted himself strongly to persuade the populace to permit the king and royal family to depart to St Cloud. By these measures, which were little relished by a fickle and infuriated people, he lost their confidence and favour But what finally destroyed his popularity, was his conduct on the occasion of the tumultuous meeting of the populace on the 17th of July 1791, to demand the abolition of monarchy; for being called by the national assembly to disperse the mob, who had assaulted the soldiery, he ordered

Bailly.

Bailment ‖ Bailly.

the latter to fire, by which means forty persons were killed and above a hundred wounded. Having thus become obnoxious to the people, whom he had faithfully served, he resigned his office at the dissolution of the constituent assembly in the end of the year 1791; and having resumed his philosophical researches, lived for some time in retirement. But the times of bloody proscription approached; and he was doomed to fall a sacrifice to the ferocious vengeance of the plebeian tyrant who now bore unlimited sway. He was accordingly denounced as an enemy to the republic, arrested, and thrown into prison. Arraigned before a sanguinary tribunal, he was summarily condemned to death as a conspirator, and executed the day following, near the spot where he had given the order for the military to fire on the people. On the day of execution, his sufferings, which he bore with the utmost calmness and magnanimity, were studiously protracted. He wore the red shirt, or badge of conspiracy, and was placed in a cart with his hands tied behind his back. During the whole time of his progress to the place of execution, the rain poured incessantly on his head. The populace, as he passed, threw mud at him, and cruelly insulted him with every kind of opprobrious language. Arrived at the place of execution, it was found necessary to remove the guillotine from the spot where it had first been erected, to firmer ground. During this time he was forced to get out of the cart, and walk round the field, in order to gratify more fully the implacable and unrelenting malice of the populace. While he was ascending the platform, a spectator who happened to be near him exclaimed, in a tone of insult, "Bailly, you tremble:" "Yes," he instantly replied, "but it is from cold."

Several works written by Bailly, and found in manuscript, have been published since his death; particularly an *Essay on Fables and their History*, and *Memoirs of a Witness of the Revolution*, which come down to October 1789.

In his person Bailly was tall, and of a sedate but striking countenance. He possessed great firmness and integrity of character, combined with many amiable qualities. In the time of his magistracy he spent part of his fortune in relieving the wants of the poor. His wife, whom he married in 1787, survived him. She was the widow of Raymond Gaye, who had been his intimate friend for twenty-five years.

BAILMENT, from the French *bailler*, to deliver, means, in law, a delivery of goods in trust upon a contract, expressed or implied, that the trust shall be faithfully executed on the part of the bailee or person to whom they are delivered, and the goods re-delivered as soon as the time or use for which they were bailed shall have elapsed or been performed. There is a valuable *Essay on the Law of Bailment* by Sir William Jones.

BAILY, Francis. The history of this gentleman affords a remarkable instance of that energy with which a man successfully engaged in a laborious mercantile occupation, can devote his leisure to abstruse mathematical investigations. Mr Baily was born in Berkshire in 1774, and for many years was a stockbroker in London. While amassing a large fortune by his business, he had applied his profound mathematical knowledge to the doctrine of probabilities, and published several interesting works on that subject; as, *Tables for the Purchasing and Renewing of Leases; The Doctrine of Interest and Annuities; The Doctrine of Annuities and Assurances*, &c. In 1820 he was one of the original and most active promoters of the Astronomical Society; and on his retirement from business in 1825, he entered with all the energy of youth, rather than that of a man between fifty and sixty, into the cultivation of astronomy and its kindred sciences. To Mr Baily we owe the present form and improvement of the *Nautical Almanac*; he took an active part in the investigation of the effects of the atmosphere on the nice experiments with the pendulum; he aided in the repetition of the famous experiments of Cavendish on the specific gravity of the earth; he superintended the publication of the Astronomical Society's catalogue of the fixed stars; and the revision of the annual catalogues in the 13th volume of the Society's *Memoirs* was entirely his work. Besides these labours, he took an active share in the physical labours of the British Association. It was on his recommendation that it undertook the republication of the *Histoire Céleste* of Lalande, combined with Lacaille's catalogue, which together contain no less than 57,000 stars; and there is reason to believe that the investigations concerning the course of the tidal wave in the Atlantic owe much of their value to this able philosopher. He also superintended the construction and printing of the tables of coefficients of reduction for the 10,000 stars in the Astronomical Society's catalogue; and he had undertaken to superintend the construction of the new metrical scale for government, on the destruction of the original by fire.

Bainbridge ‖ Baird.

In fact, Mr Baily effected, in the last twenty years of his very active and useful career, a greater number of complete and refined researches than most other philosophers have accomplished during a whole lifetime. He died Aug. 30, 1844. See Sixth Preliminary Dissertation, Art. 242.

BAINBRIDGE, Dr John, an eminent physician and astronomer, born at Ashby de la Zouche, in Leicestershire, in 1582. He taught a grammar school for some years, and practised physic, employing his leisure hours in astronomy, which was his favourite study; but at length, removing to London, he was admitted a fellow of the College of Physicians, and raised his character by his description of the comet in 1618. The next year Sir Henry Savile appointed Bainbridge his first professor of astronomy at Oxford; and the masters and fellows of Merton College made him first junior, and then superior, reader of Linacre's lecture. He died in 1643. His published works are, 1. *An Astronomical Description of the late Comet*, Lond. 1619. 2. *Procli Sphæra*, 1620. 3. *Canicularia; a Treatise concerning the Canicular Days*, Oxford 1648. Several of his unpublished writings exist in manuscript in the library of Trinity College, Dublin.

BAIOLENSIANS, or Bagnolensians, a sect of heretics in the twelfth century, who in reality were Manicheans, though they somewhat disguised their errors. They rejected the Old Testament and part of the New. They were a branch of the *Cathari*, and derived their appellation from Bagnolo in Provence.

BAIRAM, a Mahometan feast, instituted in imitation of the Easter of the Christian Church. It follows the Rhamadan, or month of fasting. The lesser Bairam follows sixty days after the first.

BAIRD, General Sir David, Bart., was born at Newbyth in Aberdeenshire, in December 1757. He entered the British army in 1773, and was sent to India with the 73d Highlanders in 1779. In the following year he had the misfortune to fall into the hands of Hyder Ali, in the Mysore chief's perfidious attack on a handful of British troops at Perambucum. The prisoners, it is well known, were most barbarously treated. Baird survived his captivity; and on his release, visited his native country, but returned to India in 1791, as a lieutenant-colonel.

When Harris marched against Tippoo Saib, Baird, now a major-general, served under him in that campaign; and when it was resolved to storm Seringapatam, he solicited and obtained the honour of leading the storming party to the breach. He made a daring assault, and was soon a victor in that stronghold in which he had long been a prisoner. He seems, however, not to have been in favour with the superior powers; for he was rather unceremoniously required to resign the place his valour had contributed to gain, to a junior officer, who had not been engaged in the assault; but he received the thanks of the British parliament and of the East India Company for his gallant bearing on that im-

portant day, and being more athirst for fame than emolument, he declined the pension offered to him on that occasion by the company.

General Baird commanded the Indian army that in 1801 was sent to co-operate with Hutchinson, in the expulsion of the French from Egypt. He landed at Kosseir, conducted his army to Kenéh on the Nile, and thence to Rosetta, where he arrived just as the French were treating for the evacuation of Alexandria. Baird returned to India in 1802, where he was employed against Scindia; but, irritated at some neglect he had experienced, he relinquished his command and returned to Europe.

In 1805 he commanded the expedition against the Cape of Good Hope, and captured Cape Town; but here again, his usual ill-luck attended him, for he was recalled before he had organized his conquest, for having sanctioned the expedition of Sir Home Popham against Buenos Ayres. He served again in 1807 in the expedition against Copenhagen, and in the following year commanded the considerable force which was sent to Spain to co-operate with Sir John Moore. In the battle of Coruña, a grape-shot shattered his left arm, so as to require amputation at the shoulder-joint; and he was again thanked by the parliament of his country for his gallant services, and at last obtained the decoration of the order of the Bath, and the rank of a baronet.

Sir David married Miss Campbell Preston, a Perthshire heiress, in 1810. In 1820 he was appointed commander-in-chief in Ireland; but the same influence which had thwarted him in India, again was exerted against him, and he was removed in 1821. From that period he no more appeared in public life; and he died on the 18th August 1829. (T. S. T.)

BAIREUTH, or BAYREUTH, capital of the circle of Upper Franconia, in Bavaria, is pleasantly situated in a valley on the left bank of the Red Maine, 40 miles N.N.E. of Nuremberg. It is well built, with broad, regular, and well-paved streets; and is partially surrounded by old walls. The river is here crossed by two bridges. Among its public buildings are the modern castle, the opera-house, one of the finest in Germany, gymnasium founded in 1664, bank, riding school, and barracks. It has also five churches, a handsome synagogue, public library, theatre, hospital, an orphan and a lunatic asylum. In 1841, a monument was erected here to the poet Jean Paul Richter, who died here in 1825. Baireuth has an active trade, chiefly in grain; and manufactories of woollen and cotton goods, leather, delft, and other earthenware, and tobacco. It has also several breweries and distilleries. About half a league distant is the suburb of St George, noted for its marble works; and about two miles to the E. is the Hermitage, a fanciful building, erected in the early part of the last century, with gardens containing terraces, statues, and fountains. Pop. in 1849, 14,145.

Baireuth was formerly the capital of a principality of the same name, which, on the death of the last margrave without issue in 1791, was annexed to the kingdom of Prussia. In 1807, it was ceded by Prussia to France, which kept possession of it till 1810, when it was transferred to Bavaria.

BAIROUT. See BEYROUT.

BAITING (Saxon, *bate, contention*), the act of attacking and harassing greater and stronger animals by smaller or weaker ones, as bulls or bears by mastiffs or bull-dogs.

BAIZE, a coarse woollen stuff, in texture resembling flannel.

BAJAZET I., sultan of the Turks, commenced to reign in 1389, and died in 1403. See TURKEY, and CONSTANTINOPOLITAN HISTORY. The authority of the celebrated story of the iron cage, in which this monarch was said to have been carried about by his conqueror Timour, is considerably weakened by the silence of the Persian historian Shereffedin Ali. On the evidence on both sides of the question, see Gibbon.

BAJAZET II., son of Mahomet II., succeeded his father in 1481, and died in 1512. See TURKEY.

BAJULUS, an ancient officer in the court of the Greek emperors. There were several degrees of bajuli; as, the grand bajulus, who was preceptor to the emperor; and the simple bajuli, who were sub-preceptors. The word is derived from the Latin verb *bajulare*, to carry or bear a thing in the arms or on the shoulders; *bajulus* and *gerulus* being the names applied to those who performed this office for the children of the great; whence the subsequent figurative use of the term. The word passed in the same sense into Greece.

BAKER, a person whose occupation or business it is to bake bread. There is considerable doubt as to the time when baking first became a particular profession, and bakers were introduced. It is, however, generally agreed that they had their rise in the East, and passed from Greece to Italy about the year B.C. 173. Till that time every housewife was her own baker; for the word *pistor*, which we find in Roman authors before this period, signified, as Varro justly observes, a person who ground or pounded the grain in a mill or mortar to prepare it for baking. According to Athenæus, the Cappadocians were the most approved bakers; after them the Lydians; and then the Phœnicians. To the foreign bakers brought into Rome were added a number of freedmen, who were incorporated into a body, or, as they termed it, a college; from which neither they nor their children were ever allowed to withdraw. They held their effects in common, and could not dispose of any part of them. Every bakehouse had a *patronus* intrusted with the superintendence of it; and these patroni again elected one of their number every year, who had superintendence over all the rest, and the care of the college. Out of the body of the bakers one was every now and then admitted among the senators; and, to preserve honour and honesty in the college, they were expressly prohibited all alliance with comedians and gladiators. Every one had his own shop or bakehouse, and they were distributed into fourteen regions or wards of the city. They were excused from guardianships and other offices which might divert them from their employment. By British statutes bakers are declared not to be handicraftsmen. No man for using the mysteries or sciences of baking, brewing, surgery, or writing, shall be interpreted a handicraftsman. The bakers were a brotherhood in England before the year 1155, in the reign of King Henry II., although the white bakers were not incorporated till 1407, and the brown bakers not till 1621. The French had anciently a great baker, *grand panetier de France*, who had the superintendence of all the bakers of Paris.

BAKER, *Henry*, an ingenious and diligent naturalist, was born in Fleet Street, London, either near the end of the seventeenth, or very early in the beginning of the eighteenth century. His father's profession is not known, but his mother was in her time a midwife of great practice. He was brought up under an eminent bookseller, who preceded the elder Dodsley, to the business of a bookseller; in which, however, he appears not to have engaged at all after his apprenticeship, or if he did, it was soon relinquished by him; for although it was in his power to have drawn away many of his master's customers, he would not set up against him. Mr Baker being of a philosophical turn of mind, and having diligently attended to the methods which might be practicable and useful in the cure of stammering, especially in teaching deaf and dumb persons to speak, made this the employment of his life. In the prosecution of so valuable and difficult an undertaking he was very successful, and several of his pupils have borne testimony to the ability and good effect of his instructions. He married Sophia, youngest daughter of the famous Daniel Defoe, who brought him two sons, both of whom he survived. On the 29th of January 1740 Mr Baker was elected a fellow of the Society of Antiquaries, and on the 12th of March following the same honour was conferred upon him by the Royal Society. In 1744 Sir Godfrey Copley's gold medal was bestowed upon

Baker. him, for having, by his microscopical experiments on the crystallizations and configuration of saline particles, produced the most extraordinary discovery during that year. Having led a very useful and honourable life, he died at his apartments in the Strand on the 25th of November 1774, being then above seventy years of age. Several of Mr Baker's communications are printed in the *Philosophical Transactions;* and he was the means, by his extensive correspondence, of conveying to the society much useful intelligence. He was one of the earliest members of the Society for the Encouragement of Arts, Manufactures, and Commerce, and contributed in no small degree to its rise and establishment. His principal publications are, *The Microscope made Easy*, and *Employment for the Microscope*. The first of these was published in 1742 or 1743. The second edition of the other appeared in 1764. These treatises, especially the latter, contain the most curious and important of the observations and experiments which Mr Baker either laid before the Royal Society or published separately. His memory is perpetuated by the Bakerian Lecture of the Royal Society, for the foundation of which he left by will the sum of L.100.

BAKER, *Sir Richard*, author of the *Chronicle of the Kings of England*, was born at Sissingherst, in Kent, about the year 1568. After going through the usual course at Hart Hall, Oxford, he travelled abroad. Upon his return he took his degree as master of arts, and in 1603 received the honour of knighthood. In 1620 he was made high sheriff of Oxfordshire: but having engaged to pay some debts of his wife's family, he was reduced to poverty, and obliged to betake himself for shelter to the Fleet prison, where he died, February 18. 1645. During his confinement, he composed numerous works, historical, poetical, and miscellaneous. Amongst these are Meditations and Disquisitions on the Lord's Prayer; Meditations, &c., on several of the Psalms of David; Meditations and Prayers upon the Seven Days of the Week; *Cato Variegatus*, or Cato's Moral Distichs; *Theatrus Triumphans*, or *Theatrus Redivivus*, being a reply to Prynne's *Histriomastix*, &c. His principal work, the *Chronicle of the Kings of England*, long maintained its reputation among the less critical class of readers, but is now in little esteem. The author seems to have been sometimes more studious to please than to inform, and with that view to have sacrificed even chronology itself to method. In 1658, Edward Philips, nephew to Milton, published a third edition of this work, with the addition of the reign of Charles I. Sir Richard also translated several works from the French and Italian.

BAKER, *Thomas*, an eminent mathematician, was born at Ilton in Somersetshire about the year 1625, and entered at Magdalen Hall, Oxford, in 1640. He became vicar of Bishop's-Nymmet, in Devonshire, where he wrote *The Geometrical Key, or the Gate of Equations unlocked*, London, 1684. He died at Bishop's-Nymmet on the 5th of June 1690.

BAKER, *Thomas*, a very ingenious and learned antiquary, descended from an ancient family distinguished by its loyalty, was born at Crook in 1656. He was educated at the free school at Durham, and thence removed, in 1674, to St John's College, Cambridge, where he took his degree of A.M. in 1681, and afterwards was elected fellow. Lord Crew, bishop of Durham, collated him to the rectory of Long-Newton in his diocese, in 1687; and further intended to give him that of Sedgefield, with a golden prebend, had he not incurred his lordship's displeasure for refusing to read King James II.'s declaration for liberty of conscience. The bishop, who disgraced him for this refusal, and was excepted out of King William's pardon, took the oaths to that king, and kept his bishopric till his death. Baker resigned Long-Newton on the 1st of August 1690, refusing to take the oaths; and retired to St John's, in which he was protected till the 20th of January 1716–17, when he, with one-and-twenty others, was deprived of his fellowship. After the passing of the Registering Act in 1723, he was desired to register his annuity of L.40, which the last act required before it was amended and explained. Though this annuity, left him by his father for his fortune, with L.20 per annum out of his collieries by his elder brother, was now his whole subsistence, he could not be prevailed on to secure himself against the act. He retained a lively resentment of his deprivations; and wrote himself in all his books, as well as in those which he gave to the college library, *socius ejectus*, and in some *rector ejectus*. He continued to reside in the college as commoner-master till his death, which happened on the 2d of July 1740, in consequence of a paralytic stroke.

Baker || Bakewell.

Having been appointed one of the executors of his elder brother's will, by which a large sum was bequeathed to pious uses, he prevailed on the other two executors, who were his younger brother Francis and the Hon. Charles Montagu, to lay out L.1310 of the money upon an estate to be settled upon St John's College for six exhibitioners. He likewise gave to the college L.100 for the consideration of L.6 a-year, then only legal interest, during his life; and to the library several choice books, both printed and in manuscript, with medals and coins; besides what he left to it by his will viz. "all such books, printed and manuscript, as he had, and were wanting there." All that he ever published were, *Reflections on Learning, showing the Insufficiency thereof in its several particulars, in order to evince the usefulness and necessity of Revelation*, Lond. 1709–10; and the preface to Bishop Fisher's *Funeral Sermon for Margaret Countess of Richmond and Derby*, 1708; both without his name. His manuscript collections relative to the history and antiquities of the university of Cambridge, amounting to forty-nine volumes in folio and three in quarto, are divided between the British Museum and the public library at Cambridge: the former possesses twenty-three volumes, the latter sixteen in folio and three in quarto. Dr Knight styles him "the greatest master of the antiquities of this our university;" and Hearne says, "Optandum est ut sua quoque collectanea de antiquitatibus Cantabrigiensibus juris faciat publici Cl. Bakerus, quippe qui eruditione summa judicioque acri et subacto polleat." He had intended something like an *Athenæ Cantabrigienses*, on the plan of the *Athenæ Oxonienses*. The life of Baker has been written by Robert Martin, 8vo, 1784; and by Horace Walpole, in the quarto edition of his works.

BAKEWELL, ROBERT, a distinguished agriculturist and improver of live stock, was born at Dishley, in Leicestershire, in 1725 or 1726, and died there in October 1795. His attention was more particularly devoted to the improvement of the race of sheep known as the Dishley or New Leicestershire breed; in which he was so successful that some of his rams were let for the season at the extraordinary sum of four hundred guineas. The improvements he introduced in the breeding of live stock generally were such as to secure him a high rank among the benefactors of British husbandry.

BAKEWELL, a market-town in Derbyshire, on the River Wye, 152 miles from London. The church is a fine old structure, in the form of a cross. The inhabitants are supported by the working of the coal, lead, and zinc mines, and the stone and marble quarries in the neighbourhood. There is also a large cotton manufactory in the town. Bakewell is remarkable for its excellent trout-fishing, and for a chalybeate spring, frequented by invalids. It has a free school of very ancient date, a dispensary, and a literary and scientific institution, &c. Pop. in 1851, 2217.

BAKING.

Baking. BAKING properly means to heat anything in an oven or fire so as to harden it; and in this sense it is used when applied to the manufacture of bread, porcelain, pottery, bricks, &c. It is also used as synonymous with the words *cook* and *dress*, as when applied to baked meats, pies, &c. In the present article the baking of flour into bread will alone be treated of.

History of the art. Like most of the arts of primary importance, its origin precedes the period of history, and is involved in the obscurity of the early ages of the world. There is no evidence from Scripture that Abraham was acquainted with the method of making loaf-bread. Cakes and unleavened bread are repeatedly mentioned as made by him, but no notice is taken of loaf-bread. We are certain that it was known in the time of Moses, as in the Jewish law there is a prohibition against making use of it during the celebration of the passover. (Exodus, chap. xii. verse 15.) Egypt, both from the nature of the country and the early period of its civilization, seems very probably to have been the place where this art was first practised. The Chaldeans, however, put in a claim. They were civilized nearly as early as the Egyptians, and they were celebrated among the ancients for the excellence of their bread. The Greeks assure us that they were taught the art of making bread by the god Pan. This lively and superstitious people ascribed almost all the important arts of common life to their gods; or rather, perhaps, their gratitude induced them to deify the authors of these most useful inventions. Bakers first settled in Rome during the war with Perseus, king of Macedon. (Plinii *Hist. Nat.* xviii. 11.) It was then that the Romans became acquainted with the refinements of the Greeks, and that their capital became crowded with adventurers of all kinds, with artists and philosophers, from the prolific soil of Achaia. Before this period the Romans were often distinguished or reproached by the appellation of the *pulse-eating nation.*

Since the introduction of bakers into Rome. the art of making bread has always been practised in the south of Europe. But it made its way into the north very slowly; and even at present, in the northern countries of Europe and Asia, loaf-bread is seldom used except by the higher classes of inhabitants. In Sweden, for example, you see rolls frequently in the towns, but never loaves. Göttenburg is a town containing about 23,000 inhabitants. In the year 1812 it was crowded with merchants from all parts of Europe, being the great connecting link between Britain and the Continent. Towards the end of that year the captain of an English packet ordered a Göttenburg baker to bake for him a quantity of bread, amounting to L.1 sterling in value. The baker was confounded at so great an order, and refused to comply till the captain gave him security that he would carry off and pay for the loaves, declaring that he could never dispose of so great a quantity of bread in Göttenburg if it were left upon his hands. In the country part of Sweden no bread is made but rye-cakes, as hard nearly as flint, and which are only baked twice a year. About eighty years ago loaf-bread was almost as rare in the country places and villages of Scotland, *barley bannocks* and *oaten cakes* constituting the universal substitutes among almost all ranks. But the case is much otherwise now.

In many parts of England it is the custom for private families to bake their own bread. This is particularly the case in Kent, and in some parts of Lancashire. In the year 1804 the town of Manchester, with a population of 90,000 persons, did not contain a single public baker.

Unfermented Bread. Bread consists of two kinds, fermented and unfermented. Unfermented bread consists of the flour of various kinds of grains or pulse, formed by means of water into a thick paste or doughy mass, and then fired either in a regular oven, or a hot iron plate, or by being put into a hole heated by fuel of some kind, where it is covered over with the ashes till thoroughly cooked. When the firing is carried so far as to dry and harden this kind of unfermented bread, it receives the name of biscuit (from the French words meaning *twice fired*): when less thoroughly baked the bread forms a heavy rather solid loaf or cake, which receives the various names of cake, bannock, scone, damper, &c., and is the form of bread used most generally over the world. Baking.

Almost every kind of edible grain is used in baking unfermented bread. In the warmer regions of the globe, and in the torrid zone, maize and rice take the place of most other grains, and perhaps a larger portion of the human race feed on these two grains than on all the rest put together. In northern latitudes again, rye, barley, and oats are the chief grains used as human food. But in all the temperate zones wheat is the chief and most valuable of the grains. In various countries, but to a comparatively small extent, flour of pease, beans, lentils, millet, guinea corn or dhurra, &c., are used to form their unfermented bread.

Unfermented bread possesses this great advantage over fermented bread, that when well fired, and so dried as to have assumed the form of biscuit, it will keep unchanged for a very long period of time. Hence its value as ship stores, seeing that on board ship there is not the convenience for baking loaf-bread daily for such a large number of men.

Manufacture of Navy Biscuits. At the victualling departments of our navy yards, almost all the biscuits for ship stores are now manufactured with the aid of machinery. The application of machinery to this department gives immense advantages over the old system of baking biscuits by hand labour, in addition to doing the whole work much better, making superior biscuits, and saving fully two-thirds on wages alone. Thus it is calculated that at the baking establishments at Deptford, Gosport, and Plymouth. from seven to eight thousand tons of biscuits could be annually produced, at a saving of L.12,000 from the cost under the system of hand manufacture. Biscuits for the navy are manufactured only of the best wheaten flour, but experience has fully demonstrated that the health of the seamen is much better preserved by the flour having a certain admixture of bran in it, than when the whole bran is thoroughly removed. The following account of the manufacture of biscuits for the navy at the Royal Clarence Victualling Establishment at Weevil, near Portsmouth, from the *United Service Journal*, will be read with interest.

"It having been discovered that the flour supplied to government by contract, had in some instances been most shamefully adulterated, the corn is ground at mills comprised within the establishment, by which means the introduction of improper ingredients is prevented, and precisely the proportion of bran which is requisite in the composition of good sea biscuit is retained, and no more. The flour mill is furnished with ten pairs of stones, by which forty bushels of flour may be ground and dressed ready for baking in an hour. The baking establishment consists of 9 ovens, each 13 feet long by 11 feet wide, and 17½ inches in height. These are each heated by separate furnaces, so constructed that a blast of hot air and fire sweeps through them, and gives to the interior the requisite dose of heat in an incredible short space of time. The first operation in making the biscuits consists in mixing the flour, or rather meal and water; 13 gallons of water are first introduced into a trough, and then a sack of meal weighing 280 lb. When the whole has been poured in by a channel communicating with an upper room, a bell rings, and the trough is closed. An apparatus, consisting of two sets of what are called knives, each set ten in number, are then made to revolve

Baking. among the flour and water by means of machinery. This mixing operation lasts one minute and a half, during which time the double set of knives or stirrers makes twenty-six revolutions. The next process is to cast the lumps of dough under what are called the breaking rollers,—huge cylinders of iron, weighing 14 cwt. each, and moved horizontally by the machinery along stout tables. The dough is thus formed into large rude masses 6 feet long by 3 feet broad, and several inches thick. At this stage of the business the kneading is still very imperfect, and traces of dry flour may still be detected. These great masses of dough are now drawn out, and cut into a number of smaller masses about a foot and a half long by a foot wide, and again thrust under the rollers, which is repeated until the mixture is so complete that not the slightest trace of any inequality is discoverable in any part of the mass. It should have been stated that two workmen stand one at each side of the rollers, and as the dough is flattened out they fold it up, or double up one part upon another, so that the roller at its next passage squeezes these parts together, and forces them to mix. The dough is next cut into small portions, and being placed upon large flat boards, is, by the agency of machinery, conveyed from the centre to the extremity of the baking room. Here it is received by a workman who places it under what is called the sheet roller, but which for size, colour, and thickness, more nearly resembles a blanket. The kneading is thus complete, and the dough only requires to be cut into biscuits before it is committed to the oven. The cutting is effected by what is called the cutting-plate, consisting of a net-work of fifty-two sharp-edged hexagonal frames, each as large as a biscuit. This frame is moved slowly up and down by machinery, and the workman, watching his opportunity, slides under it the above described blanket of dough, which is about the size of a leaf of a dining-table; and the cutting frame, in its descent, indents the sheet, but does not actually cut it through, but leaves sufficient substance to enable the workman at the mouth of the oven to jerk the whole mass of biscuits unbroken into it. The dough is prevented sticking to the cutting-frame by the following ingenious device: between each of the cutter-frames is a small flat open frame, moveable up and down, and loaded with an iron ball weighing several ounces. When the great frame comes down upon the dough, and cuts out fifty-two biscuits, each of these minor frames yields to the pressure and is raised up; but as soon as the great frame rises, the weight of the balls, acting on the little frames, thrusts the whole blanket off and allows the workmen to pull it out." Each biscuit is stamped with the government mark, and the number of the oven, as well as punctured with holes, by the same movement which cuts out the piece of dough. One quarter of an hour is sufficient to bake the biscuit; they are then withdrawn from the oven, broken asunder by the hand, and placed for three days in a drying-room heated to 85° or 90°. Dr Ure mentions that it was found, on experiment at the above-mentioned baking establishment, that in 116 days, during 68 of which the work was continued for only 7½ hours; and during 48 days for only 5¾ hours each day, in all 769 working hours, 12,307 cwt., or 1,378,400 lb. of biscuits were produced from the nine ovens. The wages of the men employed amounted to L.273, 10s. 9½d.; whereas, if the same quantity had been made by hand labour, the wages alone would have amounted to L.933, 9s. 10d.; showing a saving during that time, in the matter of wages alone, to the extent of L.659, 7s. 0½d.

Fermented Bread. Fermented or loaf bread differs from unfermented bread in being light and spongy, in being full of small cavities, in having a more agreeable taste, and in being more easily chewed and digested. Fermented bread can only be made from flour which contains the substance called gluten as one of its ingredients, and wheat is the only grain which contains it in sufficient abundance to form a light and spongy bread. Rye, which next to wheat contains the greatest quantity of gluten, is also capable of being formed into a fermented bread, but very inferior in lightness and sponginess to that made from wheat flour. Gluten is the viscid substance which is left in the mouth when wheat is long chewed, and may more easily be procured by forming flour into dough with water, putting this into a muslin bag, and washing and kneading it till all the starch is washed out: the glutinous matter left in the bag is the impure gluten. The finer the wheat the larger is the proportion of this matter, and consequently the better fitted for making loaf-bread. It is this viscid substance which gives wheaten flour, when made into dough, that superior tenacity which enables it to be raised by fermentation. Wheat, besides gluten, contains starch, sugar, gum, also small quantities of albumen, caseine, and fatty matter or oil. The following table shows the relative quantities of the constituent parts of wheat flours, as ascertained by Vauquelin in 100 parts of flour. Baking.

Species of Wheat Flour.	Water.	Gluten.	Starch.	Sugar.	Gum.	Bran.
Raw wheat of Odessa flour, *Vauquelin*.....	12·0	14·55	56·50	8·48	4·00	2·3
Soft wheat of Odessa flour, *V*.....	10·0	12·00	62·00	7·56	5·80	1·2
French wheat flour, *V*....	10·0	10·96	71·49	4·72	3·32	...
Wheat of Paris hospitals (second quality..	8·0	10·30	71·20	4·80	3·60	...

Sir Humphry Davy and others have estimated the quantity of gluten in wheat flour so high as from 19 to 24 per cent. But this probably resulted from their not drying the gluten thoroughly, or freeing it sufficiently from foreign ingredients. Professor Johnston, from numerous experiments carefully conducted in his laboratory, states, "we may safely, I think, conclude from these, that English flour seldom contains more than 10 per cent. of dry gluten;" and he gives a long table of the results actually obtained in proof of his statement. (*Agric. Chemistry*, p. 871.)

When wheat is ground it is sifted so as to separate the bran, which consists of the coarse outer skin of the grain, and the parts of the grain which are more or less imperfectly or coarsely ground. Professor Johnston states, that taking as an example three lots of good wheat ground at Mr Robson's mills, Durham, the yield of the different products was respectively, per 100 parts of the wheat:—

	1st Lot.	2d Lot.	3d Lot.
Fine flour	74·2	75·1	77·9
Boxings, or coarser flour.....	9·0	8·3	6·1
Sharps or pollard.....	5·8	6·6	5·6
Bran	7·8	7·0	6·9
Waste	3·2	3·0	3·5
	100·0	100·0	100·0

From Mr John R. Tait, mill-owner and baker in Edinburgh, we have received the following as the average yield of good wheat flour, the whole being copied from one of his actual mill receipts for May 1853. Thirty-two Scotch bolls, or 16 quarters of wheat, at the average weight of 63¾ lb. per bushel—weighing in all 578 st. 11 lb.—yielded of

	St.	Lb.
Fine flour	414	0
Odd and second flour	23	13
Parings (sharps and pollard)	36	12
Bran and shellings	92	0
Waste	11	0
Total,	578	11

According to the purpose for which the flour is required, the second flour is sometimes not separated; in which case the 578 st. 11 lb. of wheat would yield 437 st. 13 lb. of flour, the other ingredients remaining the same; and Mr Tait's mill receipts are so uniform for a series of years, that the above may be taken as the average production of

Baking.

flour from the best wheat sold in the Edinburgh and Lithgow markets.

Use of Leaven.

When wheat flour is made into a dough by means of water, and is kept in a warm place, a spontaneous fermentation occurs among its particles, causing it to swell up. This, for distinction's sake, has been called the *panary* fermentation. This fermentation goes on at the expense of the sugar and starch in the flour, a portion of the carbon and oxygen of these principles combining in the proportions to form carbonic acid gas. As the escape of this gas is prevented by the tough or viscid gluten in the dough, the whole mass is swelled by the formation of numerous vesicular cavities, which are filled with this gas, and which are very apparent in the bread when baked. Dough, when thus naturally fermented, requires not only much time, but possesses the additional disadvantage of having contracted an acidity and a putrescent flavour, both of which seriously injure the quality of the bread. This used to be got the better of by using this self-fermented mass as leaven only, adding a comparatively small piece of it to a large mass of fresh-made dough. This leaven rapidly excited the fermentive process in the whole of the new mass, and the whole mass was then said to be leavened.

Yeast.

This was, however, a clumsy way of exciting the panary fermentation in large masses of dough; and it was soon discovered that the addition of yeast or barm, *i. e.* the frothy scum which rises to the surface of beer when it is undergoing fermentation, was a much more speedy mode of accomplishing the same end. At first all the yeast used was obtained from the brewers; but now, in almost every large town, yeast or barm breweries exist, where a wort from pure malt is fermented alone, for the sole purpose of supplying the bakers with yeast for baking.

Pliny informs us that yeast in his time was employed in Spain and Gaul as a *ferment* of bread. *Galliæ et Hispaniæ frumento in potum resoluto, quibus diximus generibus, spuma ita concreta pro fermento utuntur. Qua de causa levior illis quam cæteris panis est.* (*Hist. Nat.* lib. xviii. c. 7.) From this passage we see that the Romans employed leaven to raise their bread, but that they were sensible of the superiority of yeast. Leaven, however, made its way both into France and Spain, and was universally employed in the manufacture of bread till towards the end of the seventeenth century, when the bakers of Paris began to import yeast from Flanders, and to employ it pretty generally as a substitute for leaven. We have here a striking instance of the blindness and obstinacy of the learned and the powerful, and the readiness with which they are disposed to arm themselves against all alterations and improvements. The bread by this substitution was manifestly improved, both in appearance and in flavour. This variation excited attention; the cause was discovered; the faculty of medicine in Paris declared it prejudicial to the health; the French government interfered; and the bakers were prohibited, under a severe penalty, from employing yeast in the manufacture of bread.

But it is in vain for governments, colleges, and universities, to oppose themselves to those improvements which take place in the arts and manufactures essential to civilized society. The ingenuity and perseverance of self-interest is proof against prohibitions, and contrives to elude the vigilance of the most active government. The laws of Queen Elizabeth, however tyrannical and absurd, did not prevent the introduction of indigo as a dye-stuff into England. Neither did the authority of Louis the Fourteenth, nor the decision of the physicians, deter the Parisian bakers from persisting in their improved mode of making bread. The yeast in Flanders was put into sacks; the moisture was allowed to drop out; and in this comparatively dry state it was carried to the capital of France.

Baking.

The superiority of yeast bread became gradually visible to all; the decisions of the medical faculty were forgotten; and the prohibition laws were allowed tacitly to sink into oblivion. The new mode of baking by degrees extended itself to other countries, and is now, we believe, practised everywhere. In warm climates, where the yeast of beer cannot be had, other substitutes are employed, which answer the same purpose.

Nature of panary fermentation.

It was formerly much disputed whether the panary fermentation was the same as, or different from, the vinous. But the researches of Dr Colquhoun, Mr Graham, and others, have settled the question by showing that it is neither more nor less than true vinous fermentation; and the fact may be easily shown by inclosing the loaf when baking in a close oven, and condensing the vapour which escapes from it, when alcohol is obtained. If, however, the dough be allowed to sour before being subjected to the heat, no alcohol is obtained, because the next stage of the vinous fermentation has been gone through, namely, the acetous, when all the alcohol assumes the form of the acetic or lactic acids. Following out these researches, it was found that the fermentation was mainly dependent on the saccharine matter in the wheat, aided by the conversion of a portion of the starch into sugar, as happens in the well-known process of malting.

Mixing of ingredients

When the baker prepares his dough for a batch, according to circumstances he either mixes the whole ingredients together at once—called setting the whole sponge,—or else he only mixes a quarter of the ingredients at one time,—called setting quarter-sponge. The quantity of ingredients used in setting a sponge varies according to the sale of the bread; but for a bag of good wheat, weighing 280 lb., about 15 gallons of water, of about the temperature of 90°, 5 lb. of salt, and 1½ pint of yeast are employed. In Edinburgh it has been found, by numerous experiments conducted on the large scale by the best bakers, whose bread is unequalled for quality, that the best bread is produced by setting the whole sponge at once. In London, and most towns where much of the bread sold is very inferior, the custom is to mix at first only a fourth of the flour which is intended to be employed, adding only half a pint of yeast and the requisite proportion of salt. This is called setting quarter-sponge. In this case some dry flour is thrown over the top of the mass, and cloths are thrown over the barrel in which the mixture is made. It is then left for three hours. By this time active fermentation has been excited in the whole mass, which has swollen up, burst, and collapsed two or three times. An additional quarter of flour, and its proportion of salt and water, are then added to the mass, the whole intimately mixed and left for about five hours. This is termed setting half-sponge. After this period the other half of the flour, with its relative proportions of salt and water, are added, the whole mixed intimately for about an hour; and this is termed setting whole sponge; after which the dough is laid in the baking-trough and covered up for about four hours.

Setting the whole sponge the best method.

As above mentioned, the best Edinburgh bakers greatly prefer setting the whole sponge at once; and the knowledge of the chemical nature of the changes which the flour undergoes during the fermentation, quite bears out the practical conclusion that such should not only produce better bread than by setting quarter-sponge, but also that the produce of loaves from the bag of flour should be greater. By the plan of setting quarter-sponge, a portion of the flour is kept in a state of fermentation for a much longer period than by the whole-sponge process; the natural consequence of which is, that a much larger quantity of the sugar and starch in the flour is decomposed, and the whole mass has a greater tendency to pass into the next stage of fermentation—the acetous fermentation. The bread prepared by the quarter-sponge

process is therefore not only diminished in quantity, but also sooner gets sour than when the whole sponge is set at once; and instead of a bag of flour yielding from 96 to 100 loaves, each 4 lb. in weight, which it does by the whole-sponge process, the number of loaves rarely if ever exceeds 94. As a general rule it takes 3 lb. of good flour to make a well-fired loaf weighing 4 lb.

When the dough is sufficiently fermented it is well kneaded, and is then weighed out into masses weighing 4½ lb. each. During the firing this half-pound is nearly dissipated, so that when the loaf comes from the oven it weighs somewhat more than 4 lb., and when well and properly fired will not fall below that weight for 24 or 36 hours. Many London and second-rate bakers, in order to make more loaves out of a bag of flour, and yet keep up the weight of the loaf, under-fire their bread, and when it is removed from the oven, place it in a close place, and cover it over with thick cloths till it cools. This greatly deteriorates the bread, rendering it heavy, more indigestible, and prone to turn acid and mouldy. The first-rate Edinburgh bakers, who fire their bread so much more thoroughly, expose the loaves freely to the air when removed from the oven, by placing them in open shelves, and do all in their power to prevent the vapour rising from the warm bread condensing on the loaves themselves. It seems to be mainly attention to these points, viz. setting at once the whole sponge, thorough firing, and free exposure of the bread to the air during its cooling, that the great superiority of the Edinburgh bread is to be attributed. But it may be remarked that no subsequent attention will make up for the want of good flour.

Importance of thorough firing and exposure to air.

In London, where so much bad bread is made, and inferior flour is used, it is not unusual to add alum, in proportions varying from one ounce to six or eight ounces to the bag of flour: the more inferior the flour, the larger is the quantity of alum used. This addition is supposed to render the bread firmer and whiter, and it certainly appears to have such an effect on the inferior flours; and, as in London bread is valued according to its whiteness, the Londoners are content to eat an inferior and not so wholesome bread in order to please the eye. Potatoes and several other articles are used to adulterate the flour from which bread is prepared, but it is unnecessary to particularize these, as every addition to wheaten flour only deteriorates the bread baked from it. See ADULTERATION, and FOOD.

Use of alum.

An important desideratum has long been felt, viz. an easy mode of ascertaining the relative goodness of bread. The comfort and health of so many are dependent on the purity and goodness of the bread they use, that it is astonishing so few attempts have been made to find a test easy of application for this purpose. One of the most intelligent of the bakers in Edinburgh mentioned to us one test he has been in the habit of using for twenty years past with uniform success. Well-fired bread, made of good and pure wheat flour, is dry, light, and spongy. Bread made of inferior flour, or to which has been added rye, barley, potatoes, potato starch, alum, &c., or bread under-fired, or sweated, or acid, is heavier, damper, and less spongy. The test is: cut from the two loaves pieces of equal size, and put them in saucers having each the same quantity of water, the best bread will invariably absorb the most water. The same may be more accurately done by cutting the pieces of bread of equal weight, placing each in water till thoroughly saturated, and weighing each piece again. Invariably the best bread will be found to have absorbed the largest quantity of water and to weigh the heaviest.

Testing of bread.

Baking || Baku.

The varieties of bread baked in this country are endless, and it would only be waste of space to mention them here. It may merely be mentioned, that when the bread is desired to be especially light and porous the dough is fired in deep iron pans, which, by preventing the escape of carbonic acid gas from the sides of the loaf, causes the whole loaf to swell up more, and produces a greater amount of sponginess. Bread thus baked is termed *pan* or *pan-soled* bread.

With many invalids even the best fermented or leavened bread disagrees, and it has been the aim of many bakers to produce a light and spongy bread by the disengagement of carbonic acid gas or other vapour in the mass of dough, during the firing, without the use of yeast or leaven. For this purpose carbonate of ammonia has been and is extensively used; and, as this substance is totally volatilized by the heat of the oven, it imparts neither smell nor taste to the bread, yet, by assuming the gaseous form in the dough, causes it to swell out, thus rendering it light and spongy, and consequently easily digestible. With the same end in view muriatic acid (spirit of salt) and carbonate of soda, in the proper proportions for forming table salt, have been used with perfect success. Others again have used with the same view carbonate of soda and tartaric acid, in the proper proportions to neutralize each other; and it is by one of these three processes that most of the light spongy unfermented bread now sold is prepared. Whenever acid of any kind is used for this end, it ought always to be used in the exact proportion to neutralize the soda used; if the soda be in excess, the bread assumes a yellowish discoloured hue; if the acid be in excess, the bread is unpleasant to eat. We have often baked very pleasant bread by using 600 grains carbonate of soda and six drachms muriatic acid to 8 lb. of flour. Some however use a half more of the soda and acid to the same quantity of flour. When from oversight, or from the panary fermentation having gone on too rapidly, the dough has become sour, the acidity may be checked, and the bread rendered wholesome, by the addition of a small quantity of carbonate of soda or of magnesia. (J. S—K.)

Varieties of unleavened bread.

BAKU, or BADKU, a town, with an adjoining district of the same name, in the Russian province of Daghestan. Badku is the most spacious and convenient port in the Caspian. It stands in the peninsula of Apsheron, in Long. 49. 40. E. Lat. 40. 22. N. It is a place of considerable trade, and is defended by a double wall and ditch, constructed during the reign of Peter the Great. The town, which is situated on a declivity, is of an obtuse-triangular form, and was a celebrated resort of the ancient worshippers of fire. Before the conquest of the Saracens it was annually visited by thousands of pilgrims, and is still visited by a few Persian fire-worshippers. In the adjacent district a great quantity of excellent cotton is produced, which is exported from Badku; together with fruit, opium, rice, silk, wine, rock-salt, and naphtha. Cloths, dye-stuffs, iron, linen, and silk stuffs, are imported from Astracan, with which place its principal trade is carried on. In the plain nine miles north of the city, enormous quantities of naphtha are produced. It is drawn from wells, some of which yield from 1000 to 1500 lb. in a day; and the district, in dry weather, has often afforded as much as 5600 lb. in one day. The naphtha consists of two kinds, the impure or black, containing petroleum, and the pale yellow or white, which is pure naphtha. The quantity annually obtained in the district amounts to 240,000 Russian poods, or 9,600,000 lb. of the first sort, and 900 poods, or 36,000 lb. of the latter. The fundamental rock of this district appears to be a secondary limestone, on which is imposed a bed of white clay; then two strata of bituminous shale separated by a bed of sand; next a stratum of fossiliferous sandstone, covered by a bed of clay. The naphtha oozes through the fissures of the white clay, and probably is thus distilled by subterranean heat. These wells contain inexhaustible springs of oil; and they are no sooner emptied than the oil begins to flow, and continues until it has attained its former level. It is used by the natives for lamp-oil, and emits a clear light, with much smoke and a disagreeable odour. All around the town the

Bala ‖ Balaam.

country is deeply impregnated with inflammable matter, both above and below the surface. About 15 miles to the N.E. is a fire temple of the Guebres; a remarkable spot, something less than a mile in circumference, from the centre of which a bluish flame is seen to arise. Here are some small houses; and the inhabitants, when they wish to smother the flame, cover the space inclosed with walls by a thick loam of earth. When an incision is made in the floor, the flame arises; and when it is no longer wanted for culinary or other purposes, it is again suppressed by closing the aperture. The whole country around Badku has at times the appearance of being enveloped in flames. It often appears as if fire rolled down the mountains in large masses with great velocity; and at night a bright blue light is observed to cover the whole western range of hills. This fire does not consume, or emit any sensible warmth.

The jurisdiction of Baku extends over thirty-two villages. It was ceded to Russia in 1723, and restored to Persia in 1735. After remaining for some years under the dominion of Persia, in 1801 it was taken possession of by the Russians, by whom it is still retained. The district, including the town, contains, according to Klaproth, 19,000 inhabitants.

BALA, a market-town of Wales, county of Merioneth, and hundred of Penllyn, at the northern extremity of a small lake, 17 miles N.E. of Dolgelly. It consists principally of one wide street. Its manufactures are flannels, stockings, and gloves. The lake of Bala is four miles long and about half a mile broad. It is very deep and clear, and abounds with pike, perch, trout, eels, and the *gwyniad*, or *coregonus lavaretus*. The beds of limestone in the slate of this district, from their fossil contents, belong to the upper and lower series of silurian rocks.

BALAAM, a prophet and diviner of the city of Pethor on the Euphrates, whose practices with Balak, king of the Moabites, are recorded in the Book of Numbers, chap. xxii. In 2 Peter ii. 15, Balaam is called the son of Bosor, which Gesenius attributes to an early corruption of the text, but Dr Lightfoot considers it to be a Chaldaism, and infers from the apostle's use of it, that he was then resident at Babylon.

Of the numerous paradoxes which we find in this remarkable person, not the least striking is, that with the practice of an art expressly forbidden to the Israelites, he united the knowledge and worship of Jehovah, and was in the habit of receiving intimations of his will. The sacred narrative gives us no reason to suppose that he had any previous knowledge of the Israelites. In the absence of more copious and precise information, we may reasonably conjecture that Jacob's residence for twenty years in Mesopotamia contributed to maintain some just ideas of religion, though mingled with much superstition. To this source, and the existing remains of patriarchal religion, Balaam was probably indebted for that truth which he unhappily "held in unrighteousness."

On the narrative contained in Numb. xxii. 22–35 a difference of opinion has long existed, even among those who fully admit its authenticity. The advocates for a literal interpretation urge, that in a historical narrative it would be unnatural to regard any of the occurrences as taking place in vision, unless expressly so stated; that it would be difficult to determine where the vision begins, and where it ends; that Jehovah's "opening the mouth of the ass" must have been an external act; and, finally, that Peter's language is decidedly in favour of the literal sense. "The dumb ass, speaking with a man's voice, reproved the madness of the prophet" (2 Peter ii. 16). Those who conceive that the whole scene occurred in vision to Balaam (among whom are Maimonides, Leibnitz, and Hengstenberg), insist upon the fact that dreams and visions were the ordinary methods by which God made himself known to the prophets (Numb. xii. 6); they remark that Balaam speaks of himself as the man who had his eyes shut, and who, on falling down in prophetic ecstasy, had his "eyes opened;" that he expressed no surprise on hearing the ass speak; and that neither his servants nor the Moabitish princes who accompanied him appear to have been cognizant of any supernatural appearance. Gregory of Nyssa supposes that the ass did not utter any word articulately; but that having brayed as usual, the diviner, whose practice it had been to draw presages from the cries of beasts and singing of birds, comprehended easily the ass's meaning by its noise; and that Moses designed to ridicule the superstitious art of augurs and soothsayers, as if the ass had really spoken in words articulate.

Baladan ‖ Balance.

BALADAN, the Scripture name for a king of Babylon, called by profane authors *Belesus* or *Belesis*, *Nabonassar* or *Nanybrus*. See BELESIS.

BALÆNA, the common Greenland whale. See MAMMALIA.

BALAGHAUT DISTRICTS. This country, which is in the south of India, comprehends a large proportion of the tableland supported like a terrace by the stupendous mountain ranges of the Eastern and Western Ghauts. It extends from the Toombuddra and Krishna rivers on the north, to the southern extremity of Mysore, and is named Balaghaut or "above the Ghauts," in contradistinction to Payenghaut or "below the Ghauts." This tract of country comprehends, in addition to the native state of Mysore, the three British districts of Ballary, Cuddapah, and Kurnoul, the first two having been ceded by the Nizam in 1800, in commutation of subsidy, and the last taken from the nawaub of that district in 1841, in consequence of a breach of allegiance to the paramount power. The area of the Balaghaut, excluding the Mysore, is 28,669 square miles, and its population 2,954,710. Sugar, grain, and cotton, form the staple produce

In ancient times these provinces formed part of the Hindu kingdom of Bijyanagur; and many of the modern Polygars claim their descent from the officers, and some from the royal family of that kingdom. On the fall of the Mogul government, the Balaghaut was broken into several independent states. It was conquered by Hyder Ali between the years 1766 and 1780. Upon the dismemberment of Tippoo's dominions in 1800, the dependency of Kurnoul continued in the possession of its nawaub. Of the residue of the Balaghaut, a portion was assigned to the rajah of Mysore, the representative of a family dispossessed by Hyder Ali, but rescued by the British to participate in the results of their success over that usurper's son. That which remained was divided between the British and the Nizam. The dependency of Kurnoul and the portion of territory allotted to the Nizam, are now, as above stated, annexed to the British empire; the territory of Mysore, though still nominally constituting a native state, was some time since, in consequence of the misconduct of its affairs, transferred to the direct management and control of the British government. (E. T.)

BALAGUER (*Bargusia* of the Romans), a *partido* and city of the province of Lerida, in Spain. The city is situated on the right bank of the River Segra, in a fruitful district, and is defended by a citadel. Pop. 4642, chiefly occupied in the pursuits of agriculture. Long. 1. 24. E. Lat. 41. 43. N.

BALAMBANGAN, an island in the Eastern Seas, between Magindanao and Borneo. The East India Company formerly had a settlement here, but it is now abandoned. Long. 117. 5. E. Lat. 7. 15. N.

BALANCE, a machine for ascertaining the weight of substances. There are several kinds of balances, as the common balance or scales, the steelyard, the Danish or Swedish balance, the Chinese balance, the hydrostatic balance, &c. The same name is also given to certain kinds of apparatus for measuring or comparing the intensities of very small forces, as the balance of torsion, the electric balance, &c.

The common balance, which is of the most extensive use in the affairs of life, as well as in the arts and experi-

Balance. mental physics, consists of a beam, AB (fig. 1, Plate CIII.), supported in the middle by a fulcrum or prop C, round which it turns freely, and having a scale or dish attached to each of its extremities A, B, one of which holds the weight, and the other the substance to be weighed. The balance, therefore, in reference to the mechanical powers, is a lever of the first kind; that is to say, having the fulcrum placed between the power and the weight to be raised; hence its theory is easily deduced from the statical properties of the lever. Let P represent the weight in the scale D, and Q that in E; then (supposing AB an inflexible straight line without weight), when AB becomes stable in the horizontal position, or when P *balances* Q, the condition of equilibrium is expressed by the equation

$$P \times AC = Q \times BC.$$

In order, therefore, that the two bodies P and Q may have precisely the same weight, or both exert the same force in turning the beam about its axis of motion, it is indispensable that the two points of suspension A and B be exactly equidistant from the fulcrum C.

When the two arms of the balance are not exactly of the same length, it is obvious that the two weights P and Q, which, in the case of equilibrium, are reciprocally as CA and CB, must also be unequal, in order that the foregoing equation may still be true. If, for example, AC is longer than CB, then a less weight in D will balance a greater in E; and it is on this principle that false balances are constructed. The fraud, however, may be easily detected by transferring the weights P and Q to the opposite scales; for then the less weight P being attached to the shorter arm CB, the product P × CB will be smaller than Q × CA, and the equilibrium consequently destroyed.

It may be remarked, that the true weight of a body may easily be found by means of a false balance of this kind. It is only necessary to weigh the body first in the one scale and then in the other, and the true weight will be a mean proportional between the two weights thus indicated. To demonstrate this property, let w be the true weight of the body in grains, and suppose that when placed in the scale E it balances p grains in D, and that when transferred to D it balances q grains in E, and makes $m = AC$, $n = BC$; by the statical property of the lever we have the two equations,

$$mp = nw,\ nq = mw;$$

$$\text{whence } \frac{m}{n} = \frac{w}{p},\ \frac{m}{n} = \frac{q}{w};$$

$$\text{therefore } \frac{w}{p} = \frac{q}{w} \text{ and } w = \sqrt{pq};$$

so that w is a mean proportional between p and q, and is consequently found by multiplying those numbers together, and extracting the square root of their product.

In what precedes, the beam has been regarded as an inflexible rod devoid of weight; but in order to investigate fully the properties of the instrument, and the conditions that must be fulfilled in order to render it practically useful, it is necessary to have regard to the weight of the beam, and the position of its centre of gravity in respect of the axis of motion. The great requisites of a good balance are sensibility and stability; that is to say, it ought to be such that a very small weight added to either scale disturbs the equilibrium, and causes the beam to deviate sensibly from the horizontal position; and also such, that when the equilibrium has been disturbed, it may return quickly to a state of rest. In order to discover the construction best adapted to confer these two properties, it is convenient to regard the beam as a bent lever. Let G (fig. 2) be the centre of gravity of the beam, O the middle point of the straight line joining the points of suspension A and B, H′H a horizontal straight line drawn through C, and GD, OE, BH, AH′, perpendiculars to H′H. Balance. Make

W = weight of beam,
L = weight of scales with their load,
P = the preponderating weight,
φ = COE = BOK = angle of inclination.

The condition of equilibrium is now

$$L.CE + W.CD = P.CH;$$

whence, since CH = EH − EC = OK − EC,

$$L.OC \sin.\varphi + W.GC \sin.\varphi = P.OB \cos.\varphi - P.OC \sin.\varphi;$$

$$\text{therefore, } \sin.\varphi\,[(L+P).OC + W.GC] = P.OB \cos.\varphi;$$

$$\text{and } \tan.\varphi = \frac{\sin.\varphi}{\cos.\varphi} = \frac{P.OB}{(L+P).OC + W.GC}.$$

From this equation it appears that, for any given value of P, the tangent of the angle of inclination, which measures the sensibility of the balance, is directly as the length of the beam, inversely as the weights of the beam and load, and also inversely as the distances of G and O from the axis. The sensibility is therefore greatest when the quantity (L + P) . OC + W . CG is the least possible. On the other hand, when P = 0, the stability, or the force acting to restore the beam to the horizontal position, is sin. φ [L . OC + W . CG], which will be diminished by diminishing the value of L . OC + W . CG.

In what precedes we have supposed the points G and O both to fall below the centre of the motion C; but the balance may be constructed so that one or both of these points shall coincide with C, or fall above it. Suppose, in the first place, the arms to be bent upwards, so that O falls above the fulcrum, while G remains below it. In this case the measure of stability is sin. φ (W.CG − L.OC), whence it appears that a balance of this sort can only be used for small weights; for if the load is increased till L.OC becomes equal to W.CG, the balance has no restoring power, and is indifferent to any position. If L.OC exceeds W.CG, it would entirely upset by the slightest deviation from the horizontal position.

Suppose next that the centre of gravity G falls above the fulcrum, O remaining below it. The measure of stability now becomes sin. φ (L.OC − W.CG), and consequently the balance is only useful for heavy weights; for as L.OC is diminished, the stability is lessened, and when L.OC is equal to or less than W.CG, the balance is useless. Hence it appears that when either of the points G, O, falls above C, the balance can only be employed in particular cases.

Let the point G coincide with C, and O fall below it. In this case CG vanishes, and the measure of stability becomes sin. φ L.OC, which, for any given value of φ, increases with the load, or the weight of the substance to be weighed. A balance of this sort would be unfit for weighing small bodies on account of its want of stability, though it might be used in the estimation of great weights.

Lastly, let O coincide with C, while G falls below the axis. The three points of action A, C, B, are now arranged in a straight line, and the measure of stability is sin. φ W . CG, which is constant for a given value of φ. The restoring force is therefore independent of the load in the scales, so that a balance of this sort can be employed in all cases, whether the weights are great or small; and as it is easy, diminishing W and CG, to give it any required degree of sensibility, it is this form that ought to be adopted in every case where great precision and accuracy are necessary.

Another reason for this disposition of the three points of action in a straight line is, that unless C is in the same straight line with A and B, an equilibrium will subsist between two unequal weights when AB is not exactly horizontal. In fact, since the weights P, Q, suspended from A and B, act in the direction perpendicular to H′H, the mo-

Balance. ments of these weights, or their energies in turning the beam round its axis, are respectively P × CH′, and Q × CH; therefore, when BCH is a greater angle than ACH′, and the line CH consequently less than CH′, a smaller weight at A will balance a greater at B, and the beam remain at rest though loaded with unequal weights. It is hence important, in all accurate weighing, to make certain that when the equilibrium takes place, the line AB is exactly horizontal.

Having determined from theory the conditions that ought to be observed in the construction of the balance, we shall now proceed to give a brief description of the instrument as it is constructed for assaying or other delicate purposes. In the first place, the beam ought to be as light as possible, consistently with its perfect inflexibility; for it is evident that the friction of the axis will be increased with its weight, and the sensibility proportionally diminished. To combine the qualities of lightness and inflexibility, it is found most advantageous to form the arms of the balance of two hollow cones of brass, very thin, but strengthened and inflexible by means of circular rings driven into them at proper intervals. In order to diminish as much as possible the extent of the surfaces in contact, the axis is formed of two sharp edges of tempered steel, lying in the same straight line, and supported on two planes of steel, agate, or crystal, finely polished, and placed with the greatest precision, in the same horizontal plane. In a balance made by the celebrated Troughton, the sharp edges are ground on the lower side of a cylinder of steel, which crosses the beam in the middle, and they extend over the agate planes about $\frac{1}{20}$th of an inch. The angle of the edges is about 30°. The suspension at the extremities of the beam ought also to be made by sharp edges, crossing each other at right angles; and in order to obviate any risk of displacement, the edges may be concave, those formed in the beam being sharp upwards, and the others, to which the scales are attached, being sharp downwards. The horizontality of the beam is usually indicated by a slender pointed rod called the *tongue* of the balance, rising perpendicularly above the beam, and passing through the centres of gravity and motion. A divided ivory scale, placed contiguous to it, shows deviations of the tongue from the perpendicular, and renders sensible the slightest motion of the beam. In some balances the tongue is placed below the beam, pointing downwards, in order to diminish the volume of instrument. But the preferable method is to bring the arms themselves to terminate in sharp points, and place a divided scale behind each. By this means the tongue is rendered unnecessary, and any flexure of the beam immediately becomes evident. Care must be taken that the zeros of the two scales be placed exactly in the same level. The points of suspension at the extremities of the arms ought to be adjustable both horizontally and vertically; horizontally, for the purpose of giving the two arms exactly the same length; and vertically, in order to bring the three points of action into a straight line. A nut or bob, formed of some heavy substance, placed near the middle of the beam (in the interior of the cylinder if it be hollow), and capable of being raised or lowered by a screw, serves to increase or diminish the distance of the centre of gravity of the beam from the axis of motion, and consequently to accelerate or retard the oscillations at pleasure. Two supporters, the upper ends of which are formed into angles, are placed under the beam. These, being raised by means of a screw, lift the beam from the supporting planes, and relieve the sharp edges when the balance is not in use. If the arms of the balance are hollow, this object may be accomplished with less risk by placing the supporters under the extremities of the cross steel bar on which the sharp edges are formed. Props should also be placed under the scales while Balance. loading or unloading them; and care taken to confine the oscillations within narrow limits, or prevent the beam from deviating much from the horizontal position, by which the points of action might be endangered. The sensibility, as we have seen, increases with the length of the beam; but the liability to flexure also increases in the same proportion: and the arms of a balance, such as has been described, cannot, perhaps, safely exceed nine or ten inches. When great delicacy is required, the apparatus must be protected from the disturbing influences of currents of air, by being inclosed within a glass case, having doors at the ends for the convenience of loading and unloading the scales.

Fig. 3, Plate CIII. represents a balance by Fortin, a celebrated mechanician of Paris. The beam is made of tempered steel, and the arms slightly bent, so that all the parts of action may be situated in the same plane, and the centre of gravity fall a little below the axis of motion, which is here under the beam. The planes of support are of steel, and highly polished. The suspension at the extremities of the arms is represented by fig. 4.

With a balance of great sensibility, weighing is not only a delicate, but also tedious operation. When the adjustments are all perfect, and the beam nearly poised, the oscillations should be extremely slow and regular, and extend to equal distances on each side of the zero of the scale. In fact, it is by the equality of the excursions of the index from zero that the horizontality of the beam must be inferred; for a very long time would elapse before the oscillations entirely cease. The sensibility of a balance constructed with the requisite care, according to the principles above explained, is very great. Those of Fortin of Paris have been found to oscillate by the addition of a single milligramme, when loaded with a weight of 1000 grammes in each scale; so that the weight is indicated to the millionth part. A balance constructed by the late Mr Ramsden, for the Royal Society of London, is said to vibrate with the seven-millionth part of its load. In general, however, no such exactness can be hoped for; and even when the greatest precautions are taken, and the most delicate instruments employed, it would seldom be safe to vouch for the truth of any figure carried beyond the fourth decimal.

But notwithstanding the high state of perfection to which the mechanical arts have arrived, the mathematical equality of the length of the arms, and their symmetry in respect of the axis of motion, can never be practically attained; it is therefore desirable to have the means of obtaining results in as great a degree as possible independent of such extreme precision. The following method of weighing, ascribed by the French writers to Borda, gives results not affected by the inequality of the arms, or other imperfections to which the balance is principally subject, and ought to be practised whenever very great accuracy is necessary. Let the body to be weighed, which we shall call P, be placed in the scale A, and for a counterpoise put into the scale B, substances of any sort, for instance bits of copper, lead, wire, or even chips of paper, added in small quantities till the beam becomes perfectly horizontal, which is known by the index pointing to zero. This being done, remove gently the body P from A, and substitute for it known weights, as grains and fractions of a grain, till the equilibrium is restored, and the index again settles at zero. Now it is evident that the weights in A, having been placed exactly in the same circumstances with the body P, and producing equally with it an equilibrium with the loaded scale B, must be the exact equivalent or weight of P. In fact, the accuracy of this process can only be affected by two circumstances; the

Balance. first is, the friction of the axis, or the want of sensibility in the balance; and the second is, a change of position in the point of suspension. Unless the points of suspension are identical in both operations, the weights which successively produce equilibrium with B will not be exactly equal; for even if no change takes place in the length of the arm, the friction developed at the new points of contact will have a different value, and consequently require a different force to overcome it. The chief objects to be attended to, therefore, in practising the method of double weighing, are, that the mode of contact may receive no change during the loading and unloading of the scales; and that the friction may be reduced to its least possible value by giving the finest polish to the edges, as well as the plane of support.

With regard to the weights that ought to be employed, it may be sufficient to state, that, in delicate weighing, and for philosophical purposes, they are usually reckoned by Troy grains. The geometrical series 1, 2, 4, 8, 16, &c. offers one considerable advantage, namely, that a smaller number of weights is required than when any other system is adopted; but it would, perhaps, be more convenient in practice to follow the decimal division, and use weights of the following values: 1, 2, 3, 4, &c.; 10, 20, 30, 40, &c.; 100, 200, 300, 400, &c.; 1000, 2000, 3000, 4000, &c., up to 9000; and ·1, ·2, ·3, ·4, &c.; ·01, ·02, ·03, 0·4, &c.; ·001, ·002, ·003, ·004, &c. By this means the trouble of adding would be entirely avoided, and the number of weights in the scale would equal the digits in the number by which the grains are expressed. Thus a load of 735·4 grains would be counterpoised by weights of 700 grains, 30 grains, 5 grains, and 4-10ths of a grain.

See Euler, *Comment. Petrop.* tom. x. p. 3. *Phil. Trans.* for 1766; Shuckburgh in ditto for 1798, part 2d; Prony, *Annales de Chimie*, tom. xxxvi. p. 3; Biot, *Traité de Physique*, tom. i. p. 9; Ure's *Dictionary of Chemistry*; Leslie's *Elements of Natural Philosophy*, vol. i. p. 185.

The *Steelyard* is a balance by which the weights of bodies are estimated by means of a single weight. This machine, which is represented by fig. 5, is likewise a lever of the first kind, having two unequal arms. The load L to be weighed is suspended from the extremity of the short arm CA, and the counterpoise or constant weight P is movable along CB. Divisions traced on CB indicate the weight of L corresponding to each of the positions of P. In the East, where the steelyard is much in use, the standard weight P is generally made to resemble a pomegranate in shape; whence the instrument acquired the name of *Romman*, and from this circumstance it has frequently but erroneously been denominated the *Roman* balance or *Statera*.

To find the points of division of the arm CB, let W be the weight of the bar AB, exclusive of L and P; and let p be the weight in pounds of the body L. Let $CA = l$, and x be the unknown distance of the centre of gravity of the beam from the fulcrum C. Then, carrying P along the arm CB till the beam is horizontal, let A_1 be the point at which P rests, and put $CA_1 = X_1$. Now, the beam is kept in equilibrium by its own weight acting at the centre of gravity x, and by the weights p and P acting respectively at A and A_1; therefore the condition of equilibrium is expressed by the equation

$$W x + pl + PX_1 = 0.$$

Let another weight p, equal to the former, be suspended from A, and let A_2 be the position of P when the equilibrium is restored. Make $CA_2 = X_2$, and the above equation now becomes

$$W x + 2pl + PX_2 = 0.$$

In this manner, by the successive addition of equal weights p to A, the following system of equations is formed:

$$\begin{aligned} W x + \ \ pl + PX_1 &= 0 \\ W x + 2pl + PX_2 &= 0 \\ W x + 3pl + PX_3 &= 0 \\ \cdots\cdots\cdots & \\ W x + npl + PX_n &= 0. \end{aligned}$$

Balance.

By subtracting the first of these equations from the second, the second from the third, and so on, we have

$$\begin{aligned} pl + P(X_2 - X_1) &= 0 \\ pl + P(X_3 - X_2) &= 0 \\ pl + P(X_4 - X_3) &= 0 \\ \cdots\cdots\cdots & \\ pl + P(X_n - X_{n-1}) &= 0. \end{aligned}$$

The successive differences $X_2 - X_1$, $X_3 - X_2$, &c. are therefore constant, each being equal to the constant quantity $\frac{pl}{P}$. The divisions of the arm CB may therefore be found as follows:

Having suspended the given weight p from the extremity of the shorter arm CA, find the point A_1 at which it is necessary to place P in order that the beam may be horizontal. Then, having removed p, substitute for it another weight, which is an exact multiple of p, as np, and let P be moved toward C till the equilibrium is restored, A_n being the point where P is now placed. Divide the distance $A_1 A_n$ into $n - 1$ equal parts, and the points of division will be respectively those at which P will balance the intermediate weights between p and np. If, therefore, each of those points is marked with the corresponding value of p, the weight of any body whatever suspended from A will be indicated by the number of the division at which P rests when the beam is horizontal. The distances $A_1 A_2$, $A_2 A_3$, &c. may be divided into tenths, or other fractional parts.

For weighing heavy loads the steelyard is a convenient instrument; but for small weights it is not susceptible of so much accuracy as the common balance. The pressure on the fulcrum, and consequently the friction, is greater, when the commodities to be weighed are less than the constant weight P, and the subdivision of the arm cannot be effected with the same precision as that of weights for the balance. It may be proper, however, to remark, that the instrument ought to be constructed so that the constant centres C and A may be in the same straight line with the divisions of the beam, and that the centre of gravity of the unloaded beam, when placed horizontally, shall be in the vertical passing through C, and a little below that point, as in the common balance. An index or tongue shows when the beam takes the horizontal situation.

The *Chinese Balance* is a sort of steelyard for weighing small commodities, formed of a slender tapering rod of wood or ivory, about a foot in length, perforated generally with four holes through which silk threads are passed, to serve as so many points of support. Four different sets of divisions are marked on the corresponding sides of the rod; and when any thing is to be weighed, the rod is held up by one of the strings, and a sliding weight of about 1½ ounce Troy employed as a counterpoise to the substance, which is placed in a small scale suspended from the extremity of the shorter arm. The position of the standard weight indicates the weight of the substance, as in the ordinary steelyard.

The *Danish* or *Swedish Balance*, which is commonly employed in many parts of the north of Europe for weighing coarse commodities, is of a very simple construction. It consists usually of a batten of hard wood, having a heavy lump A (fig. 6) fixed at one end, and a swivel hook at the other. The goods to be weighed are fixed to the hook, and the whole is suspended in a loop of whipcord C, in which the rod is slid backward and forward

Balance. till the equilibrium is established. The weight of the load L is determined by the position of the loop on a scale of divisions, which may be formed in the following manner.

Let O be the centre of gravity of the beam and the attached weight at A, W their weight, L the load to be weighed, and make BO = a, BC = x. The equation of equilibrium is $Lx = W(a - x)$, whence $x = \frac{Wa}{L + W}$. Now, if we suppose a to be 30 inches, W = 2 lbs., and substitute for L the numbers 1, 2, 3, &c. successively, we shall have the following values of x:

When L = 1, x = 20 inches
L = 2, x = 15
L = 3, x = 12
L = 4, x = 10
&c.

A balance constructed in this manner is obviously susceptible of very little accuracy.

The *Bent Lever Balance*, which is represented by fig. 7, is sometimes employed for expedition in the coarser processes of weighing. To one extremity of a bent lever ACB, is attached a constant weight B, which acts as a counterpoise to the load placed in the scale suspended from A. Through C, the point of support, draw the horizontal line DE, and through A and B the perpendiculars AD, BE, meeting DE in D and E. Now the equilibrium will take place when CE is to CD as the load at A to the constant weight B; and if the arms are bent so that the lines joining CA and CB are at right angles, then as B moves upward, its momentum increases in proportion to the sine of the arc it describes, while the momentum at B decreases in proportion to the cosine of a similar arc. The weight on A corresponding to any position of B, may therefore be expressed on a graduated circular scale placed behind the index at B. Theoretically considered, the range of this balance is very considerable; but the indications are little to be depended on when B approaches either the perpendicular or the horizontal line passing through C.

The *Hydrostatic Balance* is an instrument contrived for weighing bodies in water, and thereby determining their specific gravities.

It is constructed in various forms; but we shall content ourselves here with describing that which appears of all others the most accurate. VCG (fig. 8) is the stand or pillar of this hydrostatic balance, which is to be fixed in a table. From the top A hangs, by two silk strings, the horizontal bar BB, from which is suspended, by a ring *i*, the fine beam of a balance *b*, which is prevented from descending too low on either side by the gently springing piece *txyz*, fixed on the support M. The harness is annulated at *o*, to show distinctly the perpendicular position of the examen, by the small pointed index fixed above it.

The strings by which the balance is suspended, passing over two pulleys, one on each side of the piece at A, go down to the bottom on the other side, and are hung over the hook at *v*; which hook, by means of a screw P, is movable about one inch and a quarter backward and forward, and therefore the balance may be raised or depressed so much. But if a greater elevation or depression be required, the sliding piece S, which carries the screw P, is readily moved to any part of the square brass rod VK, and fixed by means of a screw.

The motion of the balance being thus adjusted, the rest of the apparatus is as follows. HH is a small board, fixed upon the piece D, under the scales *d* and *e*, and is movable up and down in a low slit in the pillar above C, and fastened at any part by a screw behind. From the point in the middle of the bottom of each scale hangs, by a fine hook, a brass wire *ad* and *ac*. These pass through two holes *m*, *m*, in the table. To the wire *ad* is suspended a cylindric wire *rs*, perforated at each end for that purpose. This wire *rs* is covered with paper, graduated by equal divisions, and is about five inches long. Balance.

In the corner of the board at E is fixed a brass tube, on which a round wire *hl* is so adapted as to move neither too tight nor too free, by its flat head I. Upon the lower part of this moves another tube Q, which has sufficient friction to make it remain in any position required. To this is fixed an index T, moving horizontally when the wire *hl* is turned about, and therefore may be easily set to the graduated wire *rs*. To the lower end of the wire *rs* hangs a weight L; and to that a wire *pn*, with a small brass ball *g* about one fourth of an inch diameter. On the other side, to the wire *ac*, hangs a large glass bubble R, by a horse hair.

Let us first suppose the weight L taken away, and the wire *pn* suspended from S; and, on the other side, let the bubble R be taken away, and the weight F suspended at *c* in its room. This weight F we suppose to be sufficient to keep the several parts hanging to the other scale in equilibrium; at the same time that the middle point of the wire *pn* is at the surface of the water in the vessel O. The wire *pn* is to be of such a size that the length of one inch shall weigh four grains.

Now, it is evident, since brass is eight times heavier than water, that for every inch the wire sinks in the water it will become half a grain lighter, and half a grain heavier for every inch it rises out of the water: consequently, by sinking two inches below the middle point, or rising two inches above it, the wire will become one grain lighter or heavier. Therefore if, when the middle point is at the surface of the water in equilibrium, the index T be set to the middle point *a* of the graduated wire *rs*, and the distance on each side *ar* and *as* contains 100 equal parts; then, if in weighing bodies the weight is required to the hundredth part of a grain, it may be easily had by proceeding in the following manner.

Let the body to be weighed be placed in the scale *d*. Put the weight X in the scale *e*; and let this be so determined, that one grain more shall be too much, and one grain less too little. Then, the balance being moved gently up or down by the screw P, till the equilibrium be nicely shown at *o*, if the index T be at the middle point *a* of the wire *rs*, it shows that the weights put into the scale *e* are just equal to the weight of the body. By this method we find the absolute weight of the body; the relative weight is found by weighing it hydrostatically in water, as follows.

Instead of putting the body into the scale *e*, as before, let it hang with the weight F at the hook *c* by a horse hair, as at R, supposing the vessel O of water were away. The equilibrium being then made, the index T standing between *a* and *r* at the 36 division, shows the weight of the body put in to be 1095·36 grains. As it thus hangs, let it be immersed in the water of the vessel N, and it will become much lighter; the scale *e* will descend till the beam of the balance rest on the support *z*. Then, suppose 100 grains put into the scale *d* restore the equilibrium precisely, so that the index T stand at the 36 division above *a*, it is evident that the weight of an equal bulk of water would in this case be exactly 100 grains.

The *Balance of Torsion* is an instrument invented by Coulomb, for comparing the intensities of very small forces. It consists essentially of a metallic wire, suspended vertically from a fixed point, to the lower end of which a horizontal needle is attached, with a small weight for the purpose of keeping the wire stretched. The intensity of any small force made to act on the extremity of

Balance ‖ Balance of Power.

the needle is measured by the arc which the needle passes over, reckoned from the point of repose. The force is thus balanced by the *torsion* of the wire, whence the name of the instrument.

To prevent any derangement from the agitation of the air, the apparatus must be covered by a glass cylinder, to which a circular scale is applied horizontally, for the purpose of measuring the amplitude of the arc traversed by the needle. A divided circle is also adapted to the top of the cylinder, and capable of being turned round on it, by means of which, and a fixed index attached horizontally to the hook from which the wire is suspended, the wire may be twisted any required number of degrees. This apparatus is represented by fig. 9. The length of the wire and the needle must be regulated by the object in view. If the forces to be measured are very small, and great sensibility is consequently required, the wire must be long and very fine; for the force of torsion is inversely proportional to the length of the wire, and directly as the fourth power of its diameter. It must also be formed of a substance possessing considerable elasticity, and for this reason brass wire is greatly superior to iron. By experiments undertaken for the purpose, Coulomb found the elasticity of some wires so perfect, that on keeping them twisted through eight circumferences for thirty hours together, the centre of torsion was not displaced by a single degree. Their length was about a metre, or 39 inches.

Balance ‖ Balance of Power.

The balance of torsion is used chiefly in experiments on electricity, magnetism, the adhesion of fluids, &c.; and it was by means of this instrument that Cavendish made his famous experiments on the attraction of lead balls, from which he deduced the mean density of the earth equal to about 5·5, that of water being unit. (T. G.)

BALANCE OF POWER,

Among states, a most important principle of foreign policy, intimately connected with the general peace and independence of nations, but which some have treated as altogether chimerical, and others represented as having led only to pernicious results. It is more generally admitted, however, to have a real foundation in the rules of intercourse and union among states, and to have exercised a great and beneficial influence on the affairs of modern Europe. We say of modern Europe, because, though the policy in question was not wholly unknown to other ages and countries, it was nowhere *systematically* pursued but among the European nations of modern times. Previous to the sixteenth century there was little political connection among those nations, their circumstances not being such as to admit of any regulated attention to foreign affairs; but about the commencement of that century they began to form one grand community or federal league, of which the actuating principle was the preservation of the balance of power. The attention to this principle thenceforth influenced all the great wars and negociations, and made every foreign movement, however remote, an object of interest throughout every part of the European system.

We shall endeavour to sketch a general outline of this important subject; and, in doing so, we shall notice, though in a brief way, all the principal topics which it seems to present for discussion.

Principle of a balance of power, and system founded on it.

1. The ultimate intention of the system founded on the balance of power, is to secure every state in the full possession and enjoyment of all its rights, by making its safety and independence objects of interest and guardianship to its neighbours. It endeavours to accomplish this great end by teaching that it is the interest of all states to check the first encroachments of ambition, to watch every movement of foreign powers, and to unite their respective forces in support of the weak against the strong. It is called the balancing system, because its aim is to prevent any state from aggrandizing itself at the expense of its neighbours, and to counterpoise any state that may have become too powerful, by a union of the forces of others.

The metaphorical terms applied to this system seem to have given rise to some very absurd misconceptions of its true theory and purposes. It has sometimes been supposed that its object was to *equalize* the powers of states composing a common system; and as it is plainly impossible either to effect or to maintain such an equality, it has thence been concluded, that the whole system is founded upon a chimera. But, with a view to the objects of this system, the question is, not what amount of power above another any state possesses, provided the power so possessed be fairly acquired, but whether any state possesses its power in such circumstances as to enable it to trespass at pleasure on a weaker neighbour. If there be no other state, or confederacy of states, capable of counteracting any injurious designs which a greater power might undertake, then it is said there is no balance; but if there be such a counterpoise, this is all that the balancing system requires to produce what, in its language, is called an equilibrium. In order to make this point as clear as possible, we beg to refer to the following definitions of the balance of power, as given by Vattel and by Gentz: "By this balance," says the former, "is to be understood such a disposition of things, as that no one potentate or state shall be able absolutely to predominate and prescribe laws to the others." (*Law of Nations*, b. iii. c. iii. § 47.)—"What is usually termed a balance of power," says M. Gentz, "is that constitution subsisting among neighbouring states, more or less connected with one another, by virtue of which no one among them can injure the independence or essential rights of another, without meeting with effectual resistance on some side, and, consequently, exposing itself to danger." (*Fragments on the Political Balance*, c. i.)

Thus, then, it is distinctly understood that the balancing system is not grounded upon an *equality* among states in respect of power, but upon a union of powers to repress the enterprises of the strong and ambitious, and to counteract the effects of necessary individual inequalities by aggregate strength.

It is quite indispensable to the existence of such a system, that one state should not be permitted to obtain such a superiority of power as to enable it to overawe all opposition, and make the safety of those around it dependent on its will; and as it is the disposition of all unchecked power to extend itself, the balancing system inculcates it as the interest, as well as the right, of every state to join in opposing the first encroachments of any ambitious potentate or community. It teaches that the danger extends much further than to the party immediately attacked or menaced; that one encroachment will pave the way to another; and that it is therefore wise to meet the danger whilst yet distant, and capable of being combated with less peril or loss. The right of interference to put down a danger of this kind is, in fact, only a modification of the right to resist an immediate attack. All human experience shows, that the state which is suffered to aggrandize itself at the expense of one neighbour, will with

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its increased means acquire stronger dispositions to encroach still further; and therefore self-defence authorizes us to treat as already an invader, any potentate whose conduct entitles us to conclude that he only waits a convenient opportunity to become so in effect. "As long," says Bacon, "as men are men, and as long as reason is reason, a just fear will be a just cause of a preventive war; but especially if it be part of the case that there be a nation that is manifestly detected to aspire to new acquests, then other states assuredly cannot be justly accused for not paying for the first blow, or for not adopting Polyphemus's courtesy, to be the last that shall be eaten up." (*Speech concerning a War with Spain.*) It is peculiarly and emphatically the language of the balancing system, *Principiis obsta*,—in other words, look well to the safety and independence of your neighbours, even the most remote, if you wish to preserve your own.

Upon this point it is by no means necessary to enter into any lengthened deductions. The principle of interference to prevent the progress of a dangerous power rests, both as to right and policy, upon the most obvious dictates of experience and prudence. No state ever yet acquired a preponderating power without abusing it; and therefore it is the right and interest of all states to prevent any one from rising to such an ascendency as may endanger the common safety.

The right in question, however, is that of guarding against injury justly to be apprehended from the conduct of a state which uses improper means of aggrandizement. As far, therefore, as measures of hostility are concerned, there must be actual encroachment in order to warrant them. The balancing system does not say there shall be no alterations in the relative strength of states; for a state may fairly and honourably increase her power by wise legislation, or by the cultivation of her own internal resources. To attempt to impede a state which takes this road to greatness, would be to make war upon those very arts by the successful cultivation of which peace and happiness are spread throughout the world. The aggrandizements to which the balancing system stands opposed, are those attended with immediate violence to some, and which infer further violence to others. All that nations can do when a neighbour becomes formidable in a fair way, is to watch her, and to draw closer those ties of alliance which may enable them to counteract any bad use of her power. When Lord Bacon, in his *Essay on Empire*, counsels princes "to keep due sentinel, that none of their neighbours do so overgrow by increase of territory, by *embracing of trade*, by approaches or the like, as to become more able to annoy them than they were," he does not mean that the growth of a state by commerce is to be prevented in the same way as in the case of its extension by a seizure of territory, but, that all great power, however acquired, is in its nature dangerous, and ought to be counterpoised by timely confederation.

There is another way in which a state may become formidable, and that of a sudden, where the balancing system does not authorize immediate hostile interference. We allude here to the case of a sovereign who acquires a great accession of power by marriage or by inheritance. "It is a sacred principle of the law of nations," says Vattel, "that such an increase of power cannot, *alone and of itself*, give any one a right to take up arms in order to oppose it." (B. iii. c. 3, sect. 43.) Grotius and Puffendorf maintain the same opinion in terms equally decided. But, suppose a sovereign, who has already displayed an encroaching disposition, is about to acquire in this way an accession of power, which would render him more and more formidable to his neighbours; in this case, as Vattel shows, the maxims of the balancing system authorize an immediate interference to procure securities; or, according as the danger is imminent, altogether to prevent the impending aggrandizement. It is perhaps wholly unprecedented, as this writer observes, that a state should receive any remarkable accession of power, without giving other states just grounds to interfere; but if it should be otherwise, the only course to be pursued is that which the balancing system recommends, namely, to keep a watchful eye on all the proceedings of the formidable state, and the formation of a counterpoise by means of alliances.

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These, then, are the grand expedients of the balancing system: vigilant inspection to discover, and prompt union to counteract, in their birth, all such projects of encroachment as powerful states will ever, when opportunity offers, be ready to form. By employing resident agents to procure speedy information, and by the weight of joint warnings and reclamations in every case of apprehended or of real injury, the balancing system furnishes the only peaceful means which human wisdom can devise to control the conduct of independent states; the only means which can be employed to guard against injustice, or obtain redress, without an actual appeal to the sword. It was the *habitual* employment of these expedients, with a view to guard against distant dangers, that distinguished the balancing system, as exemplified in modern Europe, from those momentary efforts and loose confederacies in which all nations, and even the rudest tribes, have occasionally united, in order to repel or pull down a powerful and common enemy.[1] Without this habitual attention to foreign affairs, and constant application of the principles of counterpoise, there cannot, indeed, be said to exist any thing like a system of reciprocal guarantee of the independence of nations, such as is involved in the idea of a balance of power.

What particular alliances each state ought to form, with a view to maintain this balance, is a matter of circumstances, and must accordingly vary with them. The object of the system is always the same,—to preserve such a distribution of power amidst the varying relations of states, as shall most effectually check the spirit of encroachment, and confine every potentate to his own dominions.

In the preceding observations we have had it in view to give a general idea of the nature, intention, and means of maintaining a balance of power among a number of connected nations of different degrees of power and magnitude. But before proceeding to any remarks on the history and results of this branch of policy, we shall recapitulate, in the words of M. Gentz, those fundamental maxims which constitute the necessary conditions of the beneficial existence of such a system as we have described. These are,—

"That no one state in the common system must ever become so powerful as to be able to coerce all the rest put together;—

"That, if the system is not merely to exist, but to be maintained, without constant perils and violent concus-

[1] "The grand and distinguishing feature of the balancing system is the perpetual attention to foreign affairs which it inculcates; the constant watchfulness over every nation which it prescribes; the subjection in which it places all national passions and antipathies to the fine and delicate view of remote expediency; the unceasing care which it dictates, of nations most remotely situated, and apparently unconnected with ourselves; the general union which it has effected of all the European powers obeying certain laws, and actuated in general by a common principle; in fine, the right of mutual inspection, universally recognized among civilized states in the rights of public envoys and residents." (Brougham's *Colonial Policy*, b. iii. sect. 1.)

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sions, every member which infringes it must be in a condition to be coerced, not only by the collective strength of the other members, but by any majority of them, if not by one individual;—and,

"That if ever a state attempts, by unlawful enterprise, to attain, or does in fact attain, to a degree of power, which enables it to defy the danger of a union of several of its neighbours, or even of the whole, such a state should be treated as a common enemy; and if it has acquired that degree of force by an accidental concurrence of circumstances, without any acts of violence, whenever it appears upon the public theatre, no means which political wisdom can devise for the purpose of diminishing its power should be neglected or left untried." (*Fragments upon the Political Balance*, c. 1.)

Ancient knowledge of the balance of power, and rise of the modern system.

2. The knowledge of the ancients in regard to these great principles of national safety, and the period when they came to obtain a decided influence among the moderns, are points of considerable historical interest. Mr Hume has proved, in a very satisfactory manner, that the principle of preserving a balance of power is distinctly to be recognised in many of the great political transactions of the ancient world. The same thing had previously been shown by Kahle, a famous physician and professor, in a learned and able work, of which a French translation by Formey, entitled *La Balance de l'Europe*, was published at Berlin in 1744. The anxiety of the Greeks with regard to the principle of equilibrium among states was particularly manifested in that famous league against the rising power of Athens which produced the Peloponnesian war. Athens herself showed that she both knew and practised this policy, by constantly throwing her power into the lighter scale, when Thebes and Sparta came to contend for the mastery of Greece. Mr Hume also traces the influence of this salutary principle in the contests which arose among the successors of Alexander; their attention to it having "preserved distinct, for several ages, the partitions made after the death of that conqueror." (*Essays*, vol. i.) The orations of Demosthenes frequently display very clear and extensive views in this branch of policy. In that for the Megalopolitans, in particular, "we may see," according to Mr Hume, "the utmost refinements in the balance of power that ever entered into the head of a Venetian or English speculatist;" and by a later writer this speech is also pointed out as "containing discussions of some of the most delicate parts of the theory." (Brougham's *Colonial Policy*, b. iii. sect. 1.) All who peruse this remarkable oration with due attention must indeed perceive that it fully bears out this character. Its reasonings may be analyzed into these leading doctrines of the balancing system: that it is the interest of every state to prevent the formation of a predominating power; that to this end the first encroachments ought to be promptly checked; and that it is necessary to join even a rival against a former friend, when that friend would otherwise infringe upon the balance.[1]

It seems, in short, to be no longer a question, that it was only with the *phrase*, and not the *idea*, of a balance of power, that the ancients were unacquainted. But we cannot agree with Mr Hume when he goes so far as to say that this principle, though it has been more generally known and acknowledged in modern times, has not had an authority much more extensive in practice, than it had among the nations of antiquity. (*Essays*, vol. i.) This opinion stands clearly refuted by all the great facts, and by the whole tenor of modern history, from the commencement of the sixteenth century. It was the more constant operation of the principle in question which gradually formed the nations of Europe into one great republic or federal league, whose common bond of union was the guarantee which it afforded of their respective independence. But neither, on the other hand, can we agree with Mr Brougham, when he affirms that the ancient states displayed nothing beyond a mere speculative knowledge in this department. (*Colonial Policy*, b. iii. § 1.) It may be very true that those more enlarged ideas of foreign policy which Demosthenes disclosed in some of his orations were not generally understood or acted upon by his contemporaries; but it is nevertheless perfectly clear, from Mr Hume's statements, the accuracy of which has never been called in question, that among the Grecian states the maxim of preserving a balance of power, though it had not produced any course of policy so regular and authoritative as the modern international system, was yet, on many occasions, the sole moving spring of their wars and alliances.

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This maxim, indeed, lies so much within the sphere of common sense, that it can scarcely fail to be attended to, wherever there is a collection of states capable of observing and attacking each other. But circumstances may be more or less favourable to the growth of a consistent policy in this respect. In modern Europe, a number of considerable states were formed under such circumstances as tended peculiarly to promote a regular intercourse among them, and consequently to develope and systematize this great principle of national security. But it did not begin to manifest itself until, in the gradual and similar progress of European society, the power of the sovereigns of these states was so far consolidated as to enable them to give part of their attention to foreign affairs, and to maintain armies beyond their own frontiers. It was in Italy, where civilization was more advanced, and where there existed a number of small states and commonwealths whose safety required that their rulers should reciprocally keep watch on each other, that the modern system of interference took its beginnings. From an early period of the fifteenth century, we see the balance of power as constant an object of concern among these states as, in the next, it came to be throughout Europe. "Their jealousy of each other," says Guicciardini, "made them watchful of every motion or measure which they conceived might any way increase the power of their neighbours;" and he presents a splendid picture of the beneficial effects, the long peace, and general independence, attendant upon this habitual attention to the balancing principle. (*History of Italy*, b. i.)

It was about the end of the same century that these ideas began to extend to other quarters, and to actuate the movements of greater potentates. There were now several princes possessed of large kingdoms, with powers and prerogatives which enabled them to take part in distant wars and negociations. The first great movement of an ambitious neighbour would naturally, therefore, excite their jealousy, and bring them into concert. Thus, when Charles VIII. of France, in 1494, invaded Italy and laid claim to Naples, the sovereigns of Germany and Spain saw the expediency of listening to the Italian princes, who suggested a confederacy to prevent France from gaining an accession of power which could not but render her a dangerous neighbour. Dr Robertson regards

[1] There is a passage of Polybius, which has been frequently quoted as pointing out the leading aim of the balancing system in terms the most explicit. The historian, after mentioning that Hiero, king of Syracuse, acted wisely in assisting the Carthaginian in the war of the auxiliaries, adds, "Nunquam enim ejusmodi principia contemnere oportet, neque tanta cuiquam astruenda es potentia, ut cum eo postea de tuo quamvis manifesto jure disceptare ex æquo non queas." (Lib. i. cap. 83.)

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the expedition of Charles as the first great exertion of those new powers with which the progress of society had invested the princes of Europe; and views the confederacy formed against him, as the first considerable extension of those ideas of a balance of power whose influence had hitherto been limited to the narrow sphere of Italian politics. "From this era," he says, "we can trace the progress of that intercourse between nations which has linked the powers of Europe so closely together, and can discern the operations of that provident policy which, during peace, guards against remote and contingent dangers, and in war has prevented rapid and destructive conquests." (*View of the Progress of Society in Europe*, § 2.) If we look only a little later, we shall everywhere see a constant jealousy of the increase of power, and a vigilant attention to all foreign operations, combined with the application of those means of safety which peculiarly distinguish the balancing system. "During that triumvirate of kings," says Lord Bacon, in his usual expressive language, "Henry VIII. of England, Francis I. of France, and Charles V., Emperor, there was such a watch kept, that none of the three could win a palm of ground, but the other two would straightways balance it, either by confederation, or, if need were, by a war; and would not, in any wise, take up peace at interest." (*Essays on Empire.*)

It has been objected to Dr Robertson that he has represented "the principle of the balance of power as a *discovery* made by the Italian politicians in *consequence* of this invasion of Charles; whereas it was not to any such single event that the balancing system owed either its origin or refinement, but to the progress of society, which placed the whole states of Europe in the same relative situation in which the states of Italy were at that period, and taught them not to wait for an actual invasion, but to see a Charles at all times in every prince or commonwealth that should manifest the least desire of change." (Brougham's *Colonial Policy*, b. iii. § 1.) What is here said as to the origin of the balancing system is no doubt true. We have already stated that the principle on which it rests is a principle of our common nature, which cannot fail to manifest itself in certain situations; but that nations must have arrived at an advanced stage of civilization and intercourse before it can be acted upon with consistency and concert. It would therefore be absurd to represent that system as taking its rise in any single event, or its principle as a discovery of some long-sighted statesman. But Dr Robertson knew human nature too well to seek the origin of this principle in an accidental occurrence; and he knew history too well to fix its origin "as a consequence" of Charles's invasion. On the contrary, throughout the whole of his masterly chapter on the progress of the nations of Europe, with respect to the command of the national force requisite in foreign operations, he speaks of this system as holding progress with the growing improvement and intercourse of these nations; and, so far from representing the principle of the balance of power as a discovery consequent upon the event alluded to, he expressly speaks of the league against the French monarch as only exemplifying an extension of those ideas which had long been familiar to the Italian statesmen "in regulating the operations of the petty states in their own country." (*View of the Progress of Society*, § 2.)

Before concluding these very general remarks on the rise of the balancing system in modern times, we shall briefly advert to a conjecture of M. Villers upon this subject, which occurs in his able work on the Reformation. Long before the states of Europe became united in a general system, Italy and Germany, he observes, had formed partial systems, with a view to restrain the members within them, each by the other, and thus maintain a balance of power. It is possible, he adds, that the idea of the *general* balance of Europe may have been copied from these partial confederacies. (*Essai sur l'Esprit et l'Influence de la Réformation*, 2de partie.) This conjecture, if we rightly understand the learned author, appears to us exceedingly unphilosophical. The states of Europe embraced the idea of a balance of power in proportion as their circumstances enabled them to act upon it, and not in consequence of any estimate of its effects, as displayed on those earlier and narrower stages of its agency.

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3. It appears, then, to have been about the beginning of the sixteenth century that the principle of maintaining a balance of power came to be generally recognised and acted upon by the states of Europe; "at first," as M. Gentz says, "more in a practical way, and, as it were, from political instinct, but afterwards with clear, reflecting, and methodical constancy." (*Fragments.*) What the advantages were which Europe reaped from this course of policy we shall endeavour to show, after we have adverted to certain arguments generally employed by those who wish to give an unfavourable view of the balancing system.

General results and recent history of this system.

By some this system is represented as productive only of wars; as but a convenient pretext to cover projects of ambition, or to screen the restless movements of national jealousy. Others talk of it as being merely a brilliant conception, and appeal to the many violences and usurpations which modern history records, as proofs, if not of its nonentity, at least of its inefficacy. But there is surely no great respect due to that sort of estimate of the system which is founded solely on the abuses to which it is liable, or upon imperfections from which no human institution is free. They who decry or who ridicule the balancing system should be prepared to show, not that it has sometimes afforded plausible pretexts for unnecessary wars, or has sometimes failed to protect the weak against the outrages of the strong, but that it is wholly useless to interest ourselves in the safety of neighbouring nations; to take any trouble to avert dangers which are yet distant; or to seek to strengthen ourselves against a powerful enemy with any strength not our own. This view of things, were it to prevail, would, as M. Gentz observes, open the most desirable prospects to every sovereign whose power and ambition might prompt him to aspire to universal domination.

It must, we think, appear obvious to every one who reflects upon the subject, that the balancing system is, upon the whole, favourable to peace. The wars which peculiarly belong to it are in the nature of a sacrifice of a smaller present, to secure a greater future good; and the tendency of the system is to render these wars less and less frequent. The evil passions which give rise to ambitious attacks, like all other evil passions, will be more apt to be indulged the less exposed they are to opposition or restraint. And it cannot be questioned that, in proportion as the maxims of this system are vigilantly and steadily pursued, there will be less inducement, because less prospect of success, for ambitious undertakings.

Its object is to alarm, and to arm all against the prince whose power prompts him to transgress upon others; and the prince who knows that all his motions are keenly watched, and that his first successes would only expose him to a more extended contest, must see how hopeless would be any attempt to possess himself of the territories even of the weakest of his neighbours. Such is the general tendency of the system; and however it may have occasionally failed to prevent outrages, it cannot be doubted that it has proved a formidable barrier against conquest, and a rampart of defence to the weaker states.

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The complaint of a certain class of French politicians, alluded to by Mr Burke in his *Letters on a Regicide Peace*, "that Rome had frequently acquired more territory in a *single year*, than all the power of France, actuated by all her ambition, had enabled her to acquire *in two centuries*," forms, in fact, though unintended, one of the finest panegyrics that could have been pronounced upon the salutary influence of the modern system. The advocates of that system can, indeed, appeal to history for the most satisfactory of all proofs of its efficacy, in the remarkable fact, that, for a period of nearly three centuries, no European state, however small, has lost its independence from external violence. When we recollect the number of small states which, during so long a period, enjoyed an independent existence in the immediate neighbourhood of powerful nations, and reflect for a moment on those evil passions which have, in all ages, prompted the strong to prey on the weak; we must admit that, but for that salutary jealousy of power, and united resistance to its encroachments, which it was the object and office of this system to nourish and enforce, these otherwise helpless states would have been speedily absorbed, or their independence annihilated, by the mighty masses with which they were in contact. It was not the preservation of such countries as Portugal or Holland, of Sweden or Denmark, which, though small compared with many others in the system, were yet possessed of considerable means of self-defence; —it was not the preservation of such states as these merely, but of a multitude of feeble communities in Germany, in Switzerland, and Italy, which affords the proudest proof of the salutary influence of the balancing system on the fortunes of modern Europe. "Consider, for instance," to use the impressive words of a distinguished writer and orator, "the situation of the republic of Geneva; think of her defenceless position in the very jaws of France; but think also of her undisturbed security, of her profound quiet, of the brilliant success with which she applied to industry and literature, while Lewis XIV. was pouring his myriads into Italy before her gates; call to mind that happy period when we scarcely dreamt more of the subjugation of the feeblest republic of Europe, than of the conquest of her mightiest empire; and say whether any spectacle can be imagined more beautiful to the moral eye, or which affords a more striking proof of progress in the noblest principles of true civilization." (Mackintosh's *Speech on the Trial of John Peltier, in* 1803.)[1]

Such were the results of the system founded on the balance of power. It was a bridle upon the strong and a bulwark to the weak. When it failed to prevent the inroads of violence and injustice, it yet acted as a restorative principle, and replaced injured nations in their former state of independence. It was at the memorable and fatal era of the partition of Poland in 1772 that it first lost this character; that the first example was set of a deliberate, successful, unchecked conspiracy against the independent existence of an unoffending country. It is here proper to mention, that some authors have spoken of this infamous transaction in terms which seem to imply that it was quite in consonance with the principles of the balancing system.[2] It is indeed true, that the maxims of that system were still so far operative as to effect a relative equality in the division of the spoil. But as the whole intention of this system is to maintain the integrity and independence of nations against unlawful attacks, the partition was just as diametrically opposite to its principle, as if the whole spoil had been appropriated by one robber, instead of being shared by three. The equality of the division did not take away from the danger of the example; the example of states combining, not to uphold, but to destroy,—not to enforce respect to the great principles of national safety, but to set them at defiance; an example too soon followed by similar violences, and which, in fact, paved the way for that total overthrow of the ancient system of Europe which ere long took place.

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The *origin* of a project so pernicious in its consequences is a matter of some interest in the history of the balancing system. We learn from Rulhière's *Histoire de l'Anarchie de Pologne*, published in 1807, that the distractions of this country had suggested the project of a partition as early as 1658; that a Swedish minister, named Stippenbach, proposed it to his own court, to Austria, and the grand duke of Prussia, whose armies were then in possession of the country; and that it would, in all probability, have been acted upon but for the discovery of the scheme by France, and the consequent interference of that power.[3] With regard to the project actually carried into execution in 1772, each party concerned was desirous to shift the blame of the first proposal on the others; but it was generally believed to have originated with Frederick, though some were of opinion that he was indebted for the idea to his brother, Prince Henry. Frederick, however, in one of his posthumous pieces (*Mémoires de* 1763 *jusqu'à* 1775), states that the scheme was devised by the empress Catharine; and this is corroborated by M. Rulhière, who asserts that she communicated it to Prince Henry during his visit to St Petersburg in 1770; a piece of information, he adds, which was detailed to him in the most circumstantial manner, by three different secretaries, who

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[1] We shall here add a striking passage in reference to our subject from this celebrated oration. "These small states were, in many respects, one of the most interesting parts of the ancient system of Europe. Unfortunately for the repose of mankind, great states are compelled, by regard to their own safety, to consider the military spirit and martial habits of their people as one of the main objects of their policy. Frequent hostilities seem almost the necessary condition of their greatness; and, without being great, they cannot long remain safe. Smaller states, exempted from this cruel necessity—a hard condition of greatness, a bitter satire on human nature—devoted themselves to the arts of peace, to the cultivation of literature, and the improvement of reason. They became places of refuge for free and fearless discussion; they were the impartial spectators and judges of the various contests of ambition which from time to time disturbed the quiet of the world. They thus became peculiarly qualified to be the organs of that public opinion which converted Europe into a great republic, with laws which mitigated, though they could not extinguish, ambition; and with moral tribunals to which even the most despotic sovereigns were amenable. If wars of aggrandizement were undertaken, their authors were arraigned in the face of Europe. If acts of internal tyranny were perpetrated, they resounded from a thousand presses throughout all civilized countries. Princes on whose will there were no legal checks thus found a moral restraint which the most powerful of them could not brave with absolute impunity. They acted before a vast audience, to whose applause they could not be utterly indifferent. The very constitution of human nature, the unalterable laws of the mind of man, against which all rebellion is fruitless, subjected the proudest tyrants to this control. No elevation of power,—no depravity, however consummate,—no innocence, however spotless,—can render man wholly independent of the praise or blame of his fellow-men."

[2] See, for example, the terms in which Count Hertzberg speaks of the partition, in his essay, *Sur la Balance du Commerce et celle du Pouvoir*. (*Œuvres*, tome i.) The language of M. Gentz upon this subject, in his able work, *L'Etat de l'Europe avant et après la Révolution Française*, is extremely exceptionable; but in his later work, referred to in this article, he condemns the partition as wholly inconsistent with, and as having in fact led to the subversion of, the balancing system.

[3] "J'ai retrouvé," says M. Rulhière, "dans les archives des affaires étrangères de France, cette anecdote importante, et jusqu'à présent ignorée." (Tom. i. p. 9.)

accompanied the prince to the Russian court. (Tome iv. p. 151–210.) It seems to be generally acknowledged, that the proposal, when first made to the cabinet of Vienna, was opposed by that power; and that her accession would not have been obtained but for the astonishing apathy displayed by France, and, indeed, by all the other states of Europe. The silence of England during the perpetration of this shameless plot against the independence of nations, if it can be accounted for, can never, at any rate, be excused; inasmuch as the fact appears pretty well established, that, had she, as the guardian of the political balance, raised her voice against the partition, Europe might have been saved from the fatal effects of that new system of robbery and oppression which the spoilers of Poland were suffered, without any sort of interruption, to exemplify. "To my certain knowledge," says Mr Burke, "if Great Britain had at that time been willing to concur in preventing the execution of a project so dangerous in the example, even exhausted as France then was by the preceding war, and under a lazy and unenterprizing prince, she would have at every risk taken an active part in this business." (*Thoughts on French Affairs in* 1791.)

Interest of Great Britain in the balancing system.

4. We have still to allude to the question, whether Britain, protected as she is on all sides by nature, ought to consider it as a necessary part of her policy to attend to the European balance of power? This has been considered as constituting a separate question, by some who make no doubt that the other states of Europe could not long preserve their independence secure by any other course. Taking the question generally, we do not think there is any great difficulty in regard to it. With the multitude, to be sure, it always will be popular to argue, that Britain stands in need of no other defence than what the seas and her invincible navy afford her, and that all continental connections are useless or pernicious. But the argument from the advantages of our insular situation would not in fact bear out this conclusion, even were the seas and the navy a stronger defence than it is possible they can always be. Our commerce and our colonies, the supports of that navy, render it indispensably necessary that we should more particularly observe some nations, and ally ourselves with others. These great concerns make it, indeed, nothing less than absurd to talk of our being *insulated* as an empire or state, because Britain is an island. And, with regard to invasion, it is clear that we could not always be as secure and as free from uneasy apprehensions, in a state of total insulation from foreign connections, as with friends and confederates to employ or oppose a formidable enemy on his own confines.

Balance of Power ‖ Balasore.

But supposing the balance of power to constitute a great national object, the line of conduct which that object imposes upon us may, no doubt, be affected by our insular situation. We may on some occasions allow other nations who are more exposed to danger, and who ought, on that account, to be more on the alert to prevent encroachments, to take the first measures, and bear the first expense of resistance. We may watch and warn, and use the influence of our remonstrances and our counsels, without having recourse, except in urgent cases, to the extremity of arms.[1] It is only, in a word, as to the *application* of the general principle, and not as to its being necessary and worthy to be entertained, that there seems any fair room for difference of opinion among British statesmen. In point of fact, all our later statesmen, however differing in other respects, have distinctly assented to the *general* doctrine, that the balance of power was an interest of the highest importance to England. The last time, we believe, that this question can be said to have been fairly brought into debate, and fully discussed in Parliament, was on occasion of the famous armament against Russia for refusing to restore Oczakov to the Porte; and on that occasion, though Mr Fox and his followers reprobated the armament in the strongest terms, they did so, not because they denied the great principle to which the minister appealed, as the sole justification of the measure, that the balance of power was a British concern, and gave Britain an undoubted interest to mingle in the affairs of the continent,—not because they thought that Britain ought never to guard against any distant danger,—but because there was no such degree of danger from the retention of that city and its district, as called upon this country to interfere at the risk of a war.[2] (M. N.)

Balance of Trade. See Political Economy.

Balas Ruby, a variety of spinel ruby. See Mineralogy.

Balasinore, in Western India, a town, the chief place of the native state of the same name, situate in the province of Guzerat. The territory of the ruling nawaub contains an area of 258 square miles, and a population of 19,000. In 1768 it was subjected to tribute by the Mahrattas, which, subsequently to 1818, when the peishwa was deprived of his supremacy, has been paid to the British. The town of Balasinore is distant from Bombay N. 280 miles; Lat. 22. 58. Long. 73. 20.

Balasore, a town and seaport of Hindustan, in the British district of Cuttack, within the province of Orissa. The town, which is long and straggling, is built along the banks of the Booree Bellaun River. The English, Dutch, French, and Danes, formerly had factories here; and traces of a Portuguese establishment are also to be found in the ruins of a small Roman Catholic chapel within the town. The English factory was burnt down in November 1688, when, on account of a rupture with Aurungzebe, Captain Heath attacked and plundered the town. Balasore is the principal port of the district, and is provided with dry docks on the banks of the river, to which vessels drawing not more than 14 feet water can be floated during spring tides. Balasore roads form an extensive bay, stretching from Point Palmyras to the mouths of the Hooghly; and as the navigation of this river to Calcutta is extremely dangerous, and requires skilful pilots, it is in these roads that those who

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[1] "Other nations must watch over every motion of their neighbours; penetrate, if they can, every design; foresee every minute event; and take part, by some engagement or other, in almost every conjuncture that arises. But as we cannot be easily nor suddenly attacked, it may be our interest to watch the secret workings of the several councils abroad; to advise and warn; to abet and oppose; but it never can be our true interest easily and officiously to enter into action, much less into engagements that imply action and expense." (Bolingbroke's *Idea of a Patriot King.*)

[2] Earl Grey, when the only survivor of that illustrious group of orators and statesmen who opposed the armament, repeatedly and forcibly declared his adherence to the general doctrine; affirming, that though the epithets *wild* and *romantic* had sometimes been applied to it, he nevertheless considered the poorest peasant in England as interested in the preservation of the balance of power; and that this country ought to interfere whenever that balance appeared to be really in danger. Of all those who joined in this opposition, Mr Burke was the only statesman who did so upon a ground, as it appears to us, equally erroneous in *fact* and *principle*, namely, that Turkey never had been, nor ought to be, taken into consideration, in any question as to the maintenance of the balance of power in Europe. (See *Debates in the House of Commons*, 29th March and 12th April 1791, and 29th February and 1st March 1792.)

Balaton ‖ Baldinger.

undertake that service wait the arrival of vessels. Balasore town is distant 116 miles S.W. from Calcutta. Lat. 21. 30. Long. 87. (E. T.)

BALATON LAKE, or PLATEN ZEE, in the S.W. of Hungary, 55 miles S.W. of Pesth. It is 46 miles in length, but of varying width, with a surface of 110 square miles, exclusive of the extensive marshes by which it is surrounded.

BALBI, ADRIAN, one of the most eminent geographers of modern times, was born at Venice in 1782. In 1820 he visited Portugal, and there collected materials for his well-known work entitled *Essai Statistique sur le Royaume de Portugal et d'Algarve*, &c., which was published at Paris in 1822; and this was followed by *Variétés Politiques et Statistiques de la Monarchie Portugaise*. This work contains some curious observations respecting that country under the Roman sway, and on the state of literature and the arts. In 1826 he published the first volume of his *Atlas Ethnographique du Globe*, &c., a work of great erudition, and embodying the researches of the most distinguished German philologists and geographers. In 1832 appeared the *Abrégé de Geographie*, which comprises the whole compass of that science, and procured for the author the highest reputation. This work, in an augmented form, was translated into the principal languages of Europe. Balbi afterwards retired to Padua, where he continued to pursue his favourite science with unabated ardour. Besides those already mentioned, Balbi was the author of several other works in the same department of science. He died on the 14th of March 1848.

BALBOA, VASCO NUÑEZ DE. See PERU.

BALBRIGGAN, a seaport of Ireland, county of Dublin, and parish of Balrothery, 18½ miles N.N.E. of the capital. The harbour, though dry at low tides, has a depth of 14 feet at high-water springs, and affords a good refuge from the E. or S.E. gales. It is formed by a pier 600 feet long, with a lighthouse at its extremity, in Lat. 53. 37. N. Long. 6. 12. W. The town has considerable manufactures of cottons and hosiery, and is much frequented as a watering-place in summer. Pop. (1851) 2310.

BALDI, BERNARDINO, a distinguished mathematician and miscellaneous writer, was descended of a noble family at Urbino, in which city he was born on the 6th of June 1533. He pursued his studies at Padua with extraordinary zeal and success, and is said to have acquired, during the course of his life, no fewer than sixteen languages, though, according to Tiraboschi, the inscription on his tomb limits the number to twelve. The appearance of the plague at Padua obliged him to retire to his native city, where, some time afterwards, his acquirements were the means of his obtaining from Ferrante Gonzaga the rich abbey of Guastalla. He afterwards visited Rome, where he was honoured with the title of apostolic protonotary. Returning to Urbino, he was employed by the duke, in 1612, as his envoy to Venice, where he distinguished himself by the congratulatory oration he delivered before the Venetian senate on the election of the new doge, Andrea Memmo, who on this occasion presented Baldi with a massive gold chain. Shortly afterwards he resigned the cares of his abbey, and retired into a private station, but he did not long survive this event. He died at Urbino on the 12th of October 1617. Baldi was perhaps the most universal genius of his age, and is said to have written upwards of a hundred different works, the chief part of which have remained inedited. His various works are evidence of his abilities as a theologian, canonist, mathematician, geographer, philosopher, antiquary, historian, orator, and poet. His life has been written by Affò, Mazzuchelli, and others. Baldi's *Coronica dei Matematici* is an abridgment of a larger work on which he had bestowed twelve years of labour, and which was intended to contain the lives of more than two hundred mathematicians.

BALDINGER, ERNST GOTFRIED, a German physician of considerable eminence, and the author of a great number of medical publications, was born near Erfurth, 13th May 1738. He was originally destined for the church; but having acquired a strong predilection for medicine, his father yielded to his wishes, and with this view he prosecuted his studies at Erfurth, Halle, and Jena. In 1761 he was intrusted with the superintendence of the military hospitals connected with the Prussian encampment near Torgau; and he there gave public lectures with great applause. Having acquired considerable experience in army practice by his assiduous attention to the duties of his office, he published, in 1763, a dissertation on the diseases of soldiers, which met with so favourable a reception from the public, that he enlarged the plan of his work, and republished it under the title of *Treatise on the Diseases that prevail in Armies*, Langensalz, 1774, 8vo. In 1773 he was appointed professor of medicine at Göttingen, where he enjoyed considerable reputation. He was afterwards professor of the theory of medicine at Jena; and in 1785 was promoted to a professorship at Marpurg, where he died of apoplexy on the 21st of January 1804. Among the number of his pupils were Akermann, Sömmering, and Blumenbach.

Baldinucci ‖ Baldwin.

His writings are exceedingly numerous: many of them are scattered in various collections and journals. No less than eighty-four distinct treatises are mentioned as having proceeded from his pen. He had collected an extensive library, consisting of 16,000 volumes, of which a catalogue was published after his death.

BALDINUCCI, FILIPPO, a distinguished Italian writer on the history of the arts, was born at Florence about 1624. His chief work is entitled *Notizie de' Professori del Disegno da Cimabue in quà, Secolo v. dal* 1610 *al* 1670, and was first published in six vols. 4to, in 1681–8. An edition in twenty vols. 8vo, with notes by Manni, was published at Florence in 1767–74. The capital defect of this work is his puerile attempt to derive Italian art from the schools of Florence; in which he has been often refuted, especially by Malvasia and Lanzi. Baldinucci died in 1696.

BALDOCK, a market-town of England, county of Hertford, and hundred of Broadwater, 37 miles N. of London. It is pleasantly situated in a valley on the Great North Road, and is well paved and lighted. Its principal street has several handsome buildings. The church is a spacious edifice, with a spire, three chancels, a curious font, and some monuments of its founders the Templars. There are also places of worship belonging to the Methodists, Independents, and Quakers; and several schools, almshouses, and other charities. Manufactures, beer, malt, and straw-plait. Pop. (1851) 1920.

BALDOCK, *Ralph de*, bishop of London in the reigns of Edward I. and II., was educated at Merton College, Oxford, became dean of St Paul's, was afterwards promoted to the see of London, and at last was made lord high chancellor of England. He wrote *Historia Anglica*, or a History of the British Affairs down to his own time; and *A Collection of the Statutes and Constitutions of the Church of St Paul.* The former, though it was seen by Leland, is not now extant; the latter is preserved in the library of that cathedral. He died at Stepney, July 24. 1313.

BALDRICK, a kind of girdle, richly ornamented, which in feudal times served to indicate the rank of the wearer. The term is sometimes applied also to the zodiac.

BALDWIN, THOMAS, a celebrated English prelate, was born of obscure parents at Exeter, where, in the early part of his life, he taught a grammar-school. After this he took orders, and was made archdeacon of Exeter; but he resigned that dignity, and became a Cistercian monk in the monastery of Ford in Devonshire, of which, in a few years, he was made abbot. In the year 1180 he was consecrated bishop of Worcester. In 1184 he was promoted to the see of Canterbury by Pope Lucius III., and by his successor Urban III. was

Baldwin ‖ Balen.

appointed legate for that diocese. He laid the foundation of a church and monastery in honour of Thomas à Becket at Hackington, near Canterbury, for secular priests; but being opposed by the monks of Canterbury and the pope, he was obliged to desist. Baldwin then laid the foundation of the archiepiscopal palace at Lambeth. In 1190 he crowned King Richard I. at Westminster, and soon after followed that prince to the Holy Land, where he died at the siege of Ptolemais or St Jean d'Acre. Giraldus Cambrensis, who accompanied him in this expedition, says he was of a mild disposition, and practised great abstinence. He wrote various tracts on religious subjects, which were collected and published by Bertrand Tissier in 1662.

BALDWIN, the name of nine counts of Flanders, the last of whom ascended the throne of Constantinople in 1204. There were also four kings of Jerusalem of this name, from 1100 to 1186, when the nephew of the last, then a child, was titular king until the capture of the city by Saladin in 1187. See CRUSADES.

BALE, JOHN, bishop of Ossory, in Ireland, was born at Cove, near Dunwich in Suffolk, in the year 1495. At twelve years of age he was entered in the monastery of Carmelites at Norwich, and thence sent some years afterwards to Jesus College, Oxford. He was educated a Roman Catholic, but was afterwards converted to the Protestant religion by Thomas Lord Wentworth. On the death of Lord Cromwell the favourite of Henry VIII., who had protected him from the persecutions of the Romish clergy, he was obliged to fly, and took refuge in Flanders, where he continued eight years. Soon after the accession of Edward VI. he was recalled; and being first presented to the living of Bishop's Stocke (Bishopstoke), in Hampshire, in 1552 he was nominated to the see of Ossory. During his residence in Ireland he was remarkably assiduous in propagating the Protestant doctrines; but with little success, and frequently at the hazard of his life. On the accession of Queen Mary the tide of opposition became so powerful that, to avoid assassination, he embarked for Holland; but was so unfortunate as to be first taken by a Dutch man-of-war, and robbed by the captain of all his effects; then forced by stress of weather into St Ives in Cornwall, where he was arrested on suspicion of treason. Having obtained his release, however, after a few days' confinement, the ship in which he had embarked anchored in Dover road, where he was again seized on a false accusation, but soon liberated. On his arrival in Holland he was kept prisoner for three weeks, but at length obtained his liberty on paying L.30. From Holland he travelled to Basil in Switzerland, where he continued till Queen Elizabeth ascended the throne. After his return to England he was in 1560 made prebendary of Canterbury; where he died in November 1563, in the sixty-eighth year of his age. He was the author of many works, the most noted of which is his collection of British Biography, entitled *Illustrium Majoris Britanniæ Scriptorum Catalogus, a Japheto sanctissimi Noah filio ad An. Dom.* 1559. This work was first published in quarto in 1548, and afterwards, with various additions, in folio, 1557–59. Ames and Herbert have given a long list of his other works; and Tanner has given a list of his manuscripts, with the names of the places where they are preserved.

BALEARIC ISLANDS. The appellation is commonly derived from *βαλλεῖν, jacere*, because the inhabitants were excellent slingers. They are two in number, the Major and Minor; hence the modern names. See MAJORCA and MINORCA.

BALECHOU, JEAN-JACQUES-NICOLAS, an eminent French engraver, born at Arles in 1715; died at Avignon in 1765. His works are distinguished by decision and vigour, but are sometimes hard in the details. His chef-d'œuvre is the portrait of the king of Poland.

BALEN, HENDRICK VAN, historical and portrait painter, was born at Antwerp in 1560. He was a disciple of Adam van Oort; but quitting that master, he pursued his studies at Rome, where he resided for a considerable time. He died in 1632. All the historical subjects painted by Van Balen have merit. His designs of the Deluge, of Moses Striking the Rock, and the Drowning of Pharaoh, are meritorious compositions. His Judgment of Paris is accounted a masterly performance; and the figure of Venus, in particular, is exceedingly admired. He was Van Dyk's first master.

Bales ‖ Balfour.

BALES, PETER, a famous caligraphist, and one of the first inventors of short-hand writing. He was born in 1547, and is described by Anthony Wood as a "most dexterous person in his profession, to the great wonder of scholars and others." We are also informed that "he spent several years in sciences among Oxonians, particularly, as it seems, in Gloucester Hall; but that study which he used for a diversion only, proved at length an employment of profit." He is mentioned for his skill in micrography in Hollingshed's Chronicle, anno 1575. "Hadrian Junius," says Evelyn, "speaking as a miracle of somebody who wrote the Apostles' Creed and the beginning of St John's Gospel within the compass of a farthing: what would he have said of our famous Peter Bales, who, in the year 1575, wrote the Lord's Prayer, the Creed, Decalogue, with two short prayers in Latin, his own name, motto, day of the month, year of the Lord, and reign of the queen, to whom he presented it at Hampton Court, all of it written within the circle of a single penny, inclosed in a ring and borders of gold, and covered with a crystal so accurately wrought as to be very plainly legible; to the great admiration of her Majesty, the whole privy-council, and several ambassadors then at court?" Bales was likewise very dexterous in imitating handwritings, and about 1576 was employed by Secretary Walsingham in certain political manœuvres. We find him at the head of a school near the Old Bailey, London, in 1590, in which year he published his *Writing Schoolmaster, in three parts.* In 1595 he had a great trial of skill in the Blackfriars with one Daniel Johnson, for a golden pen of L.20 value, and won it; and a contemporary author further relates that he had also the arms of caligraphy given him, which are azure, a pen or. Bales seems to have died about the year 1610.

BALEY, WALTER, physician in ordinary to Queen Elizabeth, was born at Portsham in Dorsetshire, in 1529, and died in 1592. Having taken his degrees in arts at Oxford, he practised physic; and in 1558 was proctor of the university. About this time he obtained a prebend of Wells, which he resigned in 1579. In 1561 he was appointed queen's professor of physic; in 1563 took his degree of M.D.; and afterwards became one of Her Majesty's physicians in ordinary. His works are, *A Discourse of certain Baths in the County of Warwick, near Newnham-Regis*, 1587, 8vo; *A Discourse of three kinds of Pepper in common use*, 1588, 8vo; *Brief Treatise of the Preservation of the Eyesight*, first printed in the reign of Elizabeth in 12mo, afterwards at Oxford in 1616, 1654, and 1673, 8vo; *Directions for Health, Natural and Artificial, with Medicines for all Diseases of the Eyes*, 1626, 4to.

BALFOUR, SIR JAMES, of Pittendreich, at one time lord president of the Supreme Court in Scotland, an intriguing and corrupt man of the stormy period of the sixteenth century. He was the author of a collection of the statutes entitled *The Practicks.* See SKENE, Sir John.

BALFOUR, *Sir James*, Bart., of Denmylne and Kinnaird, lord lyon king-at-arms in the reigns of Charles I. and II., was eminent as an annalist, a lawyer, and antiquary. He appears to have been an able and indefatigable collector of MSS., and left, besides his *Annales of Scotland*, sixteen treatises on genealogies and heraldry. Some of his works are preserved in the Advocates' Library at Edinburgh, together with his correspondence; from which rich collection

Balfour || Balguy.

Mr Haig published *Balfour's Annales of Scotland, from the zeire* 1057 *to* 1603, in 4 vols. 8vo.

BALFOUR, *Robert*, a learned Scotchman, born about the year 1550, who was for many years principal of the Guienne College at Bordeaux. His principal work is his Commentary on the Logic and Ethics of Aristotle (Burdig. 1616–20, 2 tom. 4to), which is described by Dr Irving (*Lives of the Scottish Writers*) as uniting vigour of intellect with great extent and variety of learning. Balfour was one of the most learned men of the time, and is spoken of by Dempster as the "phœnix of the age," the "stay of his countrymen," and the "glory of his nation."

BALFROOSH, a large commercial town of Persia, province of Mazanderan, on the river Bahbool, which is here crossed by a bridge of nine arches, about 12 miles distant from the southern shore of the Caspian Sea. It is built in a low, swampy, though rich country; and, from the deep and almost impassable roads which lead to it, seems not at all favourably situated for the seat of an extensive inland trade. It is, however, peopled entirely by merchants, mechanics, and their dependants; and is wholly indebted for its present size and importance to its commercial prosperity. The town is of a very peculiar structure and aspect. It is placed in the midst of a forest of tall trees, by which the buildings are so separated from one another, and so concealed, that except in the bazaars it has no appearance of a populous town. The streets are broad and neat, though generally unpaved; and they are kept in good order. No ruins are to be seen, as in other Persian towns; the houses are comfortable, in good repair, and roofed with tiles; and they are inclosed by substantial walls. According to Fraser, by whom it was visited in 1822, Balfroosh had a plain and simple air of plenty, ease, and comfort, attended with a bustle and show of business which is rarely to be seen in the Persian towns. There are no public buildings of any importance. The only places of interest are the bazaars, which extend fully a mile in length, and consist of substantially-built ranges of shops, covered with a roof of wood and tiles, and well stored with commodities. There are about ten principal caravanserais, several of which are attached to the bazaar, and are let as warehouses for goods; and from twenty to thirty medresses or colleges, the place being as much celebrated for learning as for commerce. At the time of Fraser's visit, it was said to contain 200,000 inhabitants; but this was probably an exaggeration; and since that time the plague and the cholera have committed great ravages, so that at present there may not be above 50,000. It is 20 miles W. of Sori. Long. 52. 42. E. Lat. 36. 37. N.

BALGUY, JOHN, an eminent English divine, born at Sheffield, in Yorkshire, in 1686. He was admitted of St John's College, Cambridge, in 1702; and having taken the degrees of B.A. and M.A., he soon after quitted the university. In 1711 he obtained a small living, and in 1729 was preferred to the vicarage of Northallerton, which he retained till his death in 1748. Besides sermons and various theological tracts, he published a philosophical work on the *Foundation of Moral Goodness*, written in answer to Dr Hutcheson's work on the *Origin of our Ideas of Beauty and Virtue*. Some of these pieces were collected by the author into one volume, and published with a dedication to Bishop Hoadley.

BALGUY, *Thomas*, D.D., son of the above, was born in 1716. After studying in St John's College, Cambridge, he was in 1746 presented to the rectory of North Stoke, in Lincolnshire. He afterwards became archdeacon of Salisbury, and of Winchester, in succession. He was offered the bishopric of Gloucester in 1781, but was prevented from accepting it by the declining state of his health. He was afterwards afflicted with blindness, and died at Winchester in January 1795. Besides sermons and charges, he was the author of a very able and well-known work, entitled *Divine Benevolence asserted, and vindicated from the Reflections of Ancient and Modern Sceptics*, 8vo, 1782.

Balharry || Balk.

BALHARRY, a town and fortress of Hindustan, situated on the W. side of the Haggry River, 187 miles N. from Seringapatam, and the capital of the British collectorate of the same name. The population, exclusive of military, is returned at 30,426. Elevation above the sea, 1600 feet. Lat. 15. 8. Long. 76. 59.

The district, of which the town is the principal place, contains an area of 13,056 square miles, with a population of 1,229,599, and forms a portion of the Balaghaut or tableland of the Deccan. Upon the partition of Tippoo Sultan's dominions, Balharry fell to the share of the nizam, by whom it was ceded to the British in 1800, in commutation of subsidy. From its centrical position Balharry is removed from the full force of either monsoon, and the climate is consequently characterized by aridity; the annual rain-fall ranging from 12 to 26 inches.

BALI, BALLY, or LITTLE JAVA, one of the Sunda Islands, in the Eastern Seas, separated from Java by the straits of the same name, which are three miles wide. It is a large island, being seventy-five miles in length by forty in breadth. A chain of mountains crosses the island in a direction E. and W., and terminates on the E. in the volcanic peak of Bali. The climate and soil are the same as in Java; it has mountains of proportionate height, several lakes, and streams well fitted for the purposes of irrigation. Rice is produced in great quantities, and two crops are raised in the year; while in the dry season the lands yield a crop of maize. The other productions are tobacco, oil, and salt; also cotton of an excellent quality. The inhabitants, though originally sprung from the same stock as those of Java, exceed them in stature and muscular power, as well as in activity and enterprising habits. "They have," says Sir Stamford Raffles, "a higher cast of spirit, independence, and manliness than belongs to any of their neighbours." They are also more moral, not being addicted to drunkenness or licentiousness, though they indulge in the practice of eating opium. Their favourite amusements are gambling and cock-fighting, to which they devote themselves with all the vehemence and energy of their character. They are inferior to their neighbours the Javanese in mechanical art and industry. Cotton is spun into yarn, and made into cloth by the women. Knives, and warlike instruments, such as matchlocks, are also manufactured. The principal exports are rice, edible birds' nests, coarse cloths, cotton yarn, salted eggs, &c. The imports are opium, betel nut, ivory, gold, and silver. The traffic in slaves was formerly great; all prisoners of war, insolvent debtors, and those who attempted to evade the laws against emigration, being reduced to the condition of slaves. The Hindu superstition is prevalent here. The island is divided into eight states, each under its own chief, subject to the Dutch. The total population is estimated at 800,000. (Raffles's *History of Java*; Temminck's *L'Inde Achipélagique*.)

BALIOL, or BALLIOL, SIR JOHN DE, founder of Baliol College in Oxford, was the son of Hugh Baliol, of Bernard's Castle, in the diocese of Durham, and very eminent on account of his power and riches. During the contests between Henry III. and his barons he firmly adhered to the king. In 1263 he began the foundation and endowment of Baliol College, which was afterwards perfected by his widow, Dervorgille. He died in 1269. His son, John Balliol, was the competitor with Bruce for the crown of Scotland.

BALIZE. See HONDURAS.

BALK, or BALKH (the ancient kingdom of Bactria), a province of Central Asia, now a dependency of the khanat of Bokhara, lying between Lat. 35. and 37. N., and Long. 63. and 69. E. The country of Balk is bounded by the Oxus on the N., by the great mountain range of the Hindu

Balk ‖ Ballad.

Khoh and Paropamisus on the S., by Badakshan on the E., and generally by sandy deserts on the W. It is said to extend 250 miles from E. to W., and from 100 to 120 miles from N to S. Towards the S. the country abounds in hills which branch out from the Hindu Khoh range. Here the soil is generally stony, though it has many well-watered valleys. The central portion of the country is level, fertile, and well watered, from the vicinity of the hills; while towards the N., near the stream of the Oxus, it is sandy and barren. The western part of the country of Balk, which borders on the desert, is of a similar nature; but in the E. there are mountainous tracts which are well watered, and occasionally fertile. The country descends very rapidly from the mountain range of Hindu Khoh, and towards the Oxus is of a lower level and of a much hotter climate than those parts of Afghanistan which lie to the S. of these mountains. Balk is inhabited by the Usbek-Tatars, Tanjiks, and Arabs. The total population is estimated at 1,000,000.

Balk, or *Balkh* (the ancient Bactra), formerly a great city, is now an immense and desolate mass of ruins, situated on the right bank of the Adirsiah, or Balk River, in a large and fertile plain, 1800 feet above the sea. These ruins consist chiefly of fallen mosques and decayed tombs built of sun-dried bricks, and occupy a space of about twenty miles in circuit. None of these ruins are of an age prior to Mahometanism. Balk is still called by the Asiatics "Mother of Cities," but its population, which once numbered some hundred thousands, now scarcely amounts to 2000. This city is said to have been built by Kaiomurs, the founder of the Persian monarchy; and here the archi-magus resided till the followers of Zoroaster were overcome by the khalifs. Zenghis Khan sacked the city, and butchered its inhabitants; and under the house of Timour it became a province of the Mogul empire. Balk formed the government of Aurungzebe in his youth, and was at last invaded by the great Nadir. Under the Dooranee monarchy it fell into the hands of the Afghans; and for the last twenty years it has been in the possession of the Khan of Bokhara. (See Burnes's *Travels in Bokhara.*)

BALKAN, the lofty mountain range that separates the waters of the Lower Danube from those that flow into the Archipelago. The name, however, has been extended to the whole mountain group that stretches from the Adriatic to the Euxine. The highest point of this range, Mount Orbelus, is 9000 feet above the sea. It rises to the W. of the town of Sophia.

BALLAD is a word frequently used as synonymous with *song;* but it properly denotes an historical song, or a song containing a narrative of adventures or exploits either serious or comic. It is one of the most ancient species of composition, and still constitutes a great portion of the literature of the more uncivilized tribes of mankind. Giovanni Finati, who supplies us with much information respecting the manners and customs of the East, has recorded the following anecdote of ballad-literature among the Benysackr Arabs, whom he found encamped near the shores of the Dead Sea. Their chief Ibn Fays, he states, "had strangers with him from Damascus, and feasted his guests so plentifully, that the wooden dish out of which we all fed had four iron handles to it, and required three persons to lift it and set it before us. Afterwards, a great earthen pan of grease was lighted as a lamp for the company, and Ibn Fays himself, and his brother, sung a sort of slow plaintive ballad to an instrument with one string, the purport of which was the tragic account of a battle against a neighbouring tribe, in which their own father perished."[1] The leader of this wandering horde might himself be the author, as well as the reciter, of the ballad which thus regaled his guests. Ballad.

Most of the nations of modern Europe have considerable collections of the ballads which delighted their forefathers; and in some countries the political influence of such compositions has been found to be very powerful. "Of these," says Dr Aikin, "the most copious source is party; and there has seldom been an occasion of political contest in countries permitting such freedoms, in which appeal has not been made to the popular feelings by means of comic and satirical ballads, often with great effect. The share that *Lillibulero* had in producing the Revolution in this country has been noticed by grave historians. In the war of the Fronde in France, ballads were a weapon as much employed as muskets, and those written for and against Cardinal Mazarin filled several volumes. The French give to these compositions the appropriate title of *Vaudeville*, implying their fitness to walk the streets; and indeed street-poetry in general belongs to the ballad class."[2] The Spaniards,[3] and other nations of the south, have preserved ample collections of their early ballads; but the affinity of our own nation and tongue with those of the northern tribes, renders their literary reliques an object of more particular interest. The various tribes of Scandinavians have generally been distinguished for their love of poetry. Many ancient reliques of Icelandic poetry are still preserved, and are regarded as very curious specimens of the literature of the different ages to which they belong; nor are the kindred nations of Sweden and Denmark without their early and recent poets, some of whom have attained to high reputation. Of the ballad-poetry of these northern nations, many remnants have descended to our times; and ample collections of Danish, Swedish, and even Feroese ballads have recently been published by respectable editors. "The songs mentioned by Tacitus in his account of the Germans," says Mr Jamieson, "those collected by the order of Charlemagne, and those which the Goths brought with them out of the East, are now not to be found; yet it is more than probable that much more of them is preserved, in however altered a form, than we are aware of; in the elder Northern and Teutonic romances, the Danish and Swedish, Scottish and English popular ballads, and those which are sung by old women and nurses, and hawked about at fairs, in Germany."[4] The same ingenious and well-informed writer has elsewhere expressed his conviction, that many of the traditionary ballads still current in this kingdom have been preserved in the north of England and the lowlands of Scotland, ever since the arrival of the Cimbri in Britain.[5] Many of our historical ballads may at all events be considered as the productions of a remote period; but it is not to be supposed that they have been transmitted from one generation to another without innumerable transformations. A great proportion of them have doubtless been preserved by oral tradition; and they seem in general to have undergone such changes as brought them nearer to the current speech of each successive generation; for, without this progressive adaptation, the lapse of a few centuries would have rendered them unintelligible to the great body of the people; nor is it usual for any combination of words to be retained in the memory without being understood. Thus, for example, we have reason to believe that the ballad of Sir Patrick Spence derives its origin from a very early age; but the variations to which it must gradually have been subjected, may easily

[1] *Narrative of the Life and Adventures of Giovanni Finati*, translated by William John Bankes, Esq. vol. ii. p. 272. Lond. 1830, 2 vols. 8vo.

[2] Aikin's *Essay on Song-Writing* (p. xviii.), prefixed to *Vocal Poetry, or a Select Collection of English Songs.* Lond. 1810, 8vo.

[3] See the introduction to Depping's *Sammlung der besten alten Spanischen Historischen Ritter und Maurischen Romanzen.* Altenburg und Leipzig, 1817, 12mo.

[4] *Illustrations of Northern Antiquities*, p. 246. Edinb. 1814, 4to.

[5] Jamieson's *Popular Ballads and Songs*, vol. ii. p. 87. Edinb. 1806, 2 vols. 8vo.—See however Finlay's *Scottish Historical and Romantic Ballads*, vol. i. p. xxv. Edinb. 1808, 2 vols. 8vo.

Ballad. be inferred from a comparison of the different copies which are now to be found.[1] A story may thus be preserved, when most of the original words have been changed. The close affinity between the old Danish and the old Scottish and English ballads has been noticed by various writers, by Pinkerton, Jamieson, Nyerup, Geijer, and Grimm:[2] their resemblance is to be traced in the general spirit and contrivance of the poems; while some of the Danish and Scottish ballads exhibit a remarkable coincidence in their particular stories. Whether these effects are to be imputed to so remote a cause as the emigration of the ancient Scandinavians, may however admit of much doubt and hesitation. Fiction moves from one region to another with very elastic steps, and in many instances it is impossible to trace her progress.

The earliest collector of Danish ballads was Anders Sörensön Vedel, chaplain to the king of Denmark, and an intimate friend of the celebrated astronomer Tycho Brahé. His publication bears the title of a hundred select Danish ballads, or *Et hundrede vduaalde Danske Viser*. Ribe, 1591, 8vo. It is now a very rare book, even in Denmark; but a copious account of it is given by Nyerup, in the last volume of the more recent collection of *Danske Viser*. After an interval of more than a century, another clergyman, Peder Syv, reprinted this collection of Vedel, and added an equal number of ballads. Kiöbenhavn, 1695, 8vo. But the most extensive collection appeared under the following title: *Udvalgte Danske Viser fra Middelalderen;* efter A. S. Vedels og P. Syvs trykte Udgaver, og efter haandskrevne Samlinger, udgivne paa ny af Abrahamson, Nyerup, og Rahbek. Kiöbenhavn, 1812–14, 5 bind. 8vo. This work is accompanied with notes and illustrations, and appears to us to possess no inconsiderable value. A similar collection of Swedish ballads was published by Geijer and Afzelius: *Svenska Folk-Visor fran Forntiden*, samlade och utgifne af Er. Gust. Geijer och Arv. Aug. Afzelius. Stockholm, 1814–16, 3 del. 8vo. These volumes are accompanied with music, printed in a quarto form. Of Feroese ballads there is a recent collection: *Færöiske Qvæder om Sigurd Fosnersbane og hans Æt*, med et Anhang: samlede og oversatte af Hans Christian Lyngbye, Sognepræst i Gjesing; med en Indledning af P. E. Müller, Dr. og Prof. i Theol. Randers, 1822, 8vo. Dr Müller, the author of the introduction, is a learned and able writer, well known as the author of more important works.

Debes mentions that, at their weddings, and at Christmas, the Feroese were accustomed to "recreate themselves with a plain dance, holding one another by the hand, and singing some old champion's ballad."[3] These islands were peopled in the ninth century by a colony of Norwegians.[4] The language of the people, as it appears in these ballads, is removed to a considerable distance from the Icelandic as well as the Danish. The plan of publishing a Feroese dictionary was formed about seventy years ago; and the English prospectus printed upon that occasion furnishes so curious and entertaining a specimen of the language, that we are tempted to insert it with all its peculiarities.

"*Subscription.*—We are minded after many years troublesome Collection to acquaint the World with the Tongue, used upon the Isles of Fero, a Dialect of the old noble Tongue in former Times written and spoken in Norway, Denmark, Island, Swede, and in a good Deal of the english Dominion. Now it appears for the world translated in Latin, Danish, and conferr'd with the islandsh Tongue.

"If we were men of Wealth, we would not forbear to Regard the Expenses of printing this Dictionary as a great Trifle, because it, very likely, not will exceed a good Volume in 4to; but we are poor-men. Nevertheless we hope to bring it forth by Way of Subscription, and for that Reason, We invite hereby our Neighbours, the brave and Reasonable Englishmen to Deal with us the Honour of bringing this Dialect out of the Darkness, wherein it lies, and let it see the Day-Liht. No-Body of our Countrymen, as we know, has thought this before. Ballast ‖ Ballet.

"Perhaps this moment in our Life, that has been the first in Time for this Purpose, will be the Last, and no body afterwards would attend it. The Price will be 2 pence a Sheet, and upon good Paper 3 pence.

"*N. Mohr. J. C. Svabo.*"

The two pages which follow are divided into columns, for the *Names of the Subscriptors* and the *Number of Exemplars;* but it appears that the well-meaning and painstaking creatures met with too little encouragement to proceed in their enterprise. The prospectus is without a date; but we learn from Müller and Nyerup that Svabo was employed in collecting Feroese ballads in the years 1781 and 1782. (D. I.)

BALLAST, any heavy matter, as stone, gravel, or iron, thrown into the hold of a ship, in order to make her sink a proper depth in the water, that she may be capable of carrying a sufficient quantity of sail without upsetting. To ballast a ship properly, the materials should be so disposed that she may be duly poised, and maintain a proper equilibrium on the water, without either being too *stiff* or too *crank*, which are conditions equally pernicious. Stiffness, in ballasting, is occasioned by disposing a great quantity of heavy ballast, as lead or iron, in the hold, which naturally places the centre of gravity very near the keel; and that being the centre about which the vibrations are made, the lower it is placed, the more violent will be the motion of rolling Crankness, on the other hand, is occasioned by having too little ballast, or by disposing the ship's lading so as to raise the centre of gravity too high, which also endangers the mast when it blows hard. For, when the masts are deflected from the perpendicular, they strain on the shrouds in the nature of a lever, which increases as the sine of their obliquity.

Ships are said to be *in ballast* when they have no other loading. Masters of vessels are obliged to declare the quantity of ballast they bear, and to unload it at certain places. They are prohibited unloading their ballast in havens, roadsteads, &c., the neglect of which prohibition has ruined many excellent ports.

BALLATER, a village of Aberdeenshire, on the River Dee, 42 miles from Aberdeen. It is much resorted to in the summer season, on account of the romantic scenery in the vicinity, and the fine medicinal wells at Pananich, about two miles distant.

BALLENDEN, John. See Bellenden.

BALLENSTEDT, a city in the duchy of Anhalt-Bernburg. It is situated in the Hartz Forest, in a most picturesque district, selected for a seat of the sovereign, whose castle is accommodated with the usual appendages of courtly residences. The city, besides the court, contains about 3800 inhabitants, who are very industrious in linen manufactures, gardening, &c.

BALLET (derived through the Italian *ballare*, from the

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[1] Percy's *Reliques of Ancient English Poetry*, vol. i. p. 81. Scott's *Minstrelsy of the Scottish Border*, vol. i. p. 7. Jamieson's *Popular Ballads and Songs*, vol. i. p. 157.—See Motherwell's *Minstrelsy, Ancient and Modern*, p. xliv. Glasgow, 1827, 4to.

[2] Pinkerton's *Enquiry*, vol. i. p. 364. Jamieson's *Ballads*, vol. ii. p. 87. Nyerup, *Danske Viser*, Bind. v. S. 12. Geijer, *Svenska Folk-Visor*, del. i. s. liv.—The affinity between the old English and the old Danish ballads is noticed in the preface (S. xxxi.) to *Altdänische Heldenlieder, Balladen, und Märchen*, übersetzt von Wilhelm Carl Grimm. Heidelberg, 1811, 8vo.

[3] Debes's *Description of the Island and Inhabitants of Foeroe*, Englished by Dr Sterpin, p. 273. Lond. 1676, 12mo.

[4] Torfæi *Commentatio historica de Rebus gestis Færeyensium seu Faröensium*, p. 7. Havniæ, 1695, 8vo.

Ballina. Greek Βαλλίζειν, to dance) is a dramatic representation composed of dancing and pantomime guided by music.

The Greeks were the first who united the dance to their tragedies and comedies; not indeed as making part of those spectacles, but merely as an accessary.

The Romans, as usual, copied from the Greeks; but in the reign of Augustus they left their instructors far behind them. At that time a new species of entertainment was brought upon the stage, and carried to an astonishing degree of perfection. Nothing was then talked of but the wonderful performances of Bathyllus, Pylades, and Hylas, who were the first to introduce among the Romans what the French call the *ballet d'action*, in which the performer is both actor and dancer.

The enthusiasm excited among the Roman public by these celebrated *pantomimes* (*pantomimi*) was extraordinary. Pylades personified grave and tragic subjects, while Bathyllus excelled in the representation of the comic. Each had his school of disciples, and his host of partizans, whose eager rivalry often led to serious disturbances. The demoralizing effects of these exciting representations are severely noted by the great satirist Juvenal (vi. 63). These entertainments, though proscribed by some of the emperors, continued popular down to the fall of the empire. In the time of Augustus, only one actor appeared on the stage, representing singly the various parts in succession. About the end of the following century the number of performers was increased. No women took part in the public pantomimes till the last and worst period of the empire.

Buried with the other arts in the fall of the Roman empire, dancing remained uncultivated till about the fifteenth century, when ballets were revived in Italy at a magnificent entertainment given by a nobleman of Lombardy at Tortona, on account of the marriage of Galeas Duke of Milan with Isabella of Aragon. Every resource that poetry, music, dancing, and machinery could supply, was employed and exhausted on the occasion. The description given of so superb an entertainment excited the admiration of all Europe, and roused the emulation of several ingenious persons, who improved the hint by introducing amongst their countrymen a kind of spectacle equally pleasing and novel.

Female performers do not appear to have taken part in the various entertainments given at the opera in Paris till the 21st of January 1681, when the then dauphiness, the Princess of Conti, and some other ladies of the first distinction in the court of Louis XIV., performed a ballet in the opera called *Le Triomphe de l'Amour*. This additional attraction rendered the spectacle more lively than it ever had been at any other period; and it was received with so much applause, that on the 16th of May following, when the same opera was acted in Paris at the theatre of the Palais Royal, it was thought indispensable for its success to introduce female dancers. They have continued ever since to be the principal support of the opera.

A ballet perfect in all its parts, says Noverre, in his treatise on this subject, is a picture drawn from life, of the manners, dresses, ceremonies, and customs of all nations. It must therefore be a complete pantomime, and speak, as it were, through the eyes, to the very soul of the spectator. If it be deficient in point of expression, of situation, or of scenery, it degenerates into a spectacle equally flat and monotonous. (*Lettres sur les Arts Imitateurs, et sur la Danse en particulier*, 8vo. Paris, 1807.)

BALLINA, a seaport and market town of Ireland, county of Mayo, 18 miles N.N.E. of Castlebar. It is a neat clean place, pleasantly situated on the river Moy, which is here crossed by two bridges. Pop. in 1851, 4635. Ardnaree, on the opposite side of the Moy, is popularly included, making a total population of 6569. It has a parish and a Roman Catholic church, Baptist and Methodist chapels, a court-house, workhouse, hospital, dispensary, barracks, and several schools. The salmon fishery, and provision and fish curing, are important branches of its trade; and it has also breweries, flour mills, and manufactures of snuff and coarse linen. The amount of customs duty received in 1850 was L.5000. In 1798 Ballina was for a short time in the possession of the French under General Humbert.

Ballinahinch || Ballistic Pendulum.

BALLINAHINCH, a small town of Ireland, county of Down, seven miles W.N.W. of Downpatrick. It is much frequented in summer on account of a chalybeate spa about two miles N.W. of the town. Pop. in 1851, 1006.

BALLINASLOE, a town of Ireland, province of Connaught, 91 miles W.S.W. of Dublin. The River Suck, an affluent of the Shannon, divides it into two parts, the western being in the county of Galway and parish of Kilclooney, the eastern in the county of Roscommon and parish of Creagh. These are connected by a causeway across an island in the river and by two bridges. It is clean and well-built, and contains a handsome church, with a singular octagonal spire springing from scrolls. There are Roman Catholic and Methodist chapels, several public schools, district lunatic asylum, union workhouse, market-house, a savings-bank established in 1822, several flour mills, hat and coach factories, and breweries. Pop. in 1851, 6550. The great annual cattle fair, held from the 5th to the 9th of October, and for which Ballinasloe has long been celebrated, has latterly declined, as will be seen from the following table:—

	Sheep.			Horned Cattle.		
	Sold.	Unsold.	Total.	Sold.	Unsold.	Total.
1847	53,095	27,424	80,519	7,698	2,756	10,454
1848	57,287	9,758	67,045	7,297	865	8,162
1849	60,256	1,198	61,446	7,844	4,914	12,758
1850	51,668	2,404	54,072	9,395	6,400	15,795
1851	47,072	3,477	50,549	10,640	1,019	11,659

The number for sale in 1828 exceeded that of any other year since 1790, being 97,384 sheep and 11,513 horned cattle.

BALLINROBE, a small well-built town in Ireland, county of Mayo, situated on the Robe, 16 miles S.S.E. of Castlebar. It has a parish church, Roman Catholic chapel, several schools, and a union workhouse. Pop. in 1851, 2161.

BALLISTA, or Balista, a military engine used by the ancients for discharging darts, javelins, and stones. The name is derived from the Greek word *βάλλειν*, to *throw*. It would appear that the projectile force of these machines, in their several kinds, was derived from the torsion of ropes by means of a lever. Their power was very great, and indeed they may be said to have answered, in some degree, the purposes of modern artillery. The balista originally differed from the *catapulta*, which was used for discharging darts; but they are confounded by writers subsequent to the time of Julius Cæsar.

BALLISTEA, in *Antiquity*, songs accompanied by dancing, used on occasions of victory. Vopiscus has preserved a song of this kind sung in honour of Aurelian, who, in the Sarmatian war, was said to have killed forty-eight of the enemy in one day with his own hand. *Mille, mille, mille, mille, mille, mille decollavimus: Unus homo mille, mille, mille, mille decollavit; mille, mille, mille vivat, qui mille, mille occidit. Tantum vini habet nemo, quantum fudit sanguinis.* The same writer subjoins another popular song of the same kind: *Mille Francos, mille Sarmatas, semel occidimus; mille, mille, mille, mille, mille Persas quærimus.* The term is derived from the Greek *βάλλω*, I cast or toss, on account of the motions used in this dance, which consisted in elevating, swinging, and throwing round the hands. The *ballistea* were a kind of popular ballads, composed by poets of the lower class, with little regard to the laws of metre.

BALLISTIC PENDULUM, an ingenious machine, invented by Benjamin Robins, for ascertaining the velocity of

Ballistraria || Ballot.

military projectiles, and consequently the force of fired gunpowder It consists of a large block of wood, affixed to the end of a strong iron stem, having at the other end a cross steel axis, placed horizontally, about which the whole vibrates together like the pendulum of a clock. The machine being at rest, a piece of ordnance is pointed straight towards the wooden block or ball of this pendulum, and then discharged: in consequence of which the ball strikes, enters the block, and causes the pendulum to vibrate more or less according to the velocity of the projectile or the force of the blow; so that by observing the extent of the vibration, or the chord of the arc,—which is ascertained by means of a ribbon fixed to the lower extremity of the pendulum, and passed through a couple of steel edges something in the manner of a drawing pen,—the force of that blow becomes known, or the greatest velocity with which the block is moved out of its place, and consequently the velocity of the projectile which struck the blow and urged the pendulum. See Gunnery.

BALLISTRARIA, cruciform apertures in the walls of a stronghold, through which the cross-bowmen discharged their bolts. It also signified a projecting turret, otherwise called a bartizan, such as is commonly seen in the castles of the Border.

BALLOON. See Aeronautics.

Balloon, a kind of game somewhat resembling tennis, played in the open field, with a great ball of leather inflated with air, and driven to and fro with the strength of the arm.

Balloon, in the older chemistry, was the name for a spherical receiver used in distillation.

BALLOT (from the French *ballotte*, a little ball), a general expression for the practice of private voting, from its being usually accomplished by depositing a ball or ticket. Its most important signification in modern politics is when it is applied to the great question of the secret or public exercise of the suffrage in elections of members of the legislature. The *vindex tacitae libertatis*, as Cicero calls it—the giving effect to the exercise of opinion in such a manner as to defeat by secrecy the influence of other persons on him who has to exercise the function—has been sought after in many countries and times. In Greece the dikasts gave their verdict by ballot, according to arrangements varied from time to time. It was signified by a mark on a shell, or by the depositing of a ball or a stone, white or black according to the verdict; whence comes the proverbial reference to "a white stone" as connected with good fortune, and the expression "black-balling," which is sometimes even still practical as well as figurative. The Greeks, indeed, like the members of clubs and societies at the present day, had two methods of taking the vote—either by two balls and one box, or by two boxes and one ball. The well known ostracism was a species of condemnation by ballot, arising out of the old constitutional principle, that on questions of personal privilege—whether it were for conferring on the candidate what the ordinary citizen did not enjoy, or depriving him of his ordinary legal rights—the vote of a certain number of the citizens taken secretly was necessary. Of the ostracism as exercised in Athens, Mr Grote, who is a great champion of the ballot, gives an interesting vindication in his History of Greece, where he endeavours to show that, as a mere removal from the state without a forfeiture of property or position, or any other privation, it was the gentlest manner in which the republic could protect itself against those whose waxing power threatened a danger to the constitution, which, if not checked, might produce more disastrous effects, not only to the state, but to the aggrandizing citizen himself.

Among the Romans, just as we use the word ballot, *tabella* or *tabula*, a ticket, was employed to express the voting of the citizens or judges in comitia or courts of justice. In voting for a law there would be two tickets,—one inscribed V R. *uti rogas* or assent; the other A., the initial of *antiquo*—for the old law. When it was a case of election, the names of the candidates were written on the tabella, the voter putting a punctum or puncture opposite to the favoured name; and Cicero speaks of how many *puncta* a man will have in such a tribe, as we speak of the number of votes one will have in a ward. The tabellæ were cast into a cista, and the officers called *diribitores* are supposed to have been those who cast up the votes. The different laws from time to time establishing secret voting were called *Tabellariæ Leges*. Among these, the enactment most resembling the ballot in its modern acceptation, called the *Gabiana Lex*, for the election of magistrates, dates from about 140 years before Christ. Others are named the *Cassia Lex*, *Papinia Lex*, and *Cœlia Lex*.

Ballot.

Secret voting was a peculiarity of the Venetian senate, and the first shape in which the ballot was demanded in Britain was not for the purpose of elections, but of votes in parliament. In a work published after the Revolution, called *State Tracts, being a collection of several treatises relating to the Government, privately printed in the reign of King Charles II.*," a tract is reprinted, called "*The benefit of the Ballot, with the nature and use thereof;*" supposed to have been written by Andrew Marvell. Voting by ballot in the legislature was a frequent demand of the popular party in Scotland during the reign of Charles II., and in the revulsions against the court it was at one time carried out. Sir George Mackenzie mentions an instance of its use, where it was arranged that the lord clerk-register should hold a bag to receive the "billets" at the foot of the throne, and they should be then secretly examined and burned; "which form," he says, "was thereafter punctually observed: only the register having a rooted quarrel against Southesk, did mark his billet with a nip when he received it, and thereby discovered his vote." In this country secret voting is at the present day chiefly known in social clubs, where a small number generally have the power of ostracising any candidate for admission with whom they would dislike, for any private reason of their own, to associate. The election of officers and other acts of public or joint-stock bodies, are sometimes determined by private votes, as in the important instance of the proprietors of India stock. It is generally remarked that this attempt at secrecy is ineffective, and the votes of the respective stockholders are quite well known; but they do not themselves generally seek concealment.

In France, under the constitutional charter, secret voting existed in the chamber of deputies from 1840 to 1845, when it was abolished on a project of Duvergier de Hauranne accepted by M. Guizot, who thought the *scrutin secret* productive of abuse. No argument can be brought from the practice on this occasion, any more than from other instances of secret voting in the legislature, to bear on the question of secret voting in elections. The two things are quite distinct, and, according to British constitutional notions, antagonistic; for, while secrecy is demanded for the elector, on the ground that he is not and should not be responsible, the proceedings of the members of the legislature have been subjected to increasing publicity, on the ground that they are responsible to their constituents for the faithful performance of the trust reposed in them. Nor is there, perhaps, any sounder practical illustration of the question to be derived from the more extensive electoral applications of the vote by ballot in connection with the events which followed the revolution of 1848. In taking the very critical vote which justified the *coup d'état* of December 1851 and led to the establishment of the empire, it is known that fear of disturbance compelled Louis Napoleon to have recourse to secret voting, and that the effect was guarded both by a limitation of the vote to a simple yes or no to the question of the prolongation of the presidency, and by arrangements for taking the votes in small groups, which rendered concealment difficult.

Ballot.

The ballot is adopted in elections in several of the United States, and many arguments against it have been founded on its bad or ineffective operation there. It is said that the voter cannot preserve secrecy in presence of the popular coercion which renders it most necessary; that those to whom the secret arrangements are committed flagrantly betray their trust; and that the voters on either side of a contest are quite well known to the public at large. It must be remembered, however, that the characteristic defects of American elections are not those from which protection is sought in this country, nor are they of a kind for which the ballot is well adapted as a safeguard. There the evil to be obviated is the public and palpable coercion of the minority by the majority in the act of voting; in Britain it is the secret employment of individual influence away from the spot. The former influence may overbear, as it is said to do, the machinery for secrecy, but the latter has not the same means of accomplishing such an object.

In these references to experience may be traced some of the arguments which have at the present day been used in favour of and against secret voting. Among the arguments specifically brought forward against the proposal to adopt the system in England, it is said that the franchise is a trust which should be exercised with publicity, so that those interested may see how it is discharged. To this it is generally answered by the supporters of the ballot, that election is not a trust, but a function which each man must discharge according to what his own conscientious opinion, and not that of any other man, decides to be for the good of the community; and it is said that whoever ought to have any influence on an election, should enjoy it in the shape of a direct vote to be exercised by himself. Another argument used against the ballot has been, that it will be an enticement to falsehood, because voters will ever be induced to pledge themselves to particular sides, and under the protection of the ballot will falsify their pledges. The answer to this has generally been, that it may be a question whether it is a more immoral act to break a promise by voting according to conscientious opinion, or to vote against conscientious conviction in the coerced performance of a promise extracted by coercion. But it is generally maintained that secret voting will render such a balance of ethical difficulties unnecessary, because, as it will be impossible for the person who uses improper influence to be certain that it is efficacious, he will not have a sufficient prospect of success to tempt him to exercise it. Another argument against the propounders of secret voting has been, that were it the rule, any elector whose vote is desired by a person having an influence over him, would require to lead a life of hypocrisy, perpetually professing opinions which he does not hold, in order that the person exercising the influence may be led to believe that it has effectually entered into the nature of the voter and made him a partizan, whereas, under the system of open voting, he requires only to perform one act of hypocrisy—that of voting against his opinions—and is free to speak and act as he pleases in the other affairs of life. The answer generally given to this by the supporters of the ballot is, that the one effective act of hypocrisy—the voting wrong—is an act worth purchasing; but that it would not be worth the corrupter's while to buy a whole lifetime of hypocrisy, with the chance, if not the certainty, that the professed opinions would be discarded on the only occasions when the acting on them would be worth the purchase-money. It has been sometimes said that secrecy in voting is not practicable; but this is an argument rarely maintained as a serious objection to the ballot, for although the votes of a large portion of the community who are political partizans, and own their partizanship, must always be well known, there is no doubt that if it were sincerely set about, secrecy could be imparted to the votes of those who desire it.

Perhaps the argument which has proved the most influential against the ballot has been that, supposing it to be effective, it would to some extent deaden that open, candid system of party conflict, ranging the forces on every question palpably on either side, which is a main characteristic of British politics. In answer to this, it is generally admitted that the national characteristic has its merits, but it is said that the corruption of voters is a disease far outweighing them, the removal of which may be cheaply purchased by their sacrifice. It is generally admitted, however, that the progress of parliamentary morality during the past twenty years, and the gradual transition of electoral bribery from an act of gallant and justifiable expenditure, to a crime which men shrink from being charged with, has been removing or modifying a considerable portion of the disease for which the ballot has been sought as a remedy.

The ballot has occasioned frequent parliamentary discussions and divisions, yet it has never created any formidable conflict involving the fate of a party in parliament. After the accession of Lord Melbourne's government in 1835, it became in all Whig governments an open question, or one in which members of the government might take what side they pleased. It is one of those matters of which it is necessary, in a work like the present, to give some historical account, and at the same time to explain its existing position as a political question; and this has been done with an endeavour to avoid partizanship, and give a fair view of the arguments adopted by either side. (J. H. B.)

Ballston || Balm of Gilead.

BALLSTON, a town in the state of New York, celebrated for its spa.

BALLYBAY, a market and post town of Ireland, in the county of Monaghan, 86 miles from Dublin. Pop. in 1851, 1617, chiefly engaged in the linen manufacture.

BALLYCASTLE, a decayed seaport town of Ireland, county Antrim, situated on a bay opposite Rathlin island. The town is well-built, consisting of two parts, about a quarter of a mile asunder, and connected by a fine avenue. Upwards of L.150,000 were expended upon the harbour and pier, but the violence of the sea overthrew the pier and filled the harbour with sand, so that Ballycastle is now little more than a fishing village. Pop. in 1851, 1669.

BALLYMENA, a town of Ireland, county Antrim, on the Braid, an affluent of the Maine, two miles above their junction. It is 33 miles N.N.W. of Belfast, with which it is connected by railway. The town owes its prosperity chiefly to its linen trade, which gives employment to the greater part of the inhabitants. It has a parish church, several chapels and schools, a market-house, distillery, and several branch banks. Pop. in 1851, including Hanyville in the suburbs, 6493.

BALLYMONEY, a village of Ireland, county of Antrim, 140 miles N. of Dublin. Pop. in 1851, 2578.

BALLYSHANNON, a seaport and market town of Ireland, county of Donegal, situated on the Erne, at its influx into the bay of Donegal. Lat. 54. 30. N. Long. 8. 11. W. The river is here crossed by a bridge of 14 arches, which connects the town with the suburb of Purt. Below the bridge the river forms a beautiful cascade 150 yards wide, with a fall at low-water of 16 feet. The harbour is a small creek of Donegal Bay, about 600 yards long, and 350 yards broad, and is only accessible to small vessels. The town contains a church, several chapels, a bank, market-house, barracks, and a union workhouse. Previous to the Union, Ballyshannon returned two members to the Irish Parliament. Pop. in 1851, 3697.

BALM OF GILEAD. Among the more precious substances obtained from plants, applied as curative of wounds by the ruder inhabitants of the Eastern climates, the balm of Gilead, or balsam of Mecca, has been eminently distinguished during many ages. But although the balm of Gilead is well known from several scriptural allusions, and highly esteemed, it is only of secondary quality to the bal-

Balm of Gilead.

sam of Mecca, for which it is frequently substituted; and illustrations of its nature and properties must chiefly be derived from the latter. This balsam is a resinous matter, exuding, like ordinary resin, from incisions in the bark of two different vegetables; at least there are apparently two, though the distinction is not well characterized or described by naturalists. The plant producing the balsam of Mecca was first ascertained by Forskal to belong to the genus *Amyris*. He transmitted one or two specimens to Linnæus, who has characterized it as the "*Amyris Opobalsamum*, leaves pinnate, with sessile leaflets, a native of Arabia;" while he characterizes the other as "*Amyris Gileadensis*, leaves ternate, very entire peduncles, one flowered lateral, a native of Abyssinia." This plant grows to the height of fourteen feet, flourishing in a hot climate, and in a stony barren soil. In general it is lower; and Mr Bruce describes a specimen five feet and a half in height, and five inches across the stem where thickest. The wood is white, light, and of open texture, covered with a smooth bark, reddish or bluish white, resembling that of a healthy standard cherry tree, green within, and emitting a very fragrant odour; that of the branches, which are very flexible and resinous, being equally agreeable. The leaves, which are evergreen and scanty, bear some resemblance to those of rue; and the flowers, which are leguminous and of a purplish colour, resemble those of the acacia. The fruit consists of small pointed ovoidal berries, containing a yellowish fluid similar to honey, of a bitterish taste, and exhaling a pleasant perfume, approaching the odour of balm.

The balsam flows from incisions in the tree, which are made with an axe, in July, August, and the beginning of September, when the circulation of the sap is in the greatest activity; and it is received into a small earthen bottle. The total exudation is usually but three or four drops in a day, nor does the most productive tree afford above sixty. Its scarcity, therefore, and the difficulty of procuring it, have no inconsiderable effect in enhancing its value. The odour is at first strong and pungent, occasioning a sensation like that of volatile salts rashly inhaled. Its intensity is proportioned to its freshness and the care it receives; for if neglected and exposed to the influence of the air, the fragrance entirely decays. It is also of a rough, acrid, pungent taste. Originally the balsam is of a light yellow colour, somewhat turbid, and of a whitish cast, which is supposed to arise from the globules of air absorbed along with it; and it dissolves readily in water. It then acquires greater consistence, resembling honey, and becomes pellucid; and after the lapse of some years grows of deeper yellow, or gold colour, when it is very tenacious, and may be drawn out in threads. It is difficult, however, to obtain the balsam in a state of purity; for several different substances are employed in its adulteration, to detect which various experiments are resorted to. If dropped into a glass of clean water, it falls to the bottom without rising again to the surface; or if it remain still on the surface, like oil in a drop, it is certainly adulterated. If, on the contrary, it spreads on the surface of the water, diffusing itself in a thin pellicle, scarcely visible to the eye, and capable of being collected with a thread or a feather, it is the pure and natural product. In this state it will coagulate like milk, but not if otherwise. If pure, it collects in a globule when dropped on hot iron; if adulterated, it runs and spreads itself all around. The different substances used in the adulteration of this balsam are honey, wax, oil of sesamum, turpentine, and ostrich fat. Sweetness of taste betrays the honey, and a turbid appearance the presence of wax. Adulteration with oil is detected by its yielding a darker and grosser flame than that which issues from the genuine balsam when dropped on burning coals. When the consistency becomes too great, which seems a consequence of age and long preservation, fluidity is restored by the simple application of heat.

Besides the balsam now described, which is the purest and most valuable kind, and is called Opobalsamum, other two of inferior quality are obtained from the balessan, the name by which the plant is known in the East: first, Carpobalsamum, which is prepared by expression from the fruit when it has attained maturity, and which, if good, should be ponderous, of a pungent taste and balsamic odour; secondly, Xylobalsamum, which is elaborated from a decoction of the twigs.

Balm of Gilead.

Prosper Alpinus, one of the older naturalists, ascribes many properties to the balsam of Mecca, esteemed the most precious of all that bear the appellation of balsam, and in ordinary description considered as synonymous with the balm of Gilead; and the modern Arabs, Turks, and Egyptians, entertain great confidence in its efficacy. Hasselquist says it is useful as a stomachic in doses of three grains. It is also taken for complaints in the breast, in fevers, and in rheumatism. Its repute as an antiseptic is very great; and by the Egyptians it is esteemed an effectual antidote against the plague. The balsam of Mecca, however, is principally used as a cosmetic by the Eastern females of rank.

The balm of Gilead has been celebrated from a very remote antiquity. We have the testimony of Moses that it was an article of commerce in the earlier periods of Jewish history; for at the time Joseph was confined by his brethren in a pit, and during their deliberations on his fate, it is said, "And they sat down to eat bread,—and they lifted up their eyes and looked, and behold a company of Ishmaelites came from Gilead, with their camels bearing spicery, and *balm*, and myrrh, going to carry it down to Egypt." Jeremiah particularly alludes to the virtues of the *balm in Gilead*. Josephus, however, does not carry the knowledge of it so high; for he observes, that the Queen of Sheba brought the balm of Gilead as a present to Solomon. The ancients who were contemporary with Josephus, seem to have regarded Judea as exclusively possessed of this product. Pliny remarks,—"but to all other odours whatsoever is to be preferred that balsam which is produced in no other part of the world than the land of Judea, and there in two gardens only, both belonging to the king, one not exceeding twenty acres in size, and the second still smaller." Strabo, however, in the opinion of Mr Bruce, ascertained the real spot where the balsam originated, in ascribing it to that country over or near to which the Queen of Sheba reigned. "Near to to this," he says, "is the most favoured land of the Sabæans and they are a very great people. Frankincense, myrrh and cinnamon, grow among them, and on the coast that is about Saba, the balsam also." Whence Mr Bruce observes that "among the myrrh-trees behind Asab, all along the coast to the Straits of Babelmandel, is its native country. It grows to a tree above fourteen feet high, spontaneously and without culture, like the myrrh, the coffee, and the frankincense tree; they are all equally the wood of the country, and occasionally cut down for fuel." Diodorus Siculus likewise affirms that this balsam grew in a valley of Arabia Felix. But Mr Bruce, who investigated the subject with considerable care, supposes that it was towards the era of Pliny that it received its name of *Balsamum Judaicum*, or balm of Gilead, and thence became an article of commerce and fiscal revenue, which might probably operate as a discouragement to bringing it from Arabia; as also that it might be prohibited as contraband. Some centuries later than the time of those ancient authors, we see that it was known in Arabia, and perhaps in the place now most celebrated for it. In the travels of Ali Bey it is stated that there is no balsam made at Mecca; that, on the contrary, it is very scarce, and is obtained principally in the territory of Medina; and also that it was called *belsan*. As the repute of the balsam of Mecca rose, the balm of Gilead disappeared; though in the era of Galen, who flourished in the second century, and travelled into Syria and Palestine purposely to obtain a knowledge

Balmerino || Balnearii.

of this substance, it grew in Jericho, and many other parts of the Holy Land. The cause of its total decay has been ascribed, not without reason, to the royal attention being withdrawn from it by the distractions of the country. In more recent times its naturalization seems to have been attempted in Egypt; but apparently without success.

Notwithstanding the celebrity of this plant, Mr Bruce denies that it had ever been seen by the ancients, by whom he probably means the Romans, as their descriptions are so various and discordant. Prosper Alpinus, who lived in the sixteenth century, does not seem to know the real class to which it belongs; and even more recently M. Duplessy is apparently not aware of its having been figured by Bruce, and still later by Dr Woodville. Such uncertainties of old excited a violent dispute between the inhabitants of Rome and Venice whether the drug used in medicinal compounds was truly the balm of Gilead; and the point being referred to the pope, his holiness directed that information should be obtained from Egypt, in consequence of which he decided in favour of the Venetians.

Several other balsamic plants of the same genus are enumerated by botanists, each exhibiting some peculiarity. J.G.D.

BALMERINO, a village and parish of Scotland, county of Fife, situated on the Tay, 8 miles N.W. of St Andrews. Pop. in 1851, 945. It has the ruins of an abbey founded in 1229, by Emergarde, mother of Alexander II.

BALMEZ, Jayme Lucien, a Spanish ecclesiastic, eminent as a political writer and a philosopher, was born at Vich in Catalonia, on the 28th August 1810. He is the author of several able works, of which that entitled *El Protestantismo Comparado con el Catolicismo en sus relaciones con la Civilisacion Europea*, is the one on which his reputation chiefly rests. It has been translated into French, German, and English. This gifted and amiable man died at Vich, on the 9th July 1848.

BALMORAL CASTLE, a residence of Her Majesty Queen Victoria, on the right bank of the River Dee, about 9 miles above Ballater, and 50 miles from Aberdeen. The building, which is of the Scotch baronial style of architecture, modified in some of its details, is larger and finer than the old castle which it replaced. The property consists of about 10,000 acres.

BALNAVES, Henry, a Scottish Protestant, born at Kirkcaldy in Fife, in the reign of James V., and educated at the university of St Andrews. He afterwards studied in France; and returning to Scotland, he entered into the family of the Earl of Arran, who at that time was regent: but, in the year 1542, the earl dismissed him for embracing the Protestant religion. In 1564 he joined (says Mackenzie) the murderers of Cardinal Beaton; for which he was declared a traitor, and excommunicated. Whilst that party were besieged in the castle of St Andrews, they sent Balnaves to England, who returned with a considerable supply of money and provisions; but being at last obliged to surrender to the French, he was sent with the rest of the garrison a prisoner to France. During his confinement at Rouen he wrote the work entitled *Confession of Faith;* but it was not published till 1584, five years after his death. He returned to Scotland about the year 1559, and having joined the Congregation, was appointed one of the commissioners to treat with the Duke of Norfolk on the part of Queen Elizabeth. In 1563 he was made one of the Lords of Session, and appointed by the General Assembly, with other learned men, to revise the *Book of Discipline.* Knox, his contemporary and fellow-labourer, gives him the character of a very learned and pious man. Balnaves died at Edinburgh in the year 1579.

BALNEARII Servi, in *Roman Antiquity*, servants or attendants belonging to the baths. Some were appointed to heat them, called *fornacatores;* others were denominated *capsarii,* who kept the clothes of those that went into them; others *aliptæ* and *unctores*, whose care it was to pull out the hairs and anoint and perfume the body.

Balognes || Baltic Sea.

BALOGNES. See Valonges.

BALSAM, the resinous juice of a tree or shrub; the true balsams being distinguished from the spurious ones, or turpentines, by containing benzoic or an analogous acid as one of their essential ingredients, in addition to the volatile oil and resin of which alone the turpentines consist. The true balsams known in commerce are five in number, viz., the balsam of Peru, yielded by the *Myrospermum Peruiferum;* the balsam of Tolu, procured from the *M. Toluiferum;* benzoin, the produce of styrax benzoin; storax, from the *Storax officinalis;* and liquid amber, from *Liquid-ambar styraciflua.* Balsams are used in medicine in certain diseased states of the mucous membranes, and are hence frequently prescribed in cough mixtures, and during recovery from certain inflammatory and diseased conditions of the mucous surfaces of the stomach and bowels, &c. Formerly balsamic preparations were much used in surgery for dressing wounds, sores, &c., but are almost completely exploded in modern practice in this country. Balsams are used also in the manufacture of sealing-wax, pastils, &c.; and the incense burnt in Roman Catholic chapels owes its peculiar perfume chiefly to the presence of benzoin. Canadian balsam, balsam of copaiba, balm of Gilead, &c., though commonly styled balsams, are not so, properly speaking, since they contain no benzoic acid.

BALSAMINEÆ, a natural order of plants. See Botany.

BALSAMODENDRON, a genus of plants belonging to the natural order of Amyrideæ. The *B. Myrrha* produces that gum-resin which is said also to be afforded by *B. Katof.* See Botany.

BALSOVER. See Bolsover.

BALTA, the capital of the circle of the same name, in the Russian government of Podolia. It stands on the Kodima, near its junction with the Bug, and carries on a trade in corn by that river. Population, including suburbs, about 10,000. Long. 29. 44. E. Lat. 47. 56. N.

BALTIC SEA. The denomination of the Baltic, applied to the inland sea which forms the subject of this article, is first found in the work entitled *Chorographia Scandinaviæ,* by Adam of Bremen, who was canon of that city at the close of the eleventh century. The etymology of the name has given rise to many conjectures. The Swedes derive it from the Scandinavian word *baelt,* a girdle, because of its peculiar form; the Prussians, from the Sclavonian or Lettonian word *balt,* white, from its being frozen part of the year, or from *Baltus,* one of their kings; while by others it is derived from *Baltea,* the name of an island mentioned by Pytheas, a merchant of Marseilles, who, in the second or third century before the Christian era, is supposed to have sailed as far north as this sea. In the countries which bound it, its ancient name was *Variatzkoïe Morè,* or the Sea of Variaghi; by the modern Russians it is called *Baltiskoè Morè;* and by the Swedes, Danes, and Germans, the *East Sea.*

Extent of the Baltic.

The Baltic is inclosed by Sweden, Russia, Prussia, Mecklenburg, and Denmark; and it communicates with the North Sea by the Skager-Rack, Cattegat, Sound, and Great and Little Belts. From Swinemünde in the S., to Tornea in the N., its length is 770 geographical miles; and its width from Karlscrona to Memel is not less than 180 miles. Its whole area, including the Gulf of Bothnia, is about 125,000 geographical square miles. It runs first in an easterly direction as far as Memel, a distance of 300 miles, and then northwards as far as Lat. 59. 21. N., a distance of 350 miles, at which point it separates into two great gulfs. One of these, the Gulf of Finland, runs nearly due E.; the other, the Gulf of Bothnia, almost N. The Gulf of Bothnia is 400 miles in length, with an average breadth of 120 miles, but where narrowest it does not exceed 40 miles.

Baltic Sea. The archipelago of Aland lies at its entrance. The Gulf of Finland is 200 miles in length, with a mean breadth of 60 or 70 miles. Numerous rocky islands and reefs, many of them level with the water, render the navigation of this sea extremely dangerous.

Depth of the Baltic. The greatest depth of the Baltic rarely exceeds 100 fathoms. On the western side it is not more than 15 fathoms; and, in general, it is only from 8 to 10 fathoms. On the S. it nowhere exceeds 50 fathoms. The Gulf of Finland suddenly shallows from 50 or 60 fathoms to 5, or even less. The average depth of the Gulf of Bothnia is not greater than that of the rest of the sea.

Level of its waters. It has long been a generally received opinion that the waters of the Baltic are gradually diminishing. Celsius, a learned Swede, who flourished towards the middle of last century, advances this hypothesis; and, from observations made on the coasts of the Baltic, he estimated the diminution at 45 inches in a hundred years. This hypothesis was supported by Linnæus, who founded on it a theory of the earth. M. Otto, in his physical observations on this sea, has suggested another theory to account for its apparent decrease. He supposes that, instead of really subsiding, it may be only shifting its position, and gaining in one quarter what it loses in another; and this he ascribes to the large and rapid rivers, which carry along with them an immense quantity of earth and sand, by which the beds at their mouths are raised, and their banks extend towards the sea. The views of Celsius have been confirmed by the observations of Von Buch, who also discovered at several places on the western shores of Scandinavia, and at considerable elevations, deposits of sand and mud containing numerous marine shells of species still existing in the neighbouring ocean. Mr Lyell at first entertained doubts of these phenomena; but on subsequent inspection he was led to concur in the opinion of Von Buch. Mr Lyell found the marks which were cut in the rocks at water-line some years previous to his visit, to be actually several inches above the level of the Baltic. From these observations, that eminent geologist concludes, that in several parts of Sweden a gradual elevation of the land is taking place. (Lyell's *Principles of Geology.*) The great quantity of sand and mud carried down by the rivers has considerably raised the bottom of this sea, and affected its navigation, so that the mouths of rivers formerly navigable are now inaccessible.

Tides. In the Baltic, the tides are scarcely, if at all, perceptible. There are sensible tides in the Skager-Rack; but these begin to diminish in the Cattegat, and are very trifling in the Sound and Belts. There are, however, irregular variations in the level of the waters of the Baltic which bear some resemblance to tides. These elevations generally occur in autumn, when the weather threatens rain; and they last sometimes a few days, sometimes several weeks. The maximum rise is three feet and a half, and the low shores are occasionally inundated. They also render brackish the fresh-water lakes which communicate with the sea. In the Gulf of Bothnia, the subsidence of the waters is usually succeeded by north winds; whereas, near Stockholm, these winds usually follow their rise. M. Kraft, formerly professor of experimental philosophy in the Imperial Academy of Sciences at Petersburg, in his treatise on the inundations of the Neva at the autumnal equinox, observes, that three or four days before or after the full or new moon, a violent N.W. wind drives the waters of the Northern Ocean, during the influx of the tide, into the Baltic, and is accompanied or immediately succeeded by a south wind in that sea and the Gulf of Finland. By Schultens, a learned Swede, who paid particular attention to the physical geography of the Baltic, the irregular elevations of this sea are attributed to the state of the atmosphere. He had observed that when the waters were about to rise the barometer fell, and that when they were about to fall it rose. Hence he inferred that the unequal pressure of the atmosphere on different portions of the water deranged the level of the waters. The difference between the greatest and the least rise of the barometer in the northern parts of Europe is two and a half inches, which answers to three and a half feet of water, or the difference of the elevation of the waters at their extremes. Baltic Sea.

Superior and inferior currents. In the Sound there are superior and inferior currents. These were first observed by some Englishmen, who, being in a boat in the middle of the channel, found that they drifted towards the Cattegat; but having let down a loaded bucket to the depth of four or five fathoms, the boat became stationary; and when the bucket was sunk deeper, the boat drifted against the superficial current. The general currents of the Baltic are strong, and evidently occasioned by the vast number of rivers and streams that pour their waters into it, many of which, especially towards the north, rise thrice in the course of the year. At the northern extremity of the Island of Bornholm, a violent agitation of the waters, or kind of whirlpool, called by the Swedes *malt-quern*, or the grinding-mill, is occasioned by the current rushing over a circular cluster of sunken rocks. The waves of the Baltic are short and broken, in consequence of sudden changes of wind, irregular depths, and strong currents.

Saltness. The waters of this sea are not nearly so salt as those of the ocean; and when the wind blows strong from the north they become so fresh as to be fit for drinking or cooking meat. The degree of their saltness varies in different parts, and even in the same parts, according to the season or wind. According to Bergman, in his *Physical Geography*, the waters near the south coast of Norway, at the entrance of the Skager-Rack, contain from $\frac{1}{10}$th to $\frac{1}{7}$th part of their weight of salt; in the Cattegat $\frac{1}{12}$th; in the Baltic $\frac{1}{16}$th; and in the Gulf of Bothnia from $\frac{1}{40}$th to $\frac{1}{60}$th. The S.W. and W. winds augment the saltness, by introducing the waters of the ocean. In the summer it requires 300 tons of the water of the Gulf of Bothnia to produce one ton of salt, but in the winter only 50 tons. This difference is caused by congelation, and by the diminished flow of fresh water.

Analysis of its waters. The analysis of three pounds of water taken up from the British Sea, on the coast of East Friesland, and the same quantity from near Rostock in the Baltic, gave

	British Sea.	Baltic.
Muriate of soda	522	263
Muriate of magnesia	198½	111
Sulphate of lime	23	12
Sulphate of soda	1½	1
Residue	1½	1
	746½	388

The following are the results of some experiments made by Dr Thomson on the specific gravity of the water in the Firth of Forth, the Baltic off Tunaberg, the Sound, and off the Skaw Point; and also on the comparative weight of salt obtained from 1000 grains of each of the waters evaporated.

	Specific gravity.	Weight of salt.
Water of the Firth of Forth	1·02900	36·6
Baltic off Tunaberg	1·00476	7·4
Sound	1·00701	11·2
Skaw	1·02037	32·0

In the salt obtained from the water off the Skaw, he found

Muriate of soda	55·7
Sulphate of magnesia	25·0
Muriate of magnesia	19·3
	100·0

Wilcke ascertained that the specific gravity of the water of the Baltic was much influenced by the wind. When the wind was at

East, it was	1·0039
West	1·0067
North-west	1·0098
Storm at West	1·0118

Baltic Sea. Temperature.

There is great difference in the temperature in different parts of the Baltic. The general temperature of the Gulf of Bothnia in July is from 48° to 56°, but it is sometimes heated to 70°; the medium of the thermometer throughout the year at Uleoborg is 29°, and at Stockholm 42⅘°. Near the land in the Gulf of Bothnia the temperature of the atmosphere in the month of July was observed to be 68°, while the temperature of the surface of the water was 65°; and in October the temperatures of both were respectively 39° and 46°. In the Sound, the temperature of the atmosphere in the month of August was 70°; on the surface of the water 68°; and at three fathoms 66°. On the 10th of October 1813, Dr Thomson found the temperature of the Sound to be 54°. The Skager-Rack and Gulf of Norway are open to navigation all the winter, whereas several portions of the Baltic are covered with ice in a very moderate degree of cold; and generally the bays and channels are encumbered with ice at the latter end of December. The waters towards the heads of the Gulfs of Bothnia and Finland are first frozen; and the ice being conveyed by the currents to the south, the masses of it are united by the increasing cold into vast fields, which become stationary on the west towards Stockholm, and in the east towards the islands of Dagœ and Œsel. In the southern parts of the sea the ice begins to break up in April, but the Gulfs of Bothnia and Finland often continue closed till May. The rigour of the climate in the Baltic is supposed to be considerably diminished by the clearing of the forests and the progress of cultivation; at least the frosts during the fourteenth and fifteenth centuries appear in their intensity and long continuance to have exceeded those of the severest seasons in more recent times.

The winds are extremely variable in the Baltic, but they blow most commonly from the E. in the spring, and from the W. in autumn. Calms are seldom experienced except in the middle of summer.

Fisheries.

There is historical evidence that the herring fishery was a branch of national industry in the Sound as early as the year 1168;[1] and in 1389, according to Philip de Mezières, such vast shoals of herrings crowded into the Sound, that 40,000 boats, with from six to ten men each, were employed in the fishery, besides 900 large vessels, in which the herrings were salted. This important branch of industry, however, no longer exists. Salmon ascend the rivers from April to June, according as they are free from ice. On the S. they abound most in the Oder, Vistula, Düna, and Narrowa; on the N., in the Motala, Dalecarlia, Ulea, Kemi, Tornea, and Keymen. Salmon-trout is taken in some bays of the Baltic. In the middle of the River Kemi is a small island where an annual salmon fair is held.

Whales very rarely enter the Baltic. The common porpesse is the only one of the lesser species of cetaceous animals that lives habitually in this sea; and at Middlefahrt, in Funen, is a company which enjoys the exclusive privilege of taking it. There are two varieties of the common seal, which are hunted for their oil in March and April by the peasants of the Isle of Gottland, and of the islands in the Gulfs of Bothnia and Finland.

The trade of the Baltic is of great extent and importance. In 1852, 17,563 ships passed up and down the Sound, of which 3902 were British vessels. The internal trade is also very considerable. The exports consist of the various productions of the countries on its coasts, and include corn, timber, pitch and tar, hemp, flax, tallow, hides, linseed, bristles, wool, &c. Its imports are colonial products, manufactured goods, dry stuffs, wines, salt, coal, &c. The most important ports are St Petersburg, Riga, Königsberg, Danzig, Swinemünde, Lübeck, Copenhagen, Karlscrona, and Stockholm. By means of numerous large rivers and canals a considerable trade is carried on with the interior. (See Thomson's *Travels in Sweden; Tableau de la Mer Baltique*, par Catteau; *Tableau des Etats Danois*, par Catteau.)

Baltimore.

BALTIMORE, a decayed town of Ireland, county of Cork, on a headland projecting into the sea. Previous to the Union it returned two members to the Irish parliament. It has a good harbour; but the population in 1851 was only 189. N. Lat. 51. 29. W. Long. 9. 20.

BALTIMORE, in Maryland, one of the largest and most flourishing cities in the United States of North America, is situated on the north side of the Patapsco River or Bay, 14 miles above its entrance into the Chesapeake, 37 miles N.E. of Washington, and 100 S.W. of Philadelphia; Lat. 39. 17. N. Long. 76. 36. W. The natural advantages of this position were long overlooked by the settlers in the vicinity of the Chesapeake, and it was only in 1729 that they directed their attention to this place, and laid out a plan of the town. At this time a part of it was under cultivation as a farm, but all the rest was a wilderness. For some years its growth was by no means rapid, as it had to contend with all the obstacles that could be thrown in its way by the jealousy of older rivals. From an authentic sketch of Baltimore made in the year 1752, it appears that it then contained about 25 houses, only four of which were built of brick, the rest being of a more primitive structure. In 1768 it became the county town; and in 1775, according to a census then taken, it contained 564 houses, and 5934 inhabitants. From this time it rose rapidly into importance, and in 1780 became a port of entry, when a custom-house was opened. Previous to this all vessels trading to and from the port had to be entered, cleared, and registered at Annapolis. In December 1796 it obtained an act of incorporation. By the census of 1850 Baltimore contained 169,012 inhabitants, of whom 141,441 were whites, 24,625 free coloured, and 2946 slaves.

The city is pleasantly situated on slightly undulating ground, and extends about 4½ miles from E. to W., and 3½ from N. to S., covering an area of 10,000 acres. It is divided into two nearly equal parts by a rapid stream called Jones's Falls, crossed by a number of bridges. The division east of the falls is nominally subdivided into two parts—Fell's Point and Old Town. The former, the most easterly part of the town, is the principal resort of seamen, and is the place where the shipbuilding and manufactures are principally carried on. The Old Town lies to the N. and W. of this, and is principally inhabited by mechanics and labourers. The portion west of the Falls is likewise divided into two parts, the city proper and Spring Garden. The former is the centre of trade, and the residence of the more wealthy inhabitants; while the latter, which is the extreme south-western quarter, and the lowest and most unhealthy portion of the city, is inhabited by the poorer classes. Baltimore contains upwards of 100 churches, 3 universities, 4 colleges, about 50 grammar schools and academies, numerous common schools; an infirmary, several hospitals, orphan asylums, dispensaries, &c.; two theatres, a circus, a museum, and many beautiful and commodious public buildings. The city hall is a plain three-storied building, with a portico of four massive pillars. The court-house, a large and commodious edifice constructed of marble and brick, is 145 feet long, 65 wide, and two stories high. It is adorned with several Tuscan columns, and the whole is surmounted by a cupola of an imposing appearance. The state penitentiary consists of three large buildings, besides workshops, &c., and, with its gardens and walks, occupies an area of

[1] "In the year 1238 the inhabitants of Gothia (Sweden) and Frise were prevented, by their fear of the Tartars, from sending as usual their ships to the herring fishing on the coast of England; and as there was no exportation, 40 or 50 of these fish were sold for a shilling. (Matthew Paris, p. 396.) It is whimsical enough that the orders of Mogul Khan, who reigned on the borders of China, should have lowered the price of herrings in the English market." (Gibbon's *Roman Empire*, vol. xi. p. 422.)

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four acres, surrounded by a stone wall 20 feet high. The Merchants' Exchange is a spacious building 225 feet long by 141 feet wide, and contains a reading-room, the custom-house, a bank, telegraphic offices, &c. The room in which the merchants' meetings are held is 53 feet square, and is lighted by a dome 115 feet above the street. On its east and west sides are colonnades, the columns of which are each a single block of fine Italian marble. Baltimore has also several splendid monuments, which have acquired for it the name of "the Monumental City." The largest of these, erected to the memory of Washington, stands on an eminence of 150 feet, and has, with its base, an altitude of 200 feet. It is built of white marble: the base is 50 feet square, and 20 feet in height, surmounted by a Doric column 20 feet in diameter, with a spiral staircase in its interior; and on the summit is a statue of Washington 13 feet high. The "Battle Monument," also of white marble, was erected by public subscription in 1815, to the memory of those who had fallen in defence of the city in the previous year. It is 52 feet high; the base is of Egyptian architecture; the column in the form of a bundle of Roman fasces, upon the bands of which are inscribed the names of those whom it commemorates; and the whole is surmounted by a female figure, the emblematical genius of the city. This city is supplied with water from an elevated part of Jones's Falls, by an aqueduct half a mile in length, and distribution pipes. There are also numerous public springs and fountains throughout the town.

The manufactures and commerce of Baltimore are very extensive and flourishing. There is scarcely a branch of industry that is not prosecuted to some extent in the city or its vicinity. Among these are shipbuilding, iron and copper works, woollen and cotton manufactures, pottery, sugar refining, distilling, saddlery, agricultural implement making, cabinet-making, tanning, &c. It is the greatest flour-market in the Union, and has a large export trade in tobacco. There belonged to the port of Baltimore, on the 30th June 1852, 159,408 tons of shipping; of which 63,608 tons were engaged in the coasting trade. There are twelve banks, with a capital (in 1853) of $7,291,415; ten fire and marine and one life insurance company, besides several agencies for other companies. The aggregate value of the different descriptions of property assessed in Baltimore for the year 1846 was $86,103,673; and for the year 1853, $104,801,438, being an increase of $18,697,765.

The harbour is excellent, and consists of three parts. Its entrance, between Fort M'Henry and the lazaretto, is about 600 yards wide, with 22 feet of water. This depth is continued with an increased width for a mile and a quarter, to near Fell's Point. The entrance to the second harbour is opposite Fell's Point, where the width is contracted to one-fourth of a mile, with a depth of 12 feet. Above this entrance it widens into an ellipse of a mile long, half a mile broad, and 15 feet deep. The third or inner harbour has a depth of 10 feet, and penetrates to near the centre of the city. Vessels of 500 or 600 tons can lie at the wharfs near Fell's Point, and those of 200 tons can come into the inner harbour. The harbour is well defended by Fort M'Henry.

The railroads of Baltimore are—the Philadelphia Wilmington and Baltimore line, opened in 1837—length, 98 miles; the Baltimore and Susquehanna, to York in Pennsylvania, opened in 1846—length 85 miles; the Baltimore and Ohio, to Wheeling, a branch of which goes to Washington, opened in 1853—length, including branches, 421 miles. It is in contemplation to extend the Baltimore and Ohio railroad to Parkersbury, and the Baltimore and Susquehanna railroad to Sunbury. It is also proposed to connect a branch to the Central Ohio railway at Zanesville with the Baltimore and Ohio line. See *Gazetteer of the United States*; De Bow's *Industrial Resources, &c., of the Southern and Western States*; Hunt's *Merchants' Magazine*.

Baltinglass || Baluze.

BALTINGLASS, a town of Ireland, county of Wicklow, on the river Slaney, 37 miles S.S.W. of Dublin. It formerly carried on a manufacture of linen and woollen cloths, but its trade is now confined to bleaching. Here an action took place in 1798 between the royalists and the insurgents, in which the latter were defeated. It has the remains of an ancient Cistercian abbey and a castle. Before the Union it returned two members to the Irish parliament. Pop. in 1851, 1572.

BALUE, JEAN, a French cardinal who raised himself from a very mean station to dignity and honours. He became almoner to Louis XI., and eventually obtained the whole management of the government; but being detected in a treasonable correspondence with the Duke of Bourgogne, he was shut up by Louis in an iron cage eight feet square, a punishment he richly merited by his crimes. On his release, however, eleven years afterwards, he was loaded with honours by Sixtus IV. He died at Ancona in 1491.

BALUSTER, a small kind of pillar used for balustrades.

BALUSTRADE (Spanish, *Balustrada*), a series or row of balusters joined by a rail, and serving as a fence or inclosure to balconies, altars, staircases, &c.

BALUZE, ETIENNE, a writer eminently distinguished by his knowledge of history, ecclesiastical antiquities, and the canon law, was born at Tulle on the 24th of December 1630, of a family which had long adhered to the legal profession. He received his elementary education at the place of his nativity, and afterwards prosecuted his studies in the university of Toulouse, where he obtained an exhibition in the College of St Martial. Having finished his course of philosophy, he commenced his attendance in the schools of law; but although he attained to great proficiency in certain departments of jurisprudence, he felt no inclination for the ordinary occupations of a lawyer, and never followed the profession of an advocate. His earliest inquiries related to different subjects of ecclesiastical antiquities; and the reputation which he thus acquired recommended him to the notice of M. de Montchal, archbishop of Toulouse, who granted him access to his library. This prelate was succeeded by M. de Marca, soon afterwards archbishop of Paris, a man who was profoundly skilled in those branches of knowledge which Baluze so long continued to cultivate. In 1656 Baluze was invited by the archbishop to the metropolis; but before his hopes of preferment were realized, his patron died.

He speedily found another favourer of his studies in M. le Tellier, afterwards chancellor of France, who conferred upon him many benefits. He was next connected with the establishment of M. de Lamothe-Houdancourt, archbishop of Auch. In 1667 M. Colbert offered him the situation of keeper of his library, one of the most magnificent private collections in Europe; and its value, both in manuscripts and in printed books, was greatly augmented by the judgment and zeal of the learned librarian. Having retained his office for some time after the death of Colbert, he resigned it in the year 1700, and retired to a house belonging to the Scottish College.

In 1670 he was appointed professor of the canon law in the Royal College, a new chair which the king was pleased to erect in his favour; and of his high qualifications for such a professorship he has left the most unequivocal proofs. He was also appointed a canon of the cathedral of Rheims; and in the privilege appended to his edition of Marius Mercator, printed in the year 1684, he is designated "Estienne Baluze, prieur de Beauvais." It may therefore be inferred that he enjoyed a considerable pension from that abbey; nor were such arrangements uncommon at that period of the history of France. He is described as "simple tonsuré;" an expression which denotes that he was not a priest or a deacon, but had only been initiated into one of the lowest of the seven holy orders. In 1683 he published a

Balzac.

volume of Councils, and it was his original intention to extend the collection; but as some of the materials which he had prepared could not be much relished at Rome, he thought it expedient to abandon his design. Of the acts of the council of Basle he had proposed to print a very ample collection; and this was indeed the part of his plan for which the whole had chiefly been undertaken. After an interval of ten years, he published his Lives of the Popes of Avignon; a work of curious research, which procured him a pension from the crown, and afterwards the office of director of the Royal College, where he succeeded the Abbé Gallois in the year 1700. But the favour of a court is at all times and in all places held by a very precarious tenure. Baluze, who had attached himself to Cardinal de Bouillon, was involved in the disgrace which attended that prelate. A *lettre de cachet* removed him from Paris: his place of exile was repeatedly changed, and his residence successively restricted to Rouen, Blois, Tours, and Orleans; nor could he obtain his recal till 1713, after the peace of Utrecht. Though at length permitted to revisit Paris, he never recovered his two offices of director and professor of the Royal College. This persecution did not however quench his literary ardour; for, during his exile, he employed himself in preparing an edition of the works of St Cyprian, which was published after his death. His constitution had never been vigorous, but the sobriety and regularity of his habits enabled him to reach a mature and healthy old age. He died on the 28th of July 1718, in his eighty-eighth year; and was buried in the church of St Sulpice. A person who had lived so long in the midst of learned dust, without either wife or children to blow it aside, could not well be without his share of peculiarities. He was not entirely exempted from caprice, and his testament exhibited this caprice in no very amiable light; his relations and domestics were almost totally forgotten, and the bulk of his property was bequeathed to a woman who appears to have had no claim upon him. Some scholars, who have collected libraries with much labour and at great expense, are inclined to cherish an anxious wish that they should be preserved entire; but, on the contrary, he was desirous that his library should be sold in detail, lest any one individual should be put in possession of those literary treasures which he himself had gradually amassed. This collection consisted of 10,799 articles, including more than 1500 manuscripts, together with 115 printed books which he had interspersed with annotations. The manuscripts were added to the Royal Library.

The merits of Baluze are perhaps more conspicuous in his capacity of editor than in that of author. If his labours had not extended beyond the *Capitularia Regum Francorum*, his name would always have been mentioned with respect by lawyers and historians; but some of his other publications greatly illustrate the history of the middle ages; nor must we forget the light which they reflect upon the history of the canon law, and upon the writings of the Latin fathers. His published works formed fifteen volumes in folio, three in 4to, sixteen in 8vo, and two in 12mo. (D. I.)

BALZAC, Honoré, one of the most distinguished and most prolific of the modern French novelists, was born at Tours on the 20th May 1799. After completing his studies at Vendôme, he entered the office of a notary at Paris, and commenced his literary career by contributions to periodical works; which attempts, however, gave little indication of his genius. Between the years 1821 and 1829 he published, under various pseudonymes, no fewer than thirteen romances; and in the last-mentioned year appeared the first work to which he affixed his name. His writings display a profound knowledge of the human heart, and several of them bear the stamp of unquestionable genius; such, for example, as *La Peau de Chagrin, Le Dernier Chouan, La Physiologie de Mariage, Le Pere Goriot, La Femme de Trente Ans;* and his later works, *Medecin de Campagne,* and *Parens Pauvres.* The most remarkable feature in his private history was his deep attachment to the Countess Eveline Hanska, a Russian princess, who rewarded his long and untiring devotion with the gift of her hand in 1848. Balzac did not long enjoy his felicity. He died at Paris, of hypertrophy of the heart, on the 30th of August 1850. His remains, attended by a vast concourse of people, were deposited in the cemetery of Père-Lachaise.

Balzac || Bamboo.

Balzac, *Jean-Louis-Guez de*, was born at Angoulême in 1594. He was one of the most popular writers of his day, but his works have long since sunk into comparative obscurity. Voltaire allows him the merit of having been the first who gave numbers and harmony to French prose, but censures his style as bombastic. His writings extend to two folio volumes, which were published in that form in 1665, with a preface by the Abbé Cassaigne; but his reputation rests chiefly on his *Letters.* He died in 1655, and was buried in the hospital of Nôtre Dame des Anges, to which he bequeathed 12,000 livres. He also left an estate of 100 francs per annum for a gold medal to be bestowed every two years for the best discourse on some moral subject. This prize is still continued.

BAMBA, a province of Congo, on the western coast of Africa, lying to the S. of the river Ambriz. This district is said to be very fertile, and to abound in gold, silver, copper, salt, &c. Its chief town bears the same name.

BAMBARRA, an extensive and important country of interior Africa, with which the journeys of Park, who was perhaps the first European that reached it, have made us tolerably acquainted. It is situated between the 5th and 9th degrees of W. Long., and the 12th and 15th of N. Lat. See Africa.

BAMBERG, a town of Bavaria, in the circle of Upper Franconia, on the river Regnitz, 3 miles above its junction with the Maine, and 33 miles N. of Nuremberg, with which it is connected by railway. It is partially surrounded by walls and ditches, and is divided by the river into three districts, which are connected by two handsome bridges. The town is well built, and the streets are well paved and lighted. The cathedral, a noble structure in the Byzantine style of architecture, is surpassed by few of the kind in Germany. It was founded in 1004 by the Emperor Henry II., and finished in 1012, but was afterwards partially burnt, and rebuilt in 1110. It contains the tombs of the founder and his empress Kunigunde, Konrad III., Pope Clement II., &c.; and numerous monuments and paintings by the most eminent masters. Among the other public buildings are St Martin's church, the church and convent of St Michael, the palace formerly the residence of the prince-bishops, town-house, and theatre. It has numerous literary and charitable institutions, as the lyceum, gymnasium, polytechnic, normal, and medical schools; library, museum, picture-gallery, hospital, and workhouse. There is a very considerable trade here, and manufactures of cloths, sealing-wax, leather, tobacco, musical instruments, carriages, &c., besides numerous breweries. The Bamberg beer is in much repute. Bamberg was formerly the capital of an independent bishopric, which was secularized in 1801, and assigned to Bavaria in 1803. Pop. (1849) 18,531.

BAMBOCCIO, a celebrated painter, born at Laeren, near Naarden, in Holland, in 1613. His name was Peeter van Laer; but in Italy he was called Bamboccio, on account of the strange proportions of his person. Nature, however, made him amends in the superior beauties of his mind. His style of painting was sweet and true, and his touch delicate, with great transparency of colouring. His subjects were taken from scenes in humble life, such as plunderings, playing at bowls, inns, cattle, conversations, &c.; yet his designs were so correct, and so highly finished, that his manner was adopted by many Italian painters of his time.

BAMBOO. This plant was ranked by the older botanists

Bamboo. in the number of reeds; but some, less sensible of its analogies with them, instituted for it a separate genus. In the *Systema Naturæ*, Linnæus describes two species, under the genus Arundo-Bambos, now termed *Bambusa*, which is characterized thus: "scales three, covering the spikelets, which are about five flowered; calyx none; corolla, a two-valved glume; style bifid; seed one." Roxburgh describes about thirty kinds of Bambusæ: but the species of Roxburgh have been by later botanists subdivided into several other genera; and we now find but a few species considered as true Bambusæ. Thus, in Willdenow's *Species Plantarum* there are but two recognised, *B. arundinacea* and *B. verticillata*. In the *Systema Vegetabilium* of Sprengel, there are three species, *B. arundinacea*, *B. spinosa*, *B. stricta*.

Loureiro, who had an opportunity of studying the nature of the bamboo in its own climate, characterizes it as having "flowers with six stamina; panicle diffused, with imbricate spikelets; branches of the culm spiny; calyx one flowered." The *Bambusa arundinacea* is a native of the warmer climates only, though growing luxuriantly without the limits of the torrid zone. It rises to the height of forty, sixty, or even eighty feet, with a hollow stem, shining as if varnished. The stem is extremely slender, not exceeding the thickness of five inches in some which are fifty feet high, and in others reaching fifteen or eighteen inches in diameter. The whole is divided into joints or articulations, separated by a short interval, called a knot or internode; and in some there is the distance of several feet between each. These joints or divisions are formed by the crossing of the vascular bundles of fibres. They produce alternate lateral buds which form small alternate branchlets springing from the base to the top, and together with the narrow-pointed leaves issuing from them, give the tree an elegant feathered appearance as it waves in the wind.

The rapidity of its growth is surprising. It sometimes grows three or four inches in a single day. Accurate observers have seen it rise twenty feet, and expand as thick as a man's wrist, in five or six weeks; and it has been known to reach thirty feet in six months. This enables us to credit the assertion, that its full dimensions are attained in a year; and that the only subsequent change is greater thickness and induration of the wood. In Malabar it is said to bear fruit when fifteen years old, and then to die.

The bamboo grows wild in most places of the East, and the warmer parts of the West. Where the country is principally dependent on its use, it is cultivated in regular plantations. It apparently succeeds best in low sheltered grounds, with rich, soft, spongy earth; but humidity is especially prejudicial to it. This plant is propagated by shoots deposited in pits at the close of autumn or commencement of winter, eighteen inches or two feet deep; and in order to obtain bamboos of considerable size, the scions are cut over as they spring up. Their subsequent treatment depends entirely on the uses to which they are to be converted; much care being bestowed on those designed for beauty or ornament only. They are propped up with rods; and, if complete plants, are cut over in order to obtain suitable shoots. It is necessary to surround the plantation with a ditch, in order to drain off superabundant humidity, which would otherwise be prejudicial. Various expedients are followed to obtain good bamboos; one of the most usual being to take a vigorous root and transplant it, leaving only four or five inches above the joint next the ground. The cavity is then filled with a mixture of horse-litter and sulphur. According to the vigour of the root, the shoots will be more numerous; but they are destroyed at an early stage during three successive years; and those springing in the fourth resemble the parent tree. It is affirmed that no culture can obtain any thing of larger size.

The utility of this plant soon becomes conspicuous. The Bamboo. soft and succulent shoots, when just beginning to spring, are cut over and served up at table, like asparagus. Like this vegetable, also, they are earthed over to keep them longer fit for consumption; and they afford a supply in succession during the whole year, though more abundantly in autumn. They are also salted and eaten with rice, or prepared after different other fashions. As the plant grows older, a kind of fluid of grateful taste and odour is secreted in the hollow joints, affording a considerable quantity of an agreeable beverage. If allowed to remain in the tree, a concrete substance, highly valued for its medicinal properties, called *tabaxir* or *tabascheer*, is produced from it. The presence of the fluid is ascertained by agitating the bamboo; after some time its quantity gradually diminishes, and then the stem is opened to reach the tabascheer. This substance, participating in nothing of a vegetable nature, has been found to be siliceous earth; it resists the impression of all acids, is indestructible by fire, and with alkalies forms a transparent glass. Notwithstanding its repute in the East, it has never been received into the European materia medica. Besides the tabascheer, many parts of the bamboo are said to be endowed with medicinal properties; a decoction of the leaves is recommended for coughs and sore throat; the bark for fever and vomiting; the buds as a diuretic; and a compound of the root with tobacco-leaves, betel nut, and oil, is believed to form an efficacious unguent. But setting aside its medicinal properties, it is highly valuable as an article of food; for many of the poorer classes in the most populous countries subsist on it in times of scarcity. Its seed is recorded in Chinese history to have preserved the lives of thousands. The Hindus eat it mixed with honey as a delicacy, equal quantities of each being put into a hollow joint, coated externally with clay, and thus roasted over a fire.

From the copious draught which a joint of the bamboo naturally yields, mankind are taught its use as a vessel for carrying water, and in some places no other bucket is employed. The Eastern nations build their houses solely of the wood, without any auxiliary substance: if entire, it forms posts or columns; split up, it serves for floors or rafters; or interwoven in lattice-work, it is employed for the sides of rooms, admitting light and air. The roof is sometimes of bamboo solely, for which two species growing in Laos, an Asiatic country, are described as specially adapted; and when split, which is accomplished with the greatest ease, it can be formed into laths or planks. It is employed in shipping of all kinds; and as houses are constructed entirely of it, so are complete vessels framed out of it, and fitted for sea. The hull is obtained from the stem; and some of the strongest plants are selected for masts of boats of moderate size. In Bengal a boat of four or five tons may be furnished with both mast and yard from the same bamboo, at the cost of threepence; and the masts of larger vessels are sometimes formed by the union of several bamboos built up and joined together. Those of considerable dimensions are used in the higher yards of ships of four or five hundred tons, for which service they are well adapted by their great strength and lightness.

The bamboo is employed in the construction of all agricultural and domestic implements; and in all materials and implements required in fishery, hooks and nets excepted. In Tibet the strongest bows are made of it, by the union of two pieces with many bands; and, in the same country also, it is employed, as we use leaden pipes, in transmitting water a distance of several miles to reservoirs or gardens. The species from which these pipes are constructed is said to grow in the mountains; and from other light and slender stalks the inhabitants obtain shafts for their arrows. In the south-west of Asia there is a certain species of equally slender growth, from which writing pens or reeds are made.

From the extreme flexibility of this substance, and also

Bamborough || Bambouk.

its divisibility, for it splits like whalebone from top to bottom, it can be reduced to the smallest dimensions, and bent into every shape. It is woven into baskets, cages, hats, or various ornamental articles. By a particular process in bruising and steeping the wood or bark, a paste is procured that is made into paper. In short, from its very origin until its decay, it never ceases to produce something beneficial. It has justly been observed: "All that composes a bamboo is profitable, of whatever species it may be. The artists of China have each made their choice, and, in the works they produce, show the advantages they have derived from it. Its uses are so numerous, so various, and so beneficial, that it is impossible to conceive how China could now dispense with this precious reed. It is no exaggeration to affirm, that the mines of this vast empire are of less importance to it than the possession of the bamboo; which, we may add, is also the chief instrument of government."

Some European climates might not prove noxious to the bamboo; but the same rapidity of vegetation, the same natural qualities, could not be expected, or only in an inferior degree, even in the most favourable situation, and consequently its utility would be greatly diminished. (J. G. D.)

BAMBOROUGH, a village in Northumberland, on the sea-coast, fourteen miles north of Alnwick, and once a royal borough. Its very ancient castle stands on an almost perpendicular rock close to the sea, and is accessible only on the south-east side, on a spot where the castle or palace of the kings of Northumberland, supposed to have been built by King Ida, who began his reign about the year 547, is said to have stood. The castle and property connected with it were vested by Lord Crewe, bishop of Durham, in trustees, for charitable purposes, in virtue of which a patrol is kept on the coast, apartments are provided for shipwrecked seamen, together with a storehouse for goods, &c. saved from wrecks; and other apartments are used as granaries for corn, to be sold cheap to the poor in times of scarcity. Bamborough has an infirmary and dispensary, with a resident surgeon, and also a large library. Pop. in 1851, 466.

BAMBOUK, a country in the interior of Western Africa, situated between the Ba-Fing and the Faleme, the two great upper tributaries of the Senegal. The chief characteristic of this country is the quantity of gold with which its soil is almost universally impregnated.

The Portuguese, it appears, penetrated early into Bambouk, and were even for some time masters of the country; but the inhabitants, inflamed by their oppressions, made a general rising, and completely drove them out. The French, when they formed their settlement on the Senegal, soon directed their eager search towards a country abounding in so valuable a commodity; but their efforts to penetrate into it proved for a long time abortive. At length, in 1716, one Compagnon succeeded, by great address, and not without risk, in gaining the favour of some leading persons, and obtaining a view of the mineral treasures of this country. David and Levens, two successive French governors, afterwards contrived to effect an entrance. Sieur Brue, the most enterprising of the governors of Senegal, laid before the French administration a plan by which, with 1200 men, he undertook to conquer and maintain Bambouk. Such an expedition might very probably have been in the first instance successful, and the French might probably, by skilful working, have greatly increased the produce of the mines; but when we consider the various casualties and difficulties attendant on the occupation of this interior region, it must appear very doubtful if this would have been in the end a profitable possession.

Bambouk is fertile and populous along the banks of the rivers, but many of the interior districts are arid and barren. There is a king, but the farims or chiefs compose nearly an independent feudal body. The population is Mandingo, yet the Mahometan religion is professed; but the observance consists chiefly in some outward ceremonies, and the marabouts or priests of that faith are carefully excluded from the kingdom. (H. M.)

Bamiyán || Banat.

BAMIYAN, a fertile valley of Afghanistan, traversed by the route from Kabul to Turkistan, and bounded on each side by lofty and almost perpendicular steeps. The pass is of importance both in a military and commercial point of view, having less elevation and fewer difficulties than other passes in its vicinity, and being the only one across the Hindu Koh practicable for artillery or heavy carriages. Bamiyan and its vicinity are celebrated for some of the most remarkable relics of antiquity; its colossal idols, the castle of Zohak, and the ruins of Ghulghalch, which are scattered over the valley. The town of Bamiyan is in Lat. 67. 50. Long. 34. 50. (E. T.)

BAMPTON, or Bampton-in-the-Bush, a market-town of Oxford, hundred of Bampton. It stands in a flat situation near the banks of the Isis, 70 miles from London, and 14 from Oxford. The church is a magnificent ancient edifice. Pop. of town and parish in 1851, 2780. Market-day Wednesday.

Bampton, a market-town in Devonshire, hundred of Bampton, 164 miles from London, and 21 from Exeter. It formerly returned two members to parliament. Pop. of town and parish in 1851, 2102. Market-day Saturday. A great battle was fought here A.D. 614, between the West Saxons and Britons, in which the former were defeated.

BAN, Banus, a Slavonian word signifying *lord*, an ancient title belonging to the wardens of the eastern marches of Hungary, and corresponding somewhat in dignity to that of the ancient margraves of the empire. The ban was equal in dignity to the palatine of Hungary, and took rank next to the king, with whom he had in his own province equal powers. The country under his jurisdiction was called a banat. This dignity is confined in modern times to the viceroy of Temesvar, who is called the ban of Croatia, and holds the third rank among the secular nobles of Hungary.

Ban or Bann (from the Saxon *bannan*, to proclaim, to send forth) is a public notice or edict, whereby a thing is commanded or forbidden. In France the word *ban* has generally been confined to the simple sense of a public proclamation. The word *banns* is used in England and in Scotland in publishing matrimonial contracts; which is done in church before marriage, to the end that if any persons can speak against the intention of the parties, either in respect of kindred, precontract, or other just cause, they may take their exception before the marriage be consummated. The use of matrimonial banns is said to have been first introduced into the Gallican church, though something like it obtained even in the primitive times; and it is this that Tertullian is supposed to mean by *trinundina promulgatio*.

The word is also used to denote proscription or banishment for a crime proved, because anciently published by sound of trumpet; or, as Vossius thinks, because those who did not appear at the above-mentioned summons were punished by proscription. Hence, "to put a prince under the ban of the empire," was to declare him divested of all his dignities. In an ecclesiastical sense, in like manner, it signifies a solemn anathema, or excommunication attended with curses. Such was the ban of the pope.

BANAGHER, a market-town of Ireland, King's County, on the river Shannon. Pop. in 1851, 1846. It is 81 miles W.S.W. of Dublin.

BANALBUFAR, a town on the western coast of the island of Majorca. It produces good wine. Pop. 5000.

BANANA, *Musa sapientum*, an herbaceous plant, a native of the West Indies. Its fruit is produced in large clusters weighing many pounds, and forms a considerable article of food among the better classes.

BANAT, an old province of Hungary, of which the capital was Temesvar. It extended from the Maros on the N. to the Danube on the S., and from Transylvania and

Banbridge || Banda Islands.

Wallachia on the E. to the Theiss on the W., comprehending the present counties of Torontal, Temesh, and Krassova. See HUNGARY.

BANBRIDGE, a town of Ireland, county of Down, on the Bann, 23 miles S.W. of Belfast. It occupies the summit of an eminence. To facilitate the access, a central carriage-way 200 yards long has been cut through the main street to a depth of 15 feet, the opposite terraces being connected by a bridge. It is a neat town, with a handsome church, several chapels, and a new market-house; and it has extensive cloth and thread factories, bleachfields, and chemical works. It is the principal seat of the linen trade in the county. Pop. in 1851, including the workhouse, 3779.

BANBURY, a market and borough town in the county of Oxford, 71 miles from London. It is well built, containing many respectable houses; and is watered by the River Cherwell. The corporation consists of a mayor, four aldermen, and twelve councillors. Banbury returns a member to parliament. It has some manufactures, but depends chiefly on the villages around it, which send their agricultural produce to the market, which is held on Thursday. The Oxford and Birmingham canal passes here. Pop. of borough in 1851, 8715.

BANCA, BANKA, or BANGKA, an island off the east coast of Sumatra, and separated from it by the Strait of Banca. It lies between Lat. 1. 30. and 3. 7. S. and Long. 105. 9. and 106. 54. E. It varies from 8 to 20 miles in breadth, and has an area of 3560 geographical square miles. Its mines of tin, which were discovered in 1710, are remarkably productive, and in 1844 yielded no less than 70,289 peculs, or 4183 tons 18 cwt. of that metal. Iron, copper, lead, silver, and arsenic, are also found there. The soil is generally dry and stony, and the greater part of the island is covered with forests, in which the logwood tree especially abounds. Its mountains, which scarcely exceed 2000 feet in height, are covered with vegetation to their summits. They are of granitic formation, containing felspar, quartz, mica, and tourmaline. Pop. in 1840, 35,000, including 18,000 Chinese. Muntak, the capital, has 3000 inhabitants, and a fort garrisoned by 200 men. There are several other forts on the island. It belongs to the Dutch.

BANCOORA, a town of Hindustan, in the presidency of Bengal, and the chief place of the district of the same name, is situate on the route from Calcutta to Benares, 100 miles north-west of the former. The district of which it forms the capital has an area of 1476 square miles, and contains a population of 480,000. It occupies a portion of the valley of the River Damooda, in which is situate the great carboniferous and iron-ore tract of Bengal. A branch from the East Indian railway, diverging near the city of Burdwan, and proceeding to Raneegunge, in the north-west angle of the district, where the most valuable collieries are situate, is now under construction. The town of Bancoora is distant from Burdwan W. 60 miles. Lat. 23. 14. Long. 87. 6. (E. T.)

BANDA, a town in Hindustan, the principal place of a district of the same name, situate in the territory constituting the lieutenant-governorship of Agra. The town is built at the base of a hill rising 300 or 400 feet above the surrounding plain, but though of considerable size and a thriving place, being the great mart for cotton, the houses, with the exception of the palace of the Nawaub of Banda, are of inferior construction. This prince is a descendant of the former native governors of Bundlecund. He has no hereditary dominions; but enjoys an allowance of L.40,000 per annum, guaranteed to him and his heirs in perpetuity by the British government. The district of Banda has an area of 2878 square miles, and a population of 552,556. The town is distant from Calcutta 560 miles. Lat. 25. 28. Long. 80. 23. (E. T.)

BANDA ISLANDS. These islands, belonging to Holland, are 130 miles to the S.E. of Amboyna, between Lat. 3. 50. and 4. 40. S. They are ten in number, viz. Banda Neira, Gonong Apee, Banda Lantoir, Pulo Ay or Way, Pulo Rondo or Pulo Roon, Rosyngen, Pulo Pisang, Craka, Capella, and Sonangy. Banda Islands.

Of these, Banda Neira is the seat of the supreme government. It is protected by one principal fortification, situate on the south side of the island, and consisting of a small square fort, with a wet ditch, and a horn-work towards the sea. This fortification, which is called Fort Napau, forms the chief defence of the Banda Islands. The troops are quartered, and the public granaries are kept in this fort; but the storehouses for the nutmegs and mace are on the outside, as well as the government-house. Above Fort Napau, on a neighbouring eminence, stands the castle of Belgica, an old pentagon, with round towers at the angles. It is surrounded with a wall, secured by small bastions, but has no ditch. It is said to have been built by the Portuguese.

Banda Lantoir or Great Banda is to the northward of Banda Neira. It is protected by a considerable fort, called Fort Hollandia, which also commands the harbour. At first view the situation of this fort appears preferable to Banda Neira for the residence of government, not only on account of its strong and commanding situation, but because the island is the largest as well as the richest in the produce of spices. Its unhealthiness has been found, however, to be a sufficient objection. The water is said to be bad, and the vapour which sometimes descends from the volcanic mountain of the neighbouring island, Gonong Apee, is represented as particularly noxious. Such fatal effects were produced by these causes, that when the Wirtemberg Company formerly garrisoned the island, out of a hundred men eight died and forty fell sick in the course of two months. The numbers of decayed houses, also, which are seen in different parts of the island, show that the experiment of a settlement has already been tried, and has not been found successful. From the sea this island appears very high; its sides are steep, and from the top of them there is a sort of table-land, which extends nearly from one end of the island to the other.

Gonong Apee is to the northward of Banda Neira, and derives its name from a large volcano about 2000 feet above the level of the sea, which constantly emits smoke, and sometimes cinders and ashes, accompanied with a crackling noise. On the south side of this island are two forts, originally intended to defend the west channel of Lantoir harbour; but, owing to an eruption of the volcano in 1778, at the same time that a dreadful hurricane laid waste the island, the lava flowed down in such quantities as to form a considerable promontory between these batteries and the channel they were intended to defend, so that they are now in a great measure useless. This island is generally unproductive, its surface being covered with a quantity of sulphur and chalk. There is no vegetation whatever on upwards of one third of the eminence on which the volcano is situated.

Pulo Way is about nine miles to the westward of Gonong Apee, and is defended by a strong fort. It is esteemed the most healthy of the whole group, and produces abundance of nutmegs, of a kind superior in quality to those of the other islands. Pulo Rondo, or Pulo Roon, is about four miles farther, in a somewhat more northerly direction. On this island the English had a factory, from which they were expelled by the Dutch about the period of the massacre of Amboyna; and the island having been since abandoned, has become a wilderness. Rosyngen is about seven miles to the S.E. of Lantoir. It produces nutmegs, mace, yams, and subsistence for a few cattle. The convicts of Amboyna were formerly kept on this island, and were compelled to cultivate the land for the use of the supreme government. Pulo Pisang is about two miles N.E. from Banda Neira, and yields some fine fruits, as well as nutmegs and mace. The other three islands are uninhabited, being little more than barren rocks.

Banda Oriental. || Bandaleer.

The Banda Islands were discovered in the year 1511 by the Portuguese, who immediately took possession of them in the name of their sovereign. About the year 1603 they were expelled by the Dutch. In 1608 the English, with the permission of the king, built a factory-house on Pulo Way, which the Dutch demolished as soon as the ship which brought out the factors returned to England. The natives of Banda, notwithstanding the opposition of the Dutch, assisted the English in forming a new colony; and shortly afterwards they, along with the natives of Lantoir, made a formal resignation of their respective islands to the new settlers. In 1620 Pulo Roon and Pulo Way were added to the English dominions, and these cessions were confirmed by a treaty concluded between the English and the Dutch. But, in defiance of this treaty, the latter determined on the expulsion of their rivals from those islands, in the possession of which they appeared to be gradually establishing themselves. They accordingly attacked them with a strong force, seized their factories, magazines, and shipping, and, after stripping the factors naked, first whipped and then loaded them with irons. Some notion may be formed of the trade, then in its infancy, by the quantity of spices seized here, which amounted to 23,000 lb. of mace and 150,000 lb. of nutmegs. In 1654 the Dutch were compelled, by the firmness of Cromwell, to restore the island of Pulo Roon, and to make satisfaction for the massacre af Amboyna. But the English settlers not being adequately supported from home, were unable to resist the power of their rivals, and the island was retaken by the Dutch in 1664. They retained undisturbed possession of their conquests in this quarter of the globe until the year 1796, when the Banda Islands, along with all the other Dutch colonies, were conquered by the British. They were restored by the treaty of Amiens in the year 1800, again captured, and finally restored by the treaty of Paris concluded in 1814.

In the space between Banda Lantoir and the islands of Banda Neira and Gonong Apee there is a very good harbour formed with entrances both from the E. and W., which enable vessels to enter it from either of the monsoons. These channels are well defended with several batteries, particularly the western one, which is very narrow. Between Gonong Apee and Banda Neira there is a third channel into this harbour from the N., but it is navigable only for small vessels.

The great articles of commerce in these islands are nutmegs and mace. The islands of Banda Neira, Banda Lantoir, and Pulo Ay, are exclusively devoted to the cultivation of the nutmeg; and the restrictions imposed by the government constitute a monopoly of this produce in the hands of the Dutch East Company. The laws and regulations generally established are calculated to support and promote the monopoly of these products rather than the happiness of the people or the improvement of the country. The annual produce amounts to about 420,000 lb. of nutmegs and 140,000 lb. of mace. They are divided into large plantations, to each of which a certain number of slaves or convicts is attached. In 1840 the population was 5081, distributed as follows:—In Banda Neira and Gonong Apee, 1223; Lantoir, 372; Pulo Ay, 148; Pulo Roon, 42; Rosyngen, 84; slaves, 2183; and convicts, 1029. See Temminck, *L'Inde Archipelagique.*

An account of the nutmeg tree and its cultivation is given under Myristica.

BANDA ORIENTAL. See Uruguay.

BANDALEER, or Bandoleer (from the Dutch *band*, and *leer, leather*), a large leathern belt thrown over the right shoulder, and hanging under the left arm. It was worn by the ancient musketeers for sustaining their fire-arms, and for holding their musket charges, which, being put up in little wooden cases coated with leather, were hung, to the number of twelve, to each bandaleer.

Bandanna || Bandello.

BANDANNA, a term of Indian origin for a kind of calico-printing, in which white or bright-coloured spots appear on a Turkey-red or dark ground.

BANDELLO, Matteo, a celebrated Italian novelist, born at Castelnuovo, near Tortona, about the year 1480. In his youth he studied both at Rome and at Paris; and his education being completed, he went to reside at Mantua. There he remained for several years, much esteemed by Pirro Gonzaga, who intrusted him with the education of his daughter, the celebrated Lucrezia Gonzaga. The incidents in the lives of the literary men who flourished in Italy during the sixteenth and seventeenth centuries have in many respects a strong similarity. Like most of his literary contemporaries, Bandello passed from one petty court to another, and was frequently employed in political missions by the patron whom he served at the time. At this period the small states of Italy were divided between the French and Spanish interests. Bandello had chiefly attached himself to those princes of Lombardy who favoured the French party; and, in consequence, when the decisive battle of Pavia put the Spaniards in possession of Milan, where Bandello at that time resided, his paternal mansion was burned, and the property of his family confiscated. He fled in disguise from Milan, and after wandering from town to town, he placed himself under the protection of Cesar Fregoso, a celebrated captain of that age, who had recently quitted the Venetian for the French service. With this general Bandello resided in Piedmont, till a truce was concluded, when he accompanied his patron to France. After the death of Cesar he continued to live with his widow and family at Agen, to the bishopric of which he was raised by Francis I. in 1550, and continued to reside in the vicinity of that town till his death, which happened about 1562.

During his residence at Agen, Bandello revised and added to the novels which he had written in Italy during his youth, and which some of his friends had recovered from the hands of the Spanish soldiers who burned his house at Milan. His *Tales* were first published at Lucca in 1554, 4to. In the complete editions of Bandello, the work is divided into four parts; the first, second, and third parts containing fifty-nine stories, and the fourth comprehending twenty-eight. The whole are dedicated to Ippolita Sforza, though she died before their publication, because it was at her desire that the work was originally undertaken. Besides this general dedication, each novel is addressed to some *Valoroso Signore*, or *Chiarissima Signora;* and in these introductions the novelist generally explains how he came to a knowledge of the event he is about to relate. He usually declares that he heard it told in company, details the conversation by which it was introduced, and pretends to report it, as far as his memory serves, in the exact words of his authority.

Bandello is chiefly indebted for his celebrity to these novels, which belong to a class of composition that enjoyed for many centuries the utmost popularity in Italy. The tales of the French Trouveurs, having passed into Italy towards the close of the thirteenth century, were first imitated in the *Cento Novelle Antiche;* which also contains stories formed from episodes in the romances of chivalry, the ancient chronicles of Italy, and jests or repartees preserved by oral tradition. Boccaccio, whose *Decameron* appeared shortly after, identified this species of composition with the history of Italian literature and the progress of the Italian language. That celebrated writer was followed by Sacchetti, Ser Giovanni, Centhio, and a numerous tribe of imitators, of whom Bandello is by much the best known and most celebrated, at least in this country. His popularity, however, has not been so great in Italy, which may probably be attributed to the negligence and impurity of his style; a fault of which the author himself appears to have been conscious, as he repeatedly apologizes for his defects in elegance of diction. *Io non sono Toscano, nè bene intendo la proprietà di quella*

Bandinelli. *lingua ; anzi mi confesso Lombardo.* Napioni, in his eulogy of Bandello, confesses that he is not remarkable for that harmony of periods, and delightful *naiveté* of expression, for which Boccaccio and others of his predecessors were so distinguished; but he adds, that none of the Italian novelists is so interesting for the development and illustration of minute historical facts, which would in vain be sought for in the histories of the revolutions of the Italian states. Some of the novels of Bandello, however, it must be admitted, are little edifying; and it is curious that one of his stories, which is perhaps the most obscene in the whole series of Italian novels, should be declared, in the introduction, to have been related by the celebrated Navagero to the Princess of Mantua and Duchess of Urbino. Besides, notwithstanding the repeated assertions of Bandello, that all his stories have some foundation in fact, and the light which his eulogists suppose that they throw on the history of the Italian republics, it cannot be denied that the greater proportion of them are derived from the Fabliaux of the French Trouveurs, and the works of preceding Italian novelists, with an alteration of the names, and some slight variations in the incidents. But while Bandello has thus copied largely from preceding fablers, none of their works has suggested more to others, or is more curious for illustrating the genealogy of fiction, and the transmission of fabulous incident from the novelist to the dramatic poet. Many of the tales of Bandello were translated by Belleforest in his *Histoires Tragiques*, whence they found their way into Paynter's *Palace of Pleasure*, and other works of a similar description which appeared in England during the reign of Queen Elizabeth. In this manner they furnished the plots of many tragedies and comedies to the most numerous and noble race of the English dramatic poets. That part of Shakspeare's *Much Ado about Nothing* which relates to Don John, Claudio, and Hero, is taken, with little variation in the incidents, from the twenty-second tale of the first part of Bandello; *The Twelfth Night* is borrowed from the thirty-sixth of the second part; and his *Romeo and Juliet* is derived from the same source (vol. ii. novel ix.). Massinger has been indebted for his *Picture*, which is, perhaps, the most agreeable and fanciful of his dramas, to the twenty-first of the first part; while Beaumont and Fletcher have derived from the same source their comedy of the *Maid in the Mill*, and the *Triumph of Death*, which is the third of their "Four Plays in One." The thirty-fifth of the second part of Bandello is the same story as the plot of Horace Walpole's *Mysterious Mother*, and the thirtieth tale of the Queen of Navarre. As the works of Bandello and the Queen of Navarre were printed nearly at the same period, it is not probable that they copied from each other; and it may be presumed, that some current tradition furnished both with the horrible incident they relate. Mr Walpole, however, disclaims having had any knowledge of the tale of the Queen of Navarre or Bandello at the time he wrote this drama. Its plot, he says, was suggested by a story he heard when very young, of a lady, who, under uncommon agonies of mind, had waited on Archbishop Tillotson, and besought his counsel in what manner she should act under the fatal circumstances that had occurred.

Besides his *Tales*, Bandello is author of a poem in eleven cantos, which was his first work, and is now very scarce, entitled *Delle Lodi della Signora Lucrezia Gonzaga*, printed at Agen, 1545, in 8vo. He also wrote a complimentary poem, in three cantos, on the birth of a son of his patron, Cesar Fregoso. Both these productions are written without taste or spirit; but it is said that some good verses, composed by Bandello, on different subjects, are still preserved in manuscript in the library of the Academy of Turin. (J. C. D.)

BANDINELLI, Baccio, a celebrated Florentine sculptor, born in 1487. His father was an eminent goldsmith, distinguished by his exquisite designs in chasing of gold and silver ornaments; and in this domestic school, Baccio, or Bartolommeo, obtained the first elements of drawing. Showing a strong inclination for the fine arts, he was early placed under Francesco Rastui, a sculptor, and he made rapid progress. He was the fellow student of Buonarotti in the garden of the Medici at Florence. As an artist, Bandinelli was very eminent; but his bad temper and arrogance made him hateful to his contemporaries, who have not in general done justice to his merit. He executed many works in marble and in bronze, of much grandeur. His best works are the marble colossal group of Hercules and Cacus in the Piazza del Gran Duco; his group of Adam and Eve; his exquisite bassi-rilievi in the choir of the cathedral of Florence; and the figures of Christ and Nicodemus on his own tomb. Bandinelli shows himself in these works an admirable master of design, and exhibits great skill in human anatomy, and in the cast of his draperies. He died at Florence in 1559. (T. S. T.)

Bandini ‖ Bandon.

BANDINI, Angelo Maria, a learned Italian, was born at Florence on the 25th of September 1726. Having been left an orphan in his infancy, he was supported by his uncle, Joseph Bandini, a lawyer of some note. He received his education among the Jesuits, and discovered an early passion for the study of antiquities. A desire which he also manifested to distinguish himself as a poet was fortunately checked by the ill success of his first attempt; and, from that period, he devoted himself principally to literary history and archæological science. The celebrated Dr Lami, with whom he had the good fortune to contract a friendship, assisted him with his counsels, and encouraged him to persevere in that path to which his genius seems to have directed him.

In the year 1747 Bandini undertook a journey to Vienna, in company with the bishop of Volterra, to whom he acted in the capacity of secretary. He was introduced to the emperor, and took the opportunity of dedicating to that monarch his *Specimen Litteraturæ Florentinæ*, which was then printing at Florence. In the following year he returned by the way of Venice, Padua, Ferrara, and Bologna, and united himself in friendship with the learned men in all these cities. Having resided some time at Florence, he repaired to Rome, and entered into orders, passing the whole of his time in the library of the Vatican, and in those of the Cardinals Passionei and Corsini. At that time the famous obelisk of Augustus was disinterred from the ruins of the *Campus Martius*. Bandini, by the order of Benedict XIV., undertook to describe and explain this curious monument; but finding that the air of Rome was injurious to his health, he returned to Florence. In 1750 he was selected by Alexander Marucelli to take charge of the valuable library which his uncle the Abbé Francis Marucelli had left, and which, according to the will of the founder, was to be open to the public. But he had scarcely entered upon the duties of this charge when the proprietor died, after bequeathing all his effects to the library, and appointing the Abbé Bandini perpetual librarian and his testamentary executor. It required two years to liquidate the succession and to form the complete catalogue of this vast library, which was at length opened to the public in the year 1752. In 1756 he was preferred by the emperor to a prebend at Florence, and appointed principal librarian to the Laurentian library. During forty-four years he continued to discharge the duties of this situation, and died in 1800, generally esteemed and regretted. On his deathbed he founded a public school, and bequeathed the remainder of his fortune to other charitable purposes. For a list of his numerous works, see *Biographie Universelle*, tom. iii. (J. C.)

BANDITTI, from the Italian *bandito*, persons proscribed, or, as we call it, outlawed, and sometimes denominated *banniti* or *toris banniti*. It is also a denomination given to highwaymen or robbers who infest roads in troops.

BANDON, or Bandonbridge, a town of Ireland, county

Bandore || Banff.

of Cork, situated on both sides of the River Bandon, which is here crossed by a bridge of six arches. It has two churches, a handsome Roman Catholic chapel, Protestant and Methodist places of worship, a convent, two market-houses, a spacious quay on the south side of the river; an infirmary, hospital, dispensary, three public libraries, two reading-rooms, two endowed schools, and a savings-bank. Its manufactures of woollen and cotton goods have much declined, but a manufacture of fine stuffs has lately sprung up; and there are also several distilleries, breweries, tanneries, and flour mills. It returns a member to parliament. Pop. (1851) 7943. By railway it is 20 miles S.W. of Cork.

BANDORE (Spanish, *bandurria*), the name of a stringed musical instrument resembling a lute, invented in the fourth year of Queen Elizabeth, by one John Rose.

BANDROL (French, *banderole*), a pennant, streamer, or little flag, in the form of a guidon, longer than broad, and usually hoisted on the masts of vessels. The term is also applied to the little silk flag that hangs on a trumpet.

BANDUSIÆ FONS, a fountain in Apulia, about six miles south of Venusia, celebrated by Horace, *Carm.* iii. 13. Some, however, suppose that this fountain is the modern *Fonte Bello*, near the poet's Sabine farm in the valley of Licenza. In the older editions of Horace it is called *Blandusia*, but in the best MS. the name is written as above. (See *Découverte de la Maison d'Horace*, by the Abbé Chaupy, vol. iii.; Obbarius's *Horace*, Jena, 1848.)

BANE, from the Saxon *bana*, a murderer, signifies destruction or overthrow. Thus, "I will be the *bane* of such a man," is a common saying; when a person receives a mortal injury by anything, we say, "it was his *bane*;" and he who is the cause of another man's death is said to be *le bane*, that is, a malefactor.

BANFF, the county town of Banffshire, is a place of great antiquity, and according to tradition, was at times the residence of Malcolm Canmore. It was in existence at least before the days of Malcolm IV., surnamed the Maiden, who dates one of his charters from thence, and it is noticed as a royalty since 1057. Writings of Malcolm, 1152, and William the Lion, 1165, evince the certainty of this tradition. There is a charter of Malcolm IV. signed at Banff the eleventh year of his reign, which corresponds with 1163. The town lost many of its ancient grants, but these were renewed in 1324 by King Robert the Bruce, and by Robert II. in 1372.

The natural situation of the town is beautiful, having its south-eastern exposure on a gentle slope, the wide blue sea on its N., the river Deveron on the E., and on the S. the richly wooded country with the magnificent mansion and grounds of the Earl of Fife. The streets are well and regularly built and paved, and are remarkable for their cleanliness.

The principal buildings are Banff Castle, a plain modern building, belonging to the Earl of Seafield; the town-house, a handsome edifice surmounted by a spire 100 feet high; a prison; parish church, Episcopal church and parsonage, Free church, United Presbyterian, Independent, Methodist, and Roman Catholic places of worship; a mason lodge of tasteful architecture; the academy, a modern edifice of Grecian design, capable of containing 400 students, to which there is attached an extensive museum; and a large and well-conducted seminary for young ladies. There are also several libraries and reading-rooms, five branch banks, and a savings-bank, public baths and hotels, custom-house, gas and water works, &c. A well-conducted newspaper, with an extensive circulation, is published weekly. At one period, Banff carried on a considerable manufactory of stockings and linen yarn, but at present there are none of any kind. It may be hoped, however, that the advantage of a commodious harbour, and the prospect of railway conveyance by the North of Scotland line, will ere long stimulate enterprise in this direction.

The principal exports are grain, cattle, salmon, herrings, haddocks, pork, butter, and potatoes. For the year ending 5th January 1853 the customs revenue of the port was L.2595. At the same date there were 144 vessels, with an aggregate of 12,689 tons, belonging to the port. Banffshire.

The salmon fishery extends for miles along the coast, a portion of which belongs to the town. The river fishing is the property of the Earl of Fife, with the sea-line towards Macduff. The latter town is about a mile to the east of Banff, with which it has communication by a stone bridge of seven arches across the Deveron.

These is also a seal and whale fishing company, with its establishment; and the steamers plying between Aberdeen, Leith, and Inverness, call regularly.

The burgh is under the jurisdiction of a provost, three bailies, and five councillors, who manage all the town's affairs. Mr Alexander Cassie of London, a native of Banff, some thirty years ago left to the poor of this town about L.20,000, the interest of which is divided twice a-year among the poor.

Banff unites with Elgin, Cullen, Inverury, Kintore, and Peterhead, in sending a member to parliament. Pop. within the parliamentary boundaries in 1851, 6000; within the municipality, 3557.

The weekly market-day is Friday, on which day a corn market is held; and there are four annual fairs.

BANFFSHIRE, a maritime county in the N.E. of Scotland, lying between Lat. 57. 6. and 57. 42. N., and Long. 2. 15. and 3. 40. N.; and bounded on the N. by the Moray Firth, E. and S. by Aberdeenshire, and W. by Morayshire and part of Inverness-shire. It has an area of 686 square miles, or 439,219 statute acres; its extent from N. to S. being 50 miles, and from E. to W. 32 miles; its average breadth not exceeding 12 miles. It contains 21 parishes, and parts of 10 others; has two royal and parliamentary burghs, Banff and Cullen; two burghs of barony, Macduff and Corncairn, in the parish of Ordiquhill; and five harbours, Banff, Cullen, Macduff, Portsoy, and Portgordon. The parliamentary burghs are contributory to Elgin, but the county returns a member to parliament. The parliamentary constituency in 1852 was 851. The parochial schoolmasters, with those of the counties of Aberdeen and Moray, share in Dick's bequest.

The surface of Banffshire presents a very diversified aspect. The lower district, which is divided from the upper by a chain of hills, is a fine open country, of a rich, deep, and highly-cultivated soil, agreeably diversified with gentle risings and young plantations. The upper district is mountainous, and at a distance wears a bleak forbidding appearance. But the scene changes on a nearer approach. Extensive farms are found embosomed in its fertile and well-cultivated glens. Some of the mountains are covered with trees in full luxuriance of growth; some presenting a beautiful intermixture of rock and copses, while others are covered with brown heath. The Spey flows along its western, and the Deveron along its eastern boundary; and both yield a considerable revenue from their salmon fishings. The principal mountains of Banffshire are Belrinnes, Knockhill, and Cairngorm, the last of which attains an elevation of 4095 feet above the level of the sea. In the lower part of the country, towards the coast, there are several elegant mansions, of which the most conspicuous are Duff House, Cullen House, Park House, Forglen House, and Gordon Castle. These, and a number of gentlemen's seats in the interior, are surrounded by extensive ornamental plantations, very tastefully laid out. The natural woods are inconsiderable both in extent and value.

The southern boundary of the county is mountainous, and is chiefly composed of gneiss and mica slate, through which granite and syenite often protrude. The granite to the eastward of Portsoy has very little mica in its composition;

the quartz assumes that letter-like form in the felspar, from which it has been termed *graphic granite*. Quartz rock appears, in the hill near Portsoy, to exist in beds, on which reposes a bed of most beautifully varied serpentine. In descending towards the coast, the primary rocks give place to graywacké-slate, which occasionally contains beds of the limestone peculiar to this formation; and these rocks are covered by the old red sandstone, which sometimes passes into quartz rock. In the graywacké near Keith, a vein of sulphuret of antimony occurs, associated with fluor spar. The bold and precipitous Troup Head, and several other parts of the coast, consist of a graywacké formation. Near Gamrie, in a bed of a bluish marly clay, are imbedded nodules of a fibrous limestone, which frequently contains fine specimens of ichthyolites or fossil fishes; of these the most remarkable species are *Cheirolepis uragus*, *Cheirocanthus Murchisoni*, and *Osteolepis arenatus*. The clay is, near the farm of Findon, about 40 feet deep, in the bottom of a ravine, the sides of which consist of old red sandstone. It extends over a considerable district; and to the westward of Banff affords many organic remains. Cudbear, or archil, a lichen used as a dye, is found growing in rocky situations.

The agriculture of Banffshire is conducted upon the newest and most approved principles. The soil, though varying even in adjacent fields, is in general rich and productive, yielding heavy crops of wheat, barley, oats, and other grain; and the grass and green crops are equally abundant. About 124,000 acres are under cultivation. The extent of the farms is in general from 150 to 200 arable acres, independently of moorland and pasture-grounds. The duration of leases is nineteen years; although there are some individuals who possess on liferent, and a few leases are held for a longer term. The whole of the farms, even the smallest pendicles, are under regular rotations of cropping, generally a five or seven course shift. The fields are well laid out and subdivided, and properly cleaned and manured; for which last purpose large quantities of lime, bone-dust, and guano, are annually imported. The ridges are all straight; and the fields, at least many of them, are inclosed with stone dykes or other fences. The swamps and wet grounds have also been drained and cultivated, so as to effect a total revolution in the ancient modes of agriculture within the county. The cattle and stock of every description are of the finest breeds which can be procured, and are sought after by the dealers at home, as well as conveyed to London, where they bring the highest prices.

This district was much indebted to one of the earls of Findlater, who, as early as the year 1754, not only introduced and exemplified on some of his own farms the most approved practices then known in England, but held out liberal encouragement to his tenants to follow his example; and his descendant, the late Earl of Seafield, did much to improve the family estates, adding to them many thousands of acres of arable land; and with truth it may be said that he was the greatest planter of trees in Great Britain within the present century. In 1846 this nobleman received the honorary gold medal of the Highland and Agricultural Society of Scotland, for his vast and thriving plantations of useful timber trees, in the counties of Banff, Moray, and Nairn. From the year 1811 to 1845, he had planted 18,938,234 Scotch firs; 11,904,798 larches; 843,450 hard woods; making the enormous aggregate of 31,686,472 forest trees, planted in 8223 acres of inclosed ground.

This county also owes much to the present Earl of Fife, by whose generous efforts, and taste for improvement, a vast amount has been done in planting and reclaiming land by favourable leases to the tenantry, and allowances for draining, &c. Green crop cultivation did not become general till after the commencement of the late war with France. Latterly, improvement has been promoted by agricultural associations, the annual premiums held out for the best specimens of live stock, and the best productions of the soil. The Banffshire Agricultural Association, which numbers about 200 members, has two shows yearly, for all sorts of stock and produce and agricultural implements, with premiums for superiority in breed of cattle, poultry, &c. The valued rental of the county is now upwards of L.150,000 sterling.

The manufactures of Banffshire are very unimportant, the inhabitants being principally engaged in agriculture and the rearing of cattle. The salmon fishery is actively prosecuted on the rivers, and the herring and other fisheries on the coast. Distilling is largely carried on in Glenlivet and other places.

Banffshire was the scene of many bloody conflicts between the Scots and their Danish invaders, but details of these encounters belong more properly to the history of Scotland. From 1624 to 1645 it was the theatre of almost incessant struggles. The Covenanting troubles of that period, combined with the frequent conflicts of the clans, were productive of serious evils. Several remains of antiquity are pointed out in different parts of the country. Of these the churches of Mortlach and Gamrie are perhaps the most remarkable. Ruins of castles and traces of encampments are often to be met with, and a great number of cairns and tumuli are also found. Among the distinguished men whom Banffshire has produced, the following may be mentioned: Archbishop Sharp of St Andrews; George Baird, distinguished for his services as sheriff of the county during the time of the Covenanters; Thomas Ruddiman the grammarian; Walter Goodall, the defender of Mary Queen of Scots; and James Ferguson the astronomer. The population of the county in 1841 and in 1851, was as follows—the apparent decrease of the number of houses in 1851 arising from stories let to different families being frequently reckoned houses in the census of 1841:—

	Houses.			Persons.		
	Inhabited.	Uninhab.	Building.	Male.	Female.	Total.
1841	11,149	474	82	23,249	26,430	49,679
1851	10,662	377	62	25,575	28,596	54,171

BANG, or Banga, the leaf of a kind of hemp or cannabis, which is used in India and in Egypt as a narcotic.

BANGALORE, a fortified town of Hindustan, in the Rajah of Mysore's territories, and a place of considerable importance during the Mussulman dynasty of Hyder Ali and his son Tippoo Sultan. In 1791 it was stormed by a force under Lord Cornwallis. Subsequently the fort, which had been constructed by Hyder in the best fashion of Mahometan architecture, was destroyed by his son Tippoo, upon finding that it was incapable of effectually resisting an assault of the British army. It was afterwards repaired in 1802. The gardens here made by Hyder and Tippoo are extensive; and owing to the elevation of the ground, the town being by observation 2901 feet above the level of the sea, European fruits and plants may be reared. During the reign of Hyder this city was populous, but was much injured by the edicts of Tippoo prohibiting all trade with the dominions of Arcot and Hyderabad, and by his forcing the merchants to buy from him a large quantity of goods at a high price. The town is well built, and has its bazaar and manufactures of silk and cotton; but its present importance arises chiefly from its being the locality of the British military establishment for the whole territory of Mysore. The distance from Seringapatam is 71 miles; from Madras 185. Lat. 12. 58. Long. 77. 38. (E. T.)

BANGKOK, the capital of Siam, stands on the banks of the river Menam, about 20 miles by water from the sea. The river is navigable to the city; but there is a bar at its mouth, which at neap ebbs has only 6 feet water on it. The river farther up is deep, though impeded by shoals and stockades. After the Burmese in 1760 took the capital Yuthia,

Bangor || Bangor-ys-coed.

the country was in a state of anarchy until a merchant of Chinese extraction put himself at the head of affairs, and made Bangkok his capital. The town extends for two miles and a half, chiefly on the east side of the river. It contains many well-built Buddhist temples, which, with their gilded pinnacles and ornamented roofs, have a good effect. On the left bank of the river are rows of floating houses. The river is nearly a quarter of a mile wide at the city. The population is believed to be from 100,000 to 150,000. The country is intersected with canals, so that the inhabitants live much on the water, especially during the annual inundations. A considerable trade is carried on with China. Except the temples and the royal palace, all the houses are of wood. Lat. 13. 58. N. Long. 100. 34. E.

BANGOR, a parliamentary borough and market town of Caernarvonshire, North Wales, nine miles N.E. of Caernarvon, to which it is a contributory borough. It consists mainly of one narrow crooked street of nearly a mile in length, stretching N.E. and S.W. through a romantic valley between two ridges of rock. It stands near the northern entrance of the Menai Strait, and the beauty of its scenery attracts many visitors, whose numbers have greatly increased since the completion of the Chester and Holyhead Railway and the Britannia tubular bridge. The principal buildings are the cathedral, Episcopal palace, deanery-house, Roman Catholic chapel, several dissenting meeting-houses, free school, union poorhouse, infirmary, market-house, assembly-rooms, temperance-hall, three banks, and railway-station. The cathedral is an embattled cruciform structure, with a low massive tower crowned with pinnacles. It occupies the site of a more ancient edifice, originally founded about 525, but destroyed by the Anglo-Normans in 1071. It was afterwards rebuilt, but suffered severely in the wars between the Welsh and Henry III.; and in 1402 it was burned down during the ravages of Owen Glyndwr. For more than ninety years it remained in ruins. The choir was rebuilt by Bishop Dean in the time of Henry VII., and the tower and nave were added by Bishop Skeffington in 1532. The principal trade of Bangor consists in the export of slates, which are raised in the quarries six miles distant, and conveyed by a railway to Port Penrhyn, at the mouth of the River Cegid, a little to the east of the town. This port is accessible for vessels of from 200 to 300 tons at all states of the tide, and has a quay upwards of 300 yards in length. Pop. of burgh in 1851, 6338.

BANGOR, a seaport and market town of Ireland, county Down, on the south side of Belfast Lough, 12 miles E.N.E. of Belfast. Pop. in 1851, 2850. It carries on a considerable cotton and linen trade, and a fishery; and has a savings-bank, market-house, a parish church, several chapels, and a public library. It is frequented as a bathing-place. Remains of an ancient abbey, said to have been destroyed by the Danes in 820, are still to be seen.

BANGOR, a seaport town in the state of Maine, North America, capital of the county of Penobscot, on the river of that name, 60 miles from the sea. Lat. 44. 47. 50. N. Long. 68. 47. W. The harbour is spacious, and affords anchorage for the largest vessels at high tide. The chief article of trade is timber. There are several good schools and a theological seminary here, and numerous churches of various denominations. Pop. 14,432.

There is another small town of this name in the state of New York, county of Franklin, 152 miles N.N.W. of Albany. Pop. 2160.

BANGOR-YS-COED, a village of North Wales, in a detached portion of Flintshire, on the Dee. Pop. 554. It was the site of one of the largest monasteries in Britain, founded before the year 180, and said to have contained in 596 no fewer than 2400 monks. Ethelfrid, king of Northumbria, in the beginning of the seventh century, massacred 1200 of these ecclesiastics, and destroyed their monastery. No traces of it are visible.

Bangorian Controversy || Banister.

BANGORIAN CONTROVERSY. See HOADLY.

BANG-PA-SOE, a fortified seaport town of Siam, situated on the left bank of the Bang-pa-Kung river, near its mouth, 39 miles E.S.E. of Bangkok. Lat. 13. 30. N. Long. 101. 11. E.

BANGUEY, an island in the Eastern Seas, lying off the north coast of Borneo. The shores abound with turtle. It is about 23 miles in length by 11 in breadth. Long. 117. 6. E. Lat. 7. 9. N.

BANIAK, an island in the Eastern Seas, off the west coast of Sumatra. It is one of a cluster of islands of the same name, and is about 17 miles in length by 7 in average breadth. The sea-slug, or *biche-de-mer*, is obtained here. Long. 96. 48. E. Lat. 2. 10. N.

BANIAN, a word used in the East to denote a Gentoo servant employed as an agent in commerce. The word is derived from the Sanscrit *banij* or *banik*, *i. e.* a merchant or trader. There is no authority for regarding the Banians as a distinct sect or caste among the inhabitants of India.

BANIAN *Tree* (*Ficus religiosa*, or *Ficus Indica*) is a native of several parts of the East Indies. It has a woody stem, branching to a great height and vast extent, with heart-shaped entire leaves terminating in acute points. Some of these trees are of amazing size and extent, as they are continually increasing, and, contrary to most other things in animal and vegetable life, seem to be exempted from decay. Every branch from the main body throws out its own roots, at first in small tender fibres, several yards from the ground; but these continually grow thicker until they reach the surface, when they strike in, increase to large trunks, and become parent trees, shooting out new branches from the top, which again in time suspend their roots, and these, swelling into trunks, produce other branches; thus continuing in a state of progression as long as the earth, the parent of them all, contributes her sustenance. On the banks of the Nerbudda stands a celebrated tree of this kind, which once covered an area so immense, that it has been known, in the march of an army, to shelter no fewer than 7000 men beneath its shade. Though now much reduced in size by the destructive power of the floods, the remainder is still near 2000 feet in circumference, measured round the principal stems, and exclusive of the spread of the branches. The Hindus have a great veneration for the banian tree, which, from its long duration, its outstretching arms, and overshadowing beneficence, they look upon as an emblem of the Deity. Near these trees the most esteemed pagodas are generally erected; under their shade the Brahmins spend their lives in religious solitude; and the natives of all castes and tribes are fond of recreating in the cool recesses, beautiful walks, and lovely vistas of this umbrageous canopy, impervious even to the direct rays of a tropical sun.

BANIAS, a town of Palestine, in the Anti-Libanus or Mount Hermon. The sources of the Jordan are about four miles N.E. of the town, now reduced to a village of 150 houses.

BANIER, ANTOINE, member of the Academy of Inscriptions and Belles-lettres, an ecclesiastic of the diocese of Clermont in Auvergne, was born in 1673. He is principally celebrated for his translation of the *Metamorphoses* of Ovid, with historical remarks and explanations; which was published in 1732 at Amsterdam, in folio, finely ornamented with copperplates by Picart, and reprinted at Paris in 1738, in 2 vols. 4to; and for his *Mythology, or Fables of the Ancients explained by History*, which was translated into English, and printed at London in 1741, in 4 vols. 8vo. He died at Paris in November 1741.

BANISTER, JOHN, a physician and surgeon in the reign of Queen Elizabeth, was educated at Oxford. In 1573 he took the degree of bachelor of physic; and obtaining a li-

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cense from the university to practise, settled at Nottingham. The time of his death is not known. His works were collected and published in 8vo and 4to in 1633.

BANJARMASSIN, a town and district of Borneo on the south-eastern coast, situated on a river of the same name, which has a shallow bar at the entrance. Lat. 3. S. Long. 114. 55. E. Many Chinese reside in this place, and carry on a considerable trade with China, exporting pepper, camphor, gold-dust, spices, wax, rattans, edible bird-nests, and biche-de-mer; and importing opium, piece-goods, coarse cutlery, gunpowder, and fire arms. In 1703 the English established a factory here; but the place was found to be extremely unhealthy, and the company's servants were finally attacked by the natives, whom they repulsed with great difficulty. The settlement was afterwards abandoned. The sultan of the district is subject to the Dutch, who established a factory here in 1848. The coal discovered in 1846 is extensively wrought by the Dutch government.

BANK, in *Political Economy*, an establishment for keeping money secure, and for dealing in money by discounting bills and otherwise. For the history of banks, see MONEY and PAPER-MONEY. That class of banks whose object is to encourage habits of saving among labourers, called banks for savings, is treated of under the head of SAVINGS-BANKS.

BANKER, a person who traffics and negotiates in money. The ancient bankers were called *argentarii* and *nummularii*; by the Greeks, *τραπεζίται*, *κολλυβισταί*, and *ἀργυραμοιβοί*. Their chief business was to put out the money of private persons to interest. They had their boards and benches for this purpose in all the markets and public places, where they took in the money from some in order to lend it to others.

BANKING, the science of a banker or dealer in money. See MONEY and PAPER-MONEY.

BANKING also denotes that branch of civil engineering which relates to the formation of banks to oppose the force of rivers, the sea, &c. See EMBANKMENT.

BANKRUPTCY, in its practical acceptation, means the arrangement by which the property of an insolvent trader or speculator is realized and distributed among his creditors according to an equitable adjustment of their claims. The term bankrupt has been derived through the Norman phraseology of English law, from the old French *banqueroute*, a word of disputed etymological origin. The term, in its earlier acceptation, involved an accusation; and the bankrupt of the old law was, according to Blackstone, "a trader who secrets himself, or does certain other acts tending to defraud his creditors." The inculpatory attribute is still retained in the law of France, where the *banqueroutier*, by coming within the penal law, is distinguished from the *failli*, or the tradesman who has become insolvent without fraud or other penal culpability.

It has been a characteristic of the laws of rude times to endeavour to trammel the extent to which legal engagements may be incurred—as, for instance, by usury laws prohibiting loans at the current or market interest of the day; while, on the other hand, they have been found to place tyrannical and exterminating remedies in the hands of creditors for enforcing such obligations as the law ordained. It seemed to be considered that there was no choice but to let the creditor exercise his will—were it to the extent of slavery or a cruel death—against the debtor unable to fulfil that obligation which the law acknowledged, and the remedies against the insolvent debtor in the twelve tables became proverbial for their sanguinary ferocity. The manner in which the conflicts between debtor and creditor in republican Rome shook the state is well known to all readers of history. It was not until the ascendancy of Julius Cæsar that a distinction is said to have been drawn between fraud and calamity, so that the debtor was released from liability to indiscriminate cruelties if he gave up all his property to those who had claims against him. It is usual, at all events, to attribute to the Lex Julia the origin of the *cessio bonorum*, or yielding up of goods—an expression still in practical use, and employed in Scotland and other countries which have inherited the civil law.

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With the rise of trade in the sixteenth century a material distinction came to be established between commercial and ordinary debtors. Perhaps the distinction, which we shall presently see to have its own peculiar justification, arose in England; and arose there not from any philosophical distinction being taken between the position of the commercial speculator and that of the ordinary debtor, but from that dislike of the civil law which made Westminster Hall reject the Roman cessio, and continue to discard it both in name and principle until the year 1826, when the first insolvent debtors' act was passed.

Nearly three centuries earlier, however, the principle of a general distribution of the debtor's goods had been at least approached as a remedy for the difficulties of mercantile men. The long line of English bankrupt statutes traces its parliamentary genealogy back to the year 1542, when an act was passed nominally intended not so much to establish a general system of realization and distribution of the property of insolvent traders, as to check certain characteristic frauds which traders were deemed to enjoy peculiar facilities for perpetrating. Thus the act (34th and 35th Hen. VIII. cap. 4) founds its remedial provisions on the preamble, "Whereas divers and sundry persons, craftily obtaining into their hands great substance of other men's goods, do suddenly flee to parts unknown, or keep their houses, not minding to pay or restore to any of their creditors their debts and duties, but at their own wills and pleasures consume the substance obtained by credit of other men, for their own pleasure and delicate living, against all reason, equity, and good conscience." Though thus directed, however, as a remedy for fraud, the statute set the precedent of a general distribution, which was more distinctly organized and assigned as an exceptional remedy against the trading classes by the act of 1570.

This being a mere remedy against frauds supposed to be peculiar to the trading class, the law of bankruptcy gradually resolved itself into a system for the speedy distribution of the effects of the insolvent trader among his creditors. While it thus changed its character from a species of penal correction and preservative against fraud, to an adjustment equally merciful to the harassed insolvent and equitable to the perplexed and discontented creditors, it retained its original peculiarity as a system applicable solely to tradesmen, and, like many other legal peculiarities which have had a fortuitous origin, this specialty has been preserved for efficient reasons.

It might appear at first that, if it be right, in the case of a tradesman in difficulties, to distribute his available effects, and enable him with his obligations discharged to start on a new race for success, it is just that all other classes of debtors should have the same privilege. It has not been usual, however, to make the privilege universal; and the following reasons may be set forth against its being so.

The true purpose of a bankrupt law is not only to release the insolvent debtor from persecuting creditors, to realize his available funds at once, and to distribute them according to an equitable adjustment among all claimants; but also to discharge the bankrupt from all subsequent legal responsibility for debts contracted before his bankruptcy. When a man is engaged in trading speculations, the justice of giving him a discharge when he yields his whole available means to his creditors, is founded on their having in some respects connived with him in his speculations, and thrown themselves on the chances of his general success. Wherever the element of credit has been admitted into trade—and there is seldom extensive trade without it—the liability of each

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associate in the circle of transactions must more or less depend on that of the others. The importer grants his bill to the producer, trusting to be able to meet it from the price of the imported commodities, and the producer who takes his bill becomes a sharer in the chances. The importer, in his turn, takes the warehouseman's bill on a similar expectation; and he in his turn receives as payment the bill of the retailer, who, knowing that he has a market for the goods, believes that he will be able to retire the bill. If, from any accidental break in the circle of credit—from the loss of a vessel, a fire, or even the failure of a trusted debtor—some one in the circle should be unable to pay his obligations, it would be cruel to leave him all his days at the mercy of every greedy or malignant man who may have had a claim against him. Thus the law of bankruptcy, after a debtor has fairly surrendered his available estate for distribution among his creditors, permits him to be discharged as if he had paid them all in full.

But, in the general case, the private debtor who purchases for consumption or possession, not to sell again, holds himself out as possessed of means to meet the obligation so incurred. At all events, he does not depend on the success of his trading with the commodity purchased by him. Hence his creditor is not a participator in a speculation, and neither directly nor indirectly looks to the debtor's chances of success for payment. In the general case, when such a debtor finds himself unable to pay his debts, his difficulties arise from wilful extravagance, or careless miscalculation; and excepting, perhaps, the too great credulity of creditors, he has no one's conduct to blame but his own. The humanity of the later English law provides for the immediate relief from execution against person or property of all persons who become embarrassed without fraud or excessive recklessness. But there is this general distinction,—and it has been the object of the preceding remarks to make it the more emphatically distinct,—that such debtors do not obtain their discharge from all obligations, which is the closing scene of a mercantile bankruptcy. If debtors not connected with trade could thus effect, when plunged into the lowest depths of insolvency, a complete release from all their obligations, we would have the spendthrift passing through the ordeal before the opening of his succession to an estate, and laughing at the creditors, of whom he is as much as ever he was morally, though he may not be legally, the debtor.

The defect of the English system, undoubtedly, was to make the distinction too broad, and, while a code of bankruptcy had been gradually reared up for the distribution of traders' estates, to leave the ordinary class of debtors to the mercy of their creditors until the jails, becoming choked, were from time to time emptied by those legal protests against the inhumanity of the law, the acts for the relief of insolvent debtors. A permanent measure for dealing with insolvents not in trade was at last adopted, and an account of it will be found under the head of insolvency. It is chiefly of importance here from its preserving the principle, that the debtor not in trade, however he may be protected from execution, is not to be relieved from his obligations, should he afterwards obtain property which might be applied to them. The commissioners appointed to inquire into the state of the law of bankruptcy and insolvency, who reported in 1840, said—

"The immediate object of the bankrupt law is the equal distribution of the effects of traders who cannot meet their engagements—its ordinary consequence, the release of such traders from all future liability of their persons and after acquired property.

"The object of the law for the relief of insolvent debtors is the personal discharge of honest debtors, prolonged imprisonment by way of punishment for the dishonest and fraudulent, and a fair distribution of their present effects, and future acquired property, among their creditors."

The availability of the future acquired property is thus the peculiar responsibility from which the trader is exempt. Perhaps the line is sometimes arbitrarily drawn, excluding some who ought to be included in the class, entitled at once to clear themselves of responsibility for past debts. That the definitions of the bankrupt acts have never cut clean, has been shown by the crowds of persons who have been admitted within the definitions of trading persons contained in them, without having been intentionally or definitely included. Still the existence of a distinction between dischargeable and undischargeable insolvents is fundamental to the bankruptcy system of the great trading nations, although there is probably a tendency to modify the difference between them. Thus in England, the measure of 1844, called "An Act for facilitating arrangements between Debtors and Creditors" (7th and 8th Vict. cap. 70), provides for the discharge of insolvents, though not in trade, if they have a certain amount of concurrence from their creditors. The insolvent must have the concurrence of a third of his creditors (calculated both by number and value) to the initial steps; and to conduct his discharge he must not only have certain proportional consents at a preliminary meeting, but at the conclusive meeting must have the votes of three-fifths in number and value, or of nine-tenths in value, or of nine-tenths of those whose debts exceed L.20. In the general bankruptcy act passed by congress in 1841 for the United States, there was a large extension of the old privileges of bankruptcy to classes of persons not in trade; and it has been stated that this was the main reason for the repeal of the act in 1843, which left the United States without any general system of bankruptcy law.

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The classes of persons subject to the bankrupt law in England have been enlarged from time to time by successive statutes. The conditions of circumstances called "acts of bankruptcy," which bring a trader within the operation of the law, have also been more fully defined from time to time. Some standard definitions have, however, been always religiously preserved from the old acts, because they possess not only their natural meaning as English sentences, but carry with them the whole substantive law of a long series of decisions, fixing their application to practical life and business. Hence, these definitions are ever terse and distinct, enabling one section of the bankrupt act to contain more law than all the others. Thus, each event is briefly described in a series of sentences like these: "If any such trader shall depart this realm, or being out of this realm, shall remain abroad or depart from his dwelling-house, or otherwise absent himself, or suffer himself to be arrested for any debt not due," &c., has an extensive practical meaning in law; and it is only to be regretted, that while great power and precision are imparted to these brief definitions by the proceedings of the courts of law for more than 200 years, the definitions, so pregnant with meaning to practical lawyers, convey little or no information to the rest of the world.

A rapid series of reforms in the English bankruptcy law began at the conclusion of the first quarter of the present century, and it may be questioned if they are yet concluded. The act of 1825 (6th Geo. IV. cap. 16) gathered up all the stray improvements which had been for some time scattered through the statute-book, and consolidated them with some new and significant alterations. It contained the fruit of Sir Samuel Romilly's enlightened speculations, and in furtherance of his suggestions, made provision for proving or adjusting the claims of annuitants and persons who were not immediate, but merely contingent creditors; both of them classes whose admission to a claim on the estate required the operation of the law of chances. A novelty in the law of England was introduced by this act, from the practice long known in Scotland as the "composition contract," by which the sanction of the bankrupt law is given to an engagement on the part of the bankrupt to pay, and on the

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part of his creditors, to accept in full, a certain sum as a single and final dividend.

A great revolution both in the judicial and administrative department of the bankrupt law was begun by Lord Brougham's Act of 1831 (1st and 2d Will. IV. cap. 56). One of its main features was the establishment of a separate tribunal in bankruptcy, and the substitution of a "fiat" instead of the old "commission" issuing from the Court of Chancery. Another great feature in this measure was the appointment of "official assignees" in connection with the court of bankruptcy, who as neutral stipendiary officers have charge of the property immediately on the bankruptcy, and see to its fair distribution among the creditors; while the "chosen assignee" in each estate, as the general representative of the creditors, finds it his function to make the estate collectively large, without reference to its division. The bankruptcy laws of England were consolidated in 1849, in an act consisting of 278 sections (12th and 13th Vict. cap. 106). Again there was a change in the essential nomenclature. The "fiat" was superseded, an "adjudication" substituted for it, and the relations of matters in order of time, of which the fiat was the criterion, came to be considered in relation to the petition for adjudication. Another and highly important arrangement completes a series of changes by which judicial inquiry and decision on the conduct of the bankrupt have gradually superseded the arbitrary votes of the creditors for treating him according as they might deem fitting, from the influence of his conduct on their feelings or opinions. A public sitting is held on the allowance of the certificate, and the commissioner there hears creditors, giving weight to their statements and pleadings, but not acting under their votes. Should no creditors give opposition, there is still to be inquiry, "and the court having regard to the conformity of the bankrupt to the law of bankruptcy, and to his conduct as a trader before as well as after his bankruptcy, and whether the allowance of such certificate be opposed by any creditor or not, shall judge of any objection against allowing such certificate, and either find the bankrupt entitled thereto and allow the same, or refuse or suspend the allowance thereof, or annex such conditions thereto as the justice of the case may require." The form of the certificate is calculated for still more emphatically bringing out this judicial determination of the bankrupt's moral rank, by dividing certificates into three classes, first, second, and third. The alternatives are, "and I farther certify that his bankruptcy has arisen from unavoidable losses and misfortunes, and that he is entitled to, and I do award him, this certificate as of the first class; *or* that his bankruptcy has not wholly arisen from unavoidable losses and misfortunes, and that he is entitled to, and I do award him, this certificate as of the second class; *or* that his bankruptcy has not arisen from unavoidable losses or misfortunes, and that he is only entitled to, and I do only award him, this certificate as of the third class."

This arrangement, adding to the judicial function of deciding on particular disputed points, that of fixing the character and position in life of the citizen, has not been long enough in force to let its effect be fully appreciated. From a return to the House of Lords in May 1853 of the number of certificates granted to bankrupts since the Consolidation Act of 1849, it appears that of a total number of 1513 certificates which had then been granted, 416 were *first*, 719 *second*, and 378 *third* class certificates. There is said, however, to be much difference of opinion among the commissioners as to the principle on which bankrupts should be classified; the first-class certificate being in many of the country districts given as a matter of course in all ordinary cases, while in London, certificates of the third-class have been awarded in ordinary cases, without any intention of conveying reflection or censure.

The establishment of the court of bankruptcy consists of two lords justices, with five London commissioners, and separate district commissioners in Manchester, Liverpool, Birmingham, Leeds, Bristol, Exeter, and Newcastle. There are ten official assignees in London, and two or more in each district, and the court has an accountant with a staff of registrars, clerks, and other subordinate officers.

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The main objects to which the vast amount of late legislation on bankruptcy has been directed, are the instantaneous adjudication and publication of the debtor's condition as a bankrupt at the moment when this becomes properly necessary, the equally instantaneous or immediate transference of all his property into impartial and responsible hands, the effective management of the property, its conversion into cash with the greatest practicable rapidity, the detection, exposure, and, in flagrant cases, the punishment of any attempts by the bankrupt to conceal or withdraw property, or unduly to favour particular claimants, a rapid and impartial distribution of the funds, and finally, the restoration of the bankrupt to society, with a character in the commercial world adjusted to that of his conduct towards his creditors. It is still a matter of complaint, that if these objects be effected it is in a very costly manner, and that the multitudinous fees incurred sweep away the greater part of the estate in petty bankruptcies. The adoption of official assignees appears to have been the only measure which has met with unqualified approbation in the commercial classes, and in a "Paper of Observations" laid before the House of Lords in 1853, in relation to a bill for extending the system to Scotland, the value of a control over elected assignees or trustees is shown in the statement, that "these new public officers commenced their useful career under the able superintendence of the commissioners, by recovering, as they were empowered by the act, very large sums of money, amounting to four millions sterling, from the former assignees under old bankruptcies. For two millions and a half of that sum the official assignees found rightful owners; one million and a half nearly for which no owners can be found remain in the bank of England invested in three per cent. consols, and yielding about L.45,000 a-year."

The Irish bankruptcy system has been modelled on that of England, the changes of which it has followed from time to time. It was in the year 1771 that the system was first extended to that country, and the Irish statute importing it (11th and 12th Geo. III. cap. 8) is an exact repetition of the sections of various English statutes. It has been followed by several successive acts, and all were consolidated in 1849 by a measure immediately following the English act in the statute-book (12th and 13th Vict. cap. 107). There were formerly thirty commissioners to Ireland, but in 1836 one salaried commissioner was appointed, and another was added soon afterwards. The old phraseology is returned to, the lord chancellor issuing a commission, and there are two official assignees. The provisions for carrying out arrangements with their creditors by debtors who are not traders according to the English act of 1844, are incorporated in the body of the measure, and this seems to have created a doubt whether, since they are a portion of an act strictly applicable to traders, they can be construed to include the class of debtors for whom they were after the example of the English act designed (see Clements *On the Law of Bankruptcy in Ireland*, p. 162). In the Irish act the distinction of certificates into three classes according to the later English arrangements has not been followed.

In Scotland the bankruptcy system, with the same general object as that of England, has a totally different machinery and nomenclature. That arrangement for the collection and distribution of a trader's insolvent estate, which in England receives the name of bankruptcy, is there called "sequestration;" and the term "bankrupt"—which, to have a proper legal signification, has the prefix "notour," or notorious—is comprehensively applied to persons, whether traders or not, whose insolvency has been rendered distinct and public, by

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legal steps for the enforcement of debts having advanced against them to a certain point—for instance, by a writ having been issued for imprisonment, or a permament attachment having been laid on property or effects. The earliest arrangement for something like an equitable adjustment of the claims of conflicting creditors was a feature of the judicious policy of the revolution settlement, and dates from the year 1691. A system, however, peculiarly adapted, like that of England, to the estates of traders, was not adopted until the year 1772; and, as it is obviously easier to enlarge than to contract the influence of legal nomenclature, it was necessary to abandon the use of the word "bankruptcy," already possessed of a broader signification, and to confer on the narrower word "sequestration" a new and wider meaning coextensive with the operation of the act. The sequestration system was revised in 1814 (54th Geo. III. cap. 137), and again in 1839 (2d and 3d Vict. cap. 42). The act of 1839 is the leading sequestration act, though some of its operative clauses were altered by a third act in the year 1853 (16th and 17th Vict. cap. 53). The chief object of the amending act was to abbreviate the procedure, so that when the arrangements are satisfactorily conducted, the payment of the first dividend and the bankrupt's discharge may take place in six months from the date of the sequestration. So far as it applies to living debtors, the sequestration, like the English bankruptcy, attaches only the estates of traders or speculators; but, by the act of 1839, the estates of a deceased person may be sequestrated without reference to his occupation, and the process has been frequently adopted as a method of distributing estates liable to complicated claims.

The sequestration issues from the Court of Session, whence it is remitted to the sheriff of the county, who to some extent fulfils the functions of the English commissioner. The system of official assignees is unknown in Scotland. The estate passes first into the hands of the "interim factor," and next into those of the "trustee," who acts in the double capacity of administrator of the property, and judge in the first instance of the claims of the individual creditors. The interim factor, who was formerly elected, is by the act of 1853 judicially nominated. The trustee is still chosen by the creditors. His election often occasions a keen contest, and the reports of decisions in the Court of Session show many instances in which such competitions are fruitful in litigation. The battle-ground of such a question is generally on the qualification of a creditor to give the vote which he has offered. It may be objected by the supporters of the opposing candidate, that the debt set forth is not a sufficient qualification for the vote, or that if it may be in itself a foundation for a vote, the statutory requisites have not been complied with in the method of stating it. It appears to have been the fundamental design of the system, that if a creditor complied with certain simple formalities and swore to his debt, he was to be admitted as a creditor for the preliminary operation of a vote, however baseless his debts might afterwards turn out to be in the fuller inquiry necessary to entitle him to a dividend. Creditors were thus to be taken at their word for the privilege of voting, provided they complied with the proper formalities. But whatever may have been the design of the founders of the system, the keenness of the aspirants for the office of trustee, and the practice of the courts of law, have together made the competitions little clusters of litigation about the debts of all the creditors who may have voted. In the act of 1853 the litigation is at all events limited to the inferior courts, and there are provisions intended to render the forms of claims less complex. A feeling has however arisen, especially among creditors out of Scotland, that the eagerness of these contests points to objects inconsistent with the impartial administration of the estate, and especially to the interests of distant creditors who cannot easily take a part in them; and it is maintained that such powers as those possessed by the trustee ought not to be committed to an officer who owes his election to the superior influence or tactics of a party among the creditors.

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On this and other grounds, there have lately been very urgent demands on the part of English merchants for a fundamental alteration of the Scottish sequestration law, and its closer adaptation to the English system; and a bill to accomplish this object was, at their instance, introduced by Lord Brougham in 1853. Undoubtedly there is no branch of the law where, on account of the universality of its influence, international uniformity is more important, nor is there any where it is more easily obtained, since the whole system is statutory and administrational, and has been subject to many changes in either end of the island. In England the nomenclature has been so frequently altered, that what was formerly a "commission" was lately a "fiat," and is now a "petition and adjudication," while the same thing in Scotland is called the "interlocutor awarding sequestration." There is much essential confusion in the totally different meaning of the word bankrupt in the two countries, and besides other nominal differences, such as that of "assignee," and "trustee;" what is termed "proving" a debt in England is called "ranking" it in Scotland, and the "certificate" of a bankrupt is called the "discharge" in a sequestration.

Almost every civilized country in the world possesses its code of bankruptcy, directed with more or less fulness to the objects which have been described as the aim of our own systems. In France a new bankruptcy law was inserted into the code of commerce in the year 1838. One fundamental peculiarity of the system there has been already referred to. The possession of a tribunal of commerce at the head of this, as of other departments of the mercantile law, is another peculiarity of the organization in that country. The *faillite* is declared by the court on the declaration which an insolvent stopping payment is bound to make to the registrar, on application by creditors as in this country, or *proprio motu* of the court itself. The court appoints one of its own members judge-commissioner, to perform functions corresponding with those of the official assignee in England. Another officer called the syndic, who is compared to the English trade assignee, is also appointed by the court, whence all the operations in the French system issue. The creditors collectively have no selection of officers, but they have, as in Britain, certain powers of general action for their common interests, as by adopting a concordat with the debtor, authorizing the business to be carried on, and the like. The portions of the code relating to this head have been made accessible to the English reader in a little work called *The Law of France in relation to Insolvency and Bankruptcy, &c.*, by Richard Miller, 1853. It has been mentioned above that a general bankruptcy system adopted by congress for the United States in 1841 was repealed in 1843, and each state in the union has now its own system. (J. H. B.)

BANKS, John, a dramatic writer in the time of Queen Anne, was bred to the law, and belonged to the society of Gray's Inn; but he early quitted the study of the law for the service of the muses. He wrote several tragedies, which, though evincing considerable pathetic powers, have otherwise no great literary merit. One of these, the *Albion Queens*, was acted, by Queen Anne's command, in 1706.

Banks, *Sir Joseph*, for upwards of forty years the distinguished president of the Royal Society of London, was born in Argyle Street, London, on the 13th of February 1743. He was the only son of Mr William Banks, a gentleman of considerable landed property, whose father had derived his fortune principally from successful practice as a physician in Lincolnshire, who had on one occasion been sheriff of that county, and had for some years represented Peterborough in parliament. The family was

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originally Swedish, though it had for several generations been settled in England.

Very few particulars are known respecting the early life of Mr Banks, which was passed principally at Revesby hall, the seat of his father, in Lincolnshire. His education was for some years intrusted to a private tutor. He was afterwards sent to Harrow school, and thence was removed to Christ's College, Oxford. He there made considerable proficiency in classical knowledge, but evinced at the same time a very decided predilection for the pursuits of natural history. Botany, in particular, was the favourite occupation of his leisure hours. The character of Linnæus excited his admiration; and the fame of that illustrious naturalist presenting itself to his youthful mind as the noblest object of emulation, he devoted himself with enthusiastic ardour and perseverance to the cultivation of that fascinating science. An anecdote is told of his being, on one occasion, so intent in exploring ditches and secluded spots in search of rare plants, as to have excited the suspicions of some countrymen, who, conceiving that he could have no innocent design, surprised him one day, while he lay asleep, exhausted with fatigue, and brought him as a thief before a magistrate, by whom, however, he was, after a strict investigation, soon liberated; but the incident occasioned much amusement in the neighbourhood.

At the age of eighteen he lost his father, and thus succeeded to an ample inheritance at a period of life when the attractions of pleasure too often operate with irresistible force. His attachments to science and to intellectual enjoyments were fortunately sufficiently powerful to enable him to resist the fascination; and the noble bent of his ambition was happily fostered by the judicious conduct of his mother, who added the effectual motive of her encouragement, and gave the best direction to his youthful energy.

Soon after the death of her husband, Mrs Banks removed with her family, consisting of her son and daughter, from Lincolnshire, and was induced to fix her residence at Chelsea, as a spot affording peculiar advantages for the pursuit of botany, in consequence of the numerous gardens in the vicinity, appropriated to the cultivation of curious plants of every description. The garden of Sir Hans Sloane, bequeathed by him to the company of apothecaries of London, was among the number; and this, as well as the Chelsea Botanic Garden, and various nursery grounds in the neighbourhood, furnished our student with abundance of objects of research.

It was about this period that he formed an acquaintance with Lord Sandwich, contracted while enjoying together the recreation of angling, of which they were both equally fond. To the friendship of this nobleman, afterwards appointed first lord of the admiralty, Mr Banks was, in the course of his life, indebted for essential aid in the furtherance of his numerous projects for the advancement of scientific knowledge. Mr Banks was no sooner of age than he quitted the university, and undertook a voyage to Newfoundland and the Labrador coast, for the purpose of exploring the botany of those unfrequented regions, and brought home from thence valuable collections, not merely of plants, but also of insects and other natural productions. Subsequently, through the interest of Lord Sandwich, then at the head of the admiralty, he obtained from government leave to embark in the ship commanded by the great navigator Captain Cook, who had been commissioned to observe the transit of Venus in the Pacific Ocean, and to fulfil also the usual objects of a general voyage of discovery. The preparations made by Mr Banks for turning to the best account the opportunities that might present themselves during the voyage were commensurate with the magnitude of the undertaking. He provided himself with the best instruments for making all kinds of observations, and for preserving specimens of natural history. He prevailed upon Dr Solander, a distinguished pupil of Linnæus, who had lately become resident in England, and was zealously devoted to the pursuits of science, to become his associate in this enterprise. He engaged draftsmen and painters to delineate all objects of interest that did not admit of being transported or preserved; and also other persons whose services might in various ways be wanted in the execution of his designs.

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The time we are speaking of forms a remarkable epoch in the history of science, as being that in which several contemporaneous expeditions for the promotion of scientific knowledge were made by the direction of the leading sovereigns of Europe. The one intrusted to Captain Cook had for its object the alliance of navigation with astronomy, from which the nation has since reaped such important advantages. This was also the time when the empress Catharine of Russia ordered extensive expeditions in Siberia under the direction of the celebrated Pallas, the primary object of which was also the observation of the transit of Venus in that part of the world, but which gave occasion to the great advancement of natural history, and the acquisition of magnificent collections of specimens. It was also at this period that Bougainville was, by command of Louis XV., circumnavigating the globe, accompanied by Commerson, to whom science is indebted for such rich accessions of knowledge. But not the least among the valuable fruits of these researches has been the lesson they have imparted to mankind, how much more imperishable is the glory that redounds to princes and to nations from such conquests in the unexplored regions of science, than from the unprincipled extensions of empire or the barbarous triumphs of the sword.

The voyages of Captain Cook, and the interesting discoveries that accrued from them, have so long been justly esteemed an important accession to the fame of our country, that a portion of that reputation must be allowed to descend to all those whose exertions contributed to their success. Of this merit a considerable share must be adjudged to Mr Banks, who brought home a splendid collection of specimens, more particularly from Otaheite, New Zealand, and Australia.

This voyage occupied three years of the life of Banks; and no sooner was he returned from it than, with unabated ardour, we find him eager to undertake another of equal extent. He had engaged his passage in the second expedition under Captain Cook, and had made all the necessary preparations for embarking, when he was suddenly obliged to relinquish his design in consequence of the conduct of Sir Hugh Palliser, who, he discovered, had been using all his influence with the admiralty to thwart his views, and frustrate the accomplishment of all his objects. It is due to the memory of Cook to state, that he took no part in this intrigue, but expressed his uniform friendship for Banks, and his deep regret at being deprived of his able co-operation. Disappointed in his hopes, Mr Banks immediately directed his efforts to the equipment of a ship at his own expense; and taking with him Dr Solander, Dr Lind, Von Troil, a Swedish naturalist, and others, who were to have been his companions in the second expedition with Captain Cook, he sailed for Iceland in July 1772; and after exploring, during two months, that interesting region of volcanoes, he returned enriched with valuable specimens and still more valuable information respecting its productions.

The island of Staffa, the existence of which was at that period scarcely known beyond the immediate neighbour-

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hood, was visited by our travellers on their way to Iceland, and its extraordinary groups of basaltic columns attracted much of their attention. The account of these, together with the drawings taken on the spot, was liberally communicated by Mr Banks to Pennant, for publication among his works. The information relating to Iceland was given to the world by M. Von Troil, who was afterwards appointed bishop of Linkioping.

But a great part of the knowledge resulting from the various travels of Mr Banks was communicated by him, from time to time, in papers to the Royal Society of London, of which he had been elected a fellow in the year 1766, and admitted in the following year, previous to his voyage with Captain Cook. He was a constant attendant on the meetings of that society, and took a very active part in its proceedings. On the resignation of Sir John Pringle, in the year 1778, Mr Banks was elected president of the Royal Society, an honour which he continued to enjoy till his death. A fierce dispute having arisen respecting the superiority of pointed over blunt conductors for lightning, it would appear that Sir John Pringle had the ill fortune to differ in opinion from the men then in power at court, who, to flatter the prejudices of the sovereign, arrayed themselves in opposition to the discoveries of Franklin, which, emanating from America, were supposed to have necessarily a revolutionary character. It was in vain that the honest president of the Royal Society made an humble representation that the prerogatives of his office did not extend to the control of the laws of nature; superior influence compelled him to retire from a situation which he could not retain with honour amidst the angry passions called forth during these philosophical polemics. His successor was more fortunate, and enjoyed during his whole life the favour of the court; in proof of which the title of baronet was conferred upon him in the year 1781. In 1795 Sir Joseph Banks obtained also from his majesty the order of the bath; and in 1797 he was appointed a member of the privy council. It does not appear, however, that he mingled much in politics, though he occasionally gave his opinion, when consulted on such questions of public interest as involved subjects of science. But to the honour of Sir Joseph Banks it ought certainly to be recorded, that, whilst he was unremitting in his solicitude to retain the full influence he enjoyed with those in power, he never made that influence subservient to the purposes of a selfish ambition, and invariably exerted it for the promotion of scientific objects, and the encouragement of those who pursued them. He made the most generous use of his library and collections, which were always open to every inquirer of respectability. His ample fortune enabled him to supply pecuniary assistance to useful works and enterprises; and, what was often as effectually serviceable, he freely gave to those who sought it the benefit of his counsel and experience.

As proofs of the unreserved manner in which he communicated the scientific treasures he had amassed to those capable of making a proper use of them, many works on natural history may be mentioned which have been enriched by the information derived from these collections, and which even owe their existence to the encouragement thus afforded to their authors. It was by their aid that the celebrated Fabricius was enabled to prosecute his extensive entomological researches. Broussonnet availed himself largely of Sir Joseph Banks's specimens of fishes for his work on ichthyology. Botanists, in particular, derived the greatest assistance from the stores of his herbarium. From this source it was that Gærtner obtained the most valuable materials for his excellent history of fruits and seeds. The admirable work of Mr Robert Brown, *On the Plants of New Holland*, was conducted under the immediate eye of Sir Joseph Banks, and with the aid of the materials derived from his collections.

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Sir Joseph Banks evinced an anxiety to diffuse over each region of the globe the productions of other climates. Thus he brought into Europe the seeds of the plants of the South Sea Islands, as he had already distributed to the latter those of Europe. We are indebted to his exertions for many of the beautiful plants which adorn our gardens and shrubberies. The sugar-cane of Otaheite was by him transplanted into the colonies; and the bread-fruit tree of the Pacific was introduced into the tropical soil of America, destined perhaps to repay in a future age to its inhabitants the benefits we ourselves have derived from the potato they formerly furnished. The flax brought from New Zealand, superior in many of its qualities to that of Europe, is among the presents he has made us. The black swan and the kangaroo are among the animals from Australia, for the introduction of which into this country we are indebted to Sir Joseph Banks.

The establishment of the British colony in New South Wales was one of the results of the expedition of Captain Cook, to which the exertions of Sir Joseph Banks mainly contributed; and who will venture to predict the important consequences this event may have on the future destinies of that vast continent of which it forms a part?

At the commencement of the American war the French king, Louis XVI., had issued general orders to his officers in all parts of the world, to offer no molestation to the vessels engaged in the expedition of discovery under Captain Cook, but, on the contrary, to furnish them with every requisite assistance in the prosecution of their objects. Sir Joseph Banks, in the spirit of generous reciprocity, exerted himself successfully to obtain, that a perpetual immunity from the evils of war for those engaged in scientific enterprises should be recognised, as it now is, as one of the laws of civilized warfare. This virtuous principle, which forms an honourable exception to the demoralizing tendency of national animosities, was adhered to in the case of the expedition of La Pérouse, orders being sent by the British government, in time of war, to make every inquiry respecting the fate of that unfortunate navigator, and supply every aid that might be required, in case the survivors should be discovered. After the disastrous termination of the expedition under D'Entrecasteaux, the collection of Labillardière being captured and brought to England, Sir Joseph Banks exerted himself successfully to obtain its release and delivery, untouched, to the French government. His motive for abstaining from the inspection of its contents was, as he expressed in a letter to Jussieu, lest any part of that knowledge, to the acquisition of which so eminent a botanist had devoted the best years of his life, should become alienated from its rightful owner. On ten different occasions collections addressed to the National Museums of Paris, and captured by British privateers, were in like manner restored and forwarded to their proper destination.

Sir Joseph Banks continued to fill the honourable office of president of the Royal Society, the just reward of his ardent zeal and unwearied exertions in the cause of science, for a period of more than forty years; enjoying the correspondence and confidence of most of the distinguished men of learning of this and other nations. His name was enrolled amongst the associates of almost every academy and learned society in Europe. His house and his table were ever open for the reception and entertainment of the leading members of the Royal Society, and of foreigners eminent for their scientific attainments, with that spirit of liberality which is so conducive to the union of interests and co-operation of efforts requisite for the successful cultivation of knowledge. The want of such a

centre of union has often led to the destruction of that harmony which should ever characterize men engaged in a common pursuit, calculated to raise them above vulgar passions; and the want of such harmony has always proved highly detrimental to the interests of science.

Notwithstanding the liberality that marked the conduct of Sir Joseph Banks in his intercourse with men of science of all countries, he had many bitter enemies; and his memory, soon after his death, was assailed by virulent invective. Yet his name will ever be remembered with gratitude by the friends of science, whom he benefited while living, and for whose use he bequeathed to the British Museum his books and botanical collections, under the care of that most distinguished botanist Mr Robert Brown. It is, however, not a little singular that, among the whole of his bequests, there is not one in favour of that society over which he had presided for above forty years, and from his connection with which he derived so much of the lustre which encompassed him; it would almost seem, indeed, as if he wished to be forgotten by them, since there is not a single syllable in his will expressive of his own recollection of that society.

Sir Joseph Banks was married, but had no family. During many of the latter years of his life he was a great sufferer from the gout, which almost totally deprived him of the use of his feet and legs. He died at his house in Soho Square, on the 19th of March 1820, at the age of 77. He was succeeded in the chair of the Royal Society for the remainder of the year by Dr Wollaston, and, at the ensuing anniversary, by Sir Humphry Davy, names that will ever remain illustrious in the annals of science. The only authentic particulars that have been yet published respecting the life of Sir Joseph Banks are contained in the *Éloge* by Cuvier, which was read to the Royal Academy of Sciences at Paris on the 2d of April 1821, and published in the fifth volume of the *Memoirs* of that academy. (P. M. R.)

BANKS, *Thomas*, an English sculptor, whose fame rests chiefly on his "Caractacus taken prisoner to Rome;" "Achilles mourning the loss of Briseïs;" and the monument to the memory of Sir Eyre Coote in Westminster Abbey. He died in 1805, at the age of 70. See SCULPTURE.

BANKS'S ISLAND, an island of New Zealand, of a circular form, about 60 miles in circumference, and visible at the distance of 12 or 15 leagues. It is of a broken irregular surface, and presents a barren appearance, though it is inhabited. It is 15 miles from Tavai-Poenammoo. The south point lies in Long. 186. 30. W. Lat. 43. 32. S.

BANN, a considerable river of Ireland, rising in the Mourne Mountains, traversing Lough Neagh, and flowing into the Atlantic. It is commonly described as two rivers separated by Lough Neagh. The upper Bann has a N.W. course from its source to Lough Neagh, and is navigable for vessels of 50 tons to its junction with the Newry canal, a little above Portadown. The lower flows in a northern direction, and is navigable up to Coleraine for vessels of 200 tons; but the bar at its mouth renders it difficult of access in rough weather. Measured in a direct line, the upper Bann is about 35 miles long, and the lower 30 miles.

BANNER, denotes either a square flag, or the principal standard of a prince or state. We find a multiplicity of opinions concerning the etymology of the word *banner*; some deriving it from the Latin *bandum*, a band or flag; others from the word *bann*, to summon the vassals to appear in arms; others, again, from the German *ban*, a field or tenement, because landed men alone were allowed a banner; and finally, there are persons who think it a corruption of *pannière*, from *pannus*, cloth, because banners were originally made of cloth.

BANNERETS, an ancient order of knights, or feudal lords, who led their vassals to battle under their own flag or banner, when summoned by the king. Bannerets are also called by ancient writers *milites vexilliferi*, and *vexillarii banerarii, bannarii, banderisii*, &c.

Anciently there were two kinds of knights, *great* and *little*; the first, called *bannerets*, composed of the upper, and the second, called *bachelors*, of the middle nobility. The banneret was allowed to march under his own flag, whereas the *bachelarius eques* followed that of another.

Banneret, according to Spelman, was a middle order between a baron and a simple knight. Hence he was sometimes callen *vexillarius minor*, to distinguish him from the greater, that is, from the baron, to whom alone properly belonged *jus vexilli*, or privilege of the square flag. Hence the banneret was also called *bannerettus, quasi baro minor*; a word frequently used by English writers in the same sense as banneret was by the French, though neither of them occur before the time of Edward II.

Some are of opinion that bannerets were originally persons who had a portion of a barony assigned them, and enjoyed it under the title of *baro proximus*, with the same prerogatives as the baron himself. Others, again, find the origin of bannerets in France, in Britanny, or in England; attributing the institution to Conan, lieutenant of Maximus, who revolted with the Roman legions in England, and deprived Gratian of the empire, A. D. 383. According to them, he divided England into forty cantons, and among these cantons distributed forty knights, to whom he gave power of assembling, on occasion, under their several banners, as many effective men as were to be found in their respective districts; whence they are called *bannerets*. It appears, however, from Froissart and others that, anciently, such of the military men as were rich enough to raise and subsist a company of armed men, and had a right to do so, were called *bannerets*; not, however, that these qualifications rendered them knights; they were only bannerets, and the appellation of knight was added because they were simple knights before.

Bannerets were second to none but knights of the garter. They were reputed the next degree below the nobility, and were allowed to bear arms with supporters. In France, it is said, the dignity was hereditary; but in England it died with the person who gained it. On the institution of baronets by King James I. the order dwindled, and at length became extinct. The last banneret created was Sir John Smith, who received the dignity after Edgehill fight, for his gallantry in rescuing the standard of Charles I.

BANNISTER, JOHN, one of the most eminent comedians of the British stage, was born in London in 1760. After a distinguished and honourable career, in 1815 he left the stage, and enjoyed in his retirement the esteem and admiration of all who had the pleasure of his acquaintance. His death took place on the 8th November 1836.

BANNOCKBURN, a village of Scotland, on the Bannock, an affluent of the Forth, three miles south of Stirling. In 1851, its population amounted to 2627, principally employed in the manufacture of tartans and carpets. Here, on the 24th of June 1314, was fought the memorable battle of Bannockburn, which secured the independence of Scotland, and established Bruce upon the throne. A fragment of the "bore stone" in which the royal standard was placed, is still to be seen, protected from the depredations of strangers by an iron frame-work. At Sauchieburn, in the neighbourhood, James III. was defeated by his subjects in 1488. See SCOTLAND.

BANQUETING ROOM or HOUSE. The ancient Romans supped in the *atrium*, or vestibule, of their houses; but in after-times magnificent saloons or banqueting-rooms were built, for the more commodious and splendid entertainment of their guests. Lucullus had several of these, each distinguished by the name of some god; and there was a particular rate of expense appropriated to each. Plutarch relates with

Bantam ‖ Bapaume.

what magnificence he entertained Cicero and Pompey, who went with a design to surprise him, by only telling a slave who waited, that the cloth should be laid in the Apollo. The Emperor Claudius, among others, had a splendid banqueting-room named Mercury. But everything of this kind was outdone by the lustre of the celebrated banqueting-house of Nero, called *domus aurea*, which, by the circular motion of its partitions and ceilings, imitated the revolution of the heavens, representing the different seasons of the year, which changed at every service, and showered down flowers, essences, and perfumes, on the guests.

BANTAM, a decayed town of Java, formerly capital of a district of the same name, at the north-western extremity of the island, situated on the Bay of Bantam, near the mouth of a river which falls into the bay. It was once a large, rich, and flourishing city, but now exhibits nothing except ruins, the memorials of its departed greatness. It is about 61 miles west from Batavia, and is situated on a low, swampy beach, surrounded by jungle, and intersected with stagnant streams, so that its climate is even more unhealthy than that of Batavia. After Batavia surrendered to the British arms in 1811, this kingdom was in a state of great distraction. the British government of Batavia accordingly interfered in favour of the rightful heir, and restored him to the throne. In former times Bantam was a free port, open to the commerce of all nations. In 1683 the trade was monopolized by the Dutch, who erected Fort Spielwyk, to shut out all other merchants. This odious policy excited great discontents among the people, who were always the bitter enemies of the Dutch; but they were unable to shake off the yoke of their oppressors, who, about the year 1742, had succeeded in completely establishing their authority. The Bay of Bantam was formerly a commodious retreat for vessels; but it is now so choked up with daily accessions of new earth washed down from the mountains, as well as by coral shoals extending a considerable way to the eastward, that it is inaccessible to vessels of any considerable burden. Prior to the Dutch conquest, Bantam was a powerful state, the sovereign of which extended his conquests in the neighbouring islands of Borneo and Sumatra. It was abandoned by the Dutch in 1817, for the more elevated station of Ceram, seven miles inland, and it is now a miserable village. Long. 106. 3. E. Lat. 6. 4. S.

BANTRY, a small seaport of Ireland, on Bantry Bay, in Lat. 51. 39. N. Long. 9. 24. W. The trade of this port, formerly considerable, is now almost confined to the exportation of grain. The pilchard fishery was once very productive, but that fish has deserted the coast. The population, which in 1831 was 4276, had decreased in 1851 to 2935.

BANTRY BAY, an inlet of the sea, on the S.W. coast of Ireland, in the county of Cork, about twenty-five miles long by four to six broad, having from ten to thirty or forty fathoms of water, surrounded by high mountains, and indented by creeks and inlets. It affords a very fine harbour for shipping, and contains two small islands, Bear and Whiddy. In 1796 a French fleet anchored here with a view of invading Ireland, and landed eight men, who were immediately taken prisoners. The fleet soon after left the coast. Long. 9. 24. to 9. 45. E. Lat. 51. 30. to 51. 40. N.

BAOBAB (*Adansonia digitata*), the largest of trees, measuring sometimes thirty feet in diameter; but its height is not in proportion. It inhabits the western side of Africa, and is cultivated in Egypt and Abyssinia. The largest are at Senegal.

BAPAUME, a fortified town in France, capital of a canton in the department of Pas de Calais, 15 miles S.S.E. of Arras. It is neat and well built, has a parish church, hospital, communal college, and a fountain supplied with water by an artesian well. Its manufactures of lace, woollens, cottons, and fine thread, are considerable. Pop. 2973.

Baphomet ‖ Baptism.

BAPHOMET, the imaginary symbol or idol which the Templars were accused of worshipping in their secret rites. See TEMPLARS. The term is supposed to have been a corruption of the name *Mahomet*. On this subject, the learned Von Hammer has written a dissertation, in which he revives the old charge against the Templars. The word, according to his interpretation, signifies the baptism of *Metis* or of fire. This was replied to by M. Raynouard, in the *Journal des Savans*, March 1819.

BAPTISM, in matters of religion, the ceremony or sacrament by which a person is initiated into the Christian church. The word is drived from the Greek βαπτιζω, a frequentative form of βαπτω, *to dip* or *wash*. Baptism is known in ecclesiastical writers by divers other names and titles. Sometimes it is called *palingenesia*, or *regeneration*; sometimes *salus*, or *life and salvation*; sometimes σφραγις, *signaculum Domini*, and *signaculum fidei*, or *the seal of faith*; sometimes absolutely *mysterium*, and *sacramentum*; sometimes *the sacrament of faith*; sometimes *viaticum*, from its being administered to departing persons; sometimes *sacerdotium laici*, or the *lay priesthood*, because allowed, in cases of necessity, to be conferred by laymen; sometimes it is called the *great circumcision*, because it was imagined to succeed in the room of circumcision, and to be a seal of the Christian covenant, as circumcision was the seal of the covenant made with Abraham. In respect that baptism had Christ for its author, and not man, it was anciently known by the name of δωρον and χαρισμα Κυριου, *the gift of the Lord*; sometimes it was simply called δωρον, without any other addition, by way of eminence, because it was both a gratuitous and singular gift of Christ. In reference to the making men complete members of Christ's body, the church, it had the name of τελειωσις, and τελειη, the *consecration* and *consummation*, because it gave men the perfection of Christians, and a right to partake of το τελειον, which was *the Lord's Supper*. It had also the name of μυησις, and μυσταγωγια, the *initiation*, because it was the admission of men to all the sacred rites and mysteries of the Christian religion.

Baptism has been supposed by many learned authors to have had its origin in the Jewish church, in which, as they maintain, it was the practice long before Christ's time to baptize proselytes or converts to their faith, as part of the ceremony of admission; and this practice, according to some, obtains among them to this day, a person turning Jew being first circumcised, and, when healed, bathed or baptized in water, in presence of the rabbin, after which he is reputed a good Jew. Others, however, insist that the Jewish proselyte baptism is not by far so ancient; and that John the Baptist was the first administrator of baptism among the Jews. Of this opinion were Deylingius, J. G. Carpzovius, Boernerus, Wernsdorfius, Zeltnerus, Owen, Knatchbull, Jennings, Gill, and others.

Grotius is of opinion that the rite of baptism derives its origin from the time of the Deluge, immediately after which, he thinks, it was instituted in memory of the world having been purged by water. Some learned men think it was added to circumcision soon after the Samaritan schism, as a mark of distinction to the orthodox Jews. Spencer, who is fond of deriving the rites of the Jewish religion from the ceremonies of the Pagans, lays it down as a probable supposition, that the Jews received the baptism of proselytes from the neighbouring nations, who were wont to prepare candidates for the more sacred functions of their religion by a solemn ablution, that, by this affinity of sacred rites, they might draw the Gentiles to embrace their religion, and that the proselytes, in the gaining of whom they were extremely diligent, might the more easily comply with the transition from Gentilism to

Baptism. Judaism. In confirmation of this opinion, he observes, first, that there is no divine precept for the baptism of proselytes, God having enjoined only the rite of circumcision for the admission of strangers into the Jewish religion; and, secondly, he contends, that, among foreign nations, the Egyptians, Persians, Greeks, Romans, and others, it was customary for those who were to be initiated into their mysteries or sacred rites, to be first purified by dipping the whole body in water. The same learned writer adds, as a further confirmation of his opinion, that the cup of blessing, added to the paschal supper, seems likewise to have been derived from a pagan original; as the Greeks at their feasts had one cup called ποτηριον αγαθου δαιμονος, *the cup of the good demon or god*, which they drank at the conclusion of their entertainment when the table was removed. Since, then, a rite of Gentile origin was added to one of the Jewish sacraments, namely, the passover, there can be no absurdity, he thinks, in supposing that baptism, which was added to the other sacrament, namely circumcision, might be derived from the same source. In the last place, he observes, that Christ, in the institution of his sacraments, paid a peculiar regard to those rites which were borrowed from the Gentiles; for, rejecting circumcision and the paschal supper, he adopted into his religion baptism and the sacred cup; thus preparing the way for the conversion and reception of the Gentiles into his church.

The design of the Jewish baptism, if baptism was practised by them, is supposed to have been to import a regeneration, whereby the proselyte was rendered a new man, and from being a slave became free. The effect of it was, to cancel all former relations; so that those who were before akin to the person, after the ceremony ceased to be so. It is to this ceremony Christ is supposed to have alluded, in his expression to Nicodemus, that it was necessary that he should be born again, in order to become his disciple. The necessity of baptism to salvation is grounded on these two sayings of our Saviour, "He that believeth, and is baptized, shall be saved;" and "Except a man be born of water and of the Spirit, he cannot enter into the kingdom of God." The ancients did not generally think the mere want of baptism, where the procuring of it was impracticable, excluded men absolutely from the hopes of eternal salvation. Some few of them, indeed, are pretty severe upon infants dying without baptism; and others seem also, in general terms, to deny eternal life to adult persons dying unbaptized. But when they interpret themselves, and speak more distinctly, they make some allowances, and specially except several cases in which the want of baptism may be supplied by other means. Such is martyrdom, which commonly goes by the name of "second baptism in men's own blood" in the writings of the ancients, because of the power and efficacy it was thought to have in saving men by the invisible baptism of the Spirit, without the external element of water. Faith and repentance were also esteemed a supplement to the want of baptism, in such catechumens as died whilst they were piously preparing themselves for baptism. Constantly communicating with the church was also thought to supply the want of baptism to persons who had been admitted to communion on a presumption of their having been duly baptized, though the contrary afterwards appeared. For infants dying without baptism, the case was thought more dangerous; as here, no personal faith, repentance, or the like, could be pleaded, to supply the defect, and to wash away original sin. On this account, they who spoke most favourably of them, as Gregory Nazianzen, and Severus, bishop of Antioch, only assigned them a middle state, neither in heaven nor hell. But the Latins, as St Augustin, Fulgentius, Marius Mercator, and others, who never admitted the opinion of a middle state, concluded, that, as they could not be received into heaven, they must go to hell. Pelagius and his followers, who denied original sin, asserted that they might be admitted to eternal life and salvation, although not to the kingdom of heaven; between which a distinction was made. Where the fault lay not on the side of the child, nor his parents, but on that of the minister, or where any unavoidable accident rendered baptism absolutely impossible, Hincmar and others made an exception, holding that the child might in that case be saved without baptism. Baptism.

The receiving of baptism is not limited to any time, nor to any age of life. Some contend for its being administered like circumcision, precisely on the eighth day, as Gregory Nazianzen; while others would have it deferred till the child is three years of age, and able to hear the mystic words, and make answer thereto, though he do not understand them. In the canon law we find divers injunctions against deferring the baptism of infants beyond certain days, as the ninth, thirtieth, and thirty-seventh, some of them involving pecuniary forfeitures in case of disobedience.

Salmasius, and Suicerus after him, deliver it as authentic history, that for the first two ages no one received baptism who was not first instructed in the faith and doctrine of Christ, so as to be able to answer for himself that he believed; and this by reason of the words, "He that believeth and is baptized;" which in effect is to say, that no infant, for the first two ages, was ever admitted to Christian baptism. They own, however, that pædobaptism afterwards came in, upon the opinion that baptism was necessary to salvation. But Vossius, Dr Forbes, Dr Hammond, Mr Walker, and especially Mr Wall, who has exactly considered the testimony and authority of almost every ancient writer who has said any thing upon this subject, endeavour to evince that infants were baptized even in the apostolical age; and it is certain that Tertullian pleads strongly against giving baptism to infants; which at least shows that there was some such practice in his age, though he disapproved of it. But the ordinary subjects of this sacrament in the first ages were converts from Judaism and Gentilism, who, before they could be admitted to baptism, were obliged to spend some time in the state of catechumens, to qualify them for making their professions of faith and a Christian life, in their own persons; for, without such personal professions, there was ordinarily no admission of them to the privilege of baptism. Those baptized in their sick beds were called *clinici*, and held in some reproach, as not being reputed good Christians; and hence we meet with several censures of clinic baptism in councils and ecclesiastical writers. But this clinic baptism was not sufficient to qualify the person, in case of recovery, for ordination. Some had their baptism put off by way of punishment, when they fell into gross and scandalous crimes, which were only to be expiated by a long course of discipline and repentance. This sometimes included five, ten, twenty, or more years; in particular cases the whole of life to the very hour of death, when very flagrant crimes had been committed.

In the earliest ages of the church, there was no stated time or place for the reception of baptism. Afterwards, Easter, Whitsuntide, and Epiphany, became solemn seasons, out of which baptism was not administered, except in cases of necessity. The catechumens who were to receive it at these times were called *competentes;* and it is to these that St Cyril addresses his catecheses. In the apostolical age, and some time after, before churches and baptisteries were generally erected, they baptized in any place where they had convenience; for example, John baptized in Jordan, Philip baptized the eunuch in the

Baptism. wilderness, and Paul baptized the jailer in his own house. But in after-ages baptisteries were built adjoining to the churches; and then rules were made that baptism should ordinarily be administered nowhere except in these buildings. Justinian, in one of his *novellæ*, refers to ancient laws appointing that none of the sacred mysteries of the church should be celebrated in private houses. Men might have private oratories for prayer in their own houses; but they were not to administer baptism or the eucharist in them, unless by a particular license from the bishop of the place. Such baptisms are frequently condemned in the ancient councils, under the name παραβαπτισμαται, *baptisms in private conventicles.*

As to the attendant ceremonies and manner of baptism in the ancient church, the person to be baptized, if an adult, was first examined by the bishop or officiating priest, who put some questions to him; as, first, whether he abjured the devil and all his works, and, secondly, whether he gave a firm assent to all the articles of the Christian faith; to each of which he answered in the affirmative. If the person to be baptized was an infant, these interrogatories were answered by his *sponsores* or godfathers. Whether the use of sponsors was as old as the days of the apostles is uncertain; the probability is it was not, since Justin Martyr, speaking of the method and form of baptism, says not a word of them. After the questions and answers, followed exorcism, the manner and end of which was this: The minister laid his hands on the person's head, and breathed in his face, implying thereby the driving away or expelling of the devil, and preparing the convert for baptism, by which the good and holy spirit was to be conferred upon him. After exorcism followed baptism itself. And, first of all, the minister, by prayer, consecrated the water for that purpose. Tertullian says, "any waters may be applied to that use; but then God must be first invocated; on which the Holy Ghost presently comes down from heaven, and moves upon them, and sanctifies them." The waters having been consecrated, the person was baptized "in the name of the Father, and of the Son, and of the Holy Ghost;" by which "dedication of him to the blessed Trinity, the person," says Clemens Alexandrinus, "is delivered from that corrupt trinity, the devil, the world, and the flesh." In performing the ceremony of baptism, the usual custom, except in clinical cases, or where there was scarcity of water, was to immerse the whole body. Thus St Barnabas, describing a baptized person, says, "We go down into the water full of sin and filth, but we ascend bearing fruit in our hearts." And this practice of immersing the whole body was so general, that we find no exception made from respect either to the tenderness of infants or the bashfulness of the other sex, unless in case of sickness or disability. But, to prevent any indecency, men and women were baptized apart; to which end, either the baptisteries were divided into two apartments, one for the men, the other for the women, as Bingham has observed; or the men were baptized at one time and the women at another, as is shown by Vossius, from the *Ordo Romanus*, Gregory's *Sacramentarium*, and other authorities. Add to this, that there was anciently an order of deaconesses, one part of whose business was to assist at the baptism of women. These precautions, however, rather indicate a scrupulous attention to delicacy, than imply any indecency in the circumstance of immersion itself. From the circumstance of candidates being immersed, however, there is no reason to infer that immersion was made in a state of nudity. The present Baptists never baptize naked, though they always immerse. After immersion followed the unction; by which, according to St Cyril, was signified that they were now cut off from the wild olive, and were ingrafted into Christ, the true olive tree; or else to show that they were now to be champions for the gospel, and were anointed thereto, as the old athletæ were for their solemn games. With this anointing was joined the sign of the cross, made upon the forehead of the person baptized; which being done, he had a white garment given him, to denote his being washed from the defilements of sin, or in allusion to that of the apostle, "As many as are baptized in Christ have put on Christ." From this custom the feast of Pentecost, which was one of the annual seasons of baptism, came to be called *Whitesunday* or Whitsunday. The garment in question was afterwards laid up in the church, that it might be an evidence against such persons as violated or denied that faith which they had owned in baptism. When the baptism was performed, the person baptized, according to Justin Martyr, "was received into the number of the faithful, who then sent up their public prayers to God for all men, for themselves, and for those who had been baptized." Baptism.

The ordinary ministers, who had the right of administering this sacrament, that is, of applying the water to the body, and pronouncing the formula, were presbyters or bishops; but on extraordinary occasions laymen were admitted to perform the same.

The present form of administering baptism in the church of Rome is as follows:—When a child is to be baptized, the persons who bring it wait at the door of the church for the priest, who comes thither in his surplice and purple stole, attended by his clerks. He begins with questioning the godfathers, whether they promise, in the child's name, to live and die in the true Catholic and Apostolic faith, and what name they would give the child. Then follows an exhortation to the sponsors; after which the priest, calling the child by its name, asks, "What dost thou demand of the church?" The godfather answers, "Eternal life." The priest proceeds: "If you are desirous of obtaining eternal life, keep God's commandments, thou shalt love the Lord thy God," &c.; after which he breathes three times in the child's face, saying, "Come out of this child, thou evil spirit, and make room for the Holy Ghost." Then he makes the sign of the cross on the child's forehead and breast, saying, "Receive the sign of the cross on thy forehead and in thy heart;" upon which, taking off his cap, he repeats a short prayer, and laying his hand gently on the child's head, repeats a second prayer; then he blesses some salt, and, putting a little of it into the child's mouth, pronounces these words, "Receive the salt of wisdom." All this is performed at the church door. The priest, with the godfathers and godmothers, coming into the church, and advancing towards the font, repeat the apostles' creed and the Lord's prayer. Arrived at the font, the priest exorcises the evil spirit again; and taking a little of his own spittle, with the thumb of his right hand rubs it on the child's ears and nostrils, repeating, as he touches the right ear, the same word, *Ephatha, be thou opened*, which our Saviour made use of to the man born deaf and dumb. Lastly, they pull off its swaddling-clothes, or strip it below the shoulders, during which the priest prepares the oil. The sponsors then hold the child directly over the font, observing to turn it due east and west; whereupon the priest asks the child, "whether he renounces the devil and all his works;" and the godfather having answered in the affirmative, the priest anoints the child between the shoulders in the form of a cross; then taking some of the consecrated water, he pours part of it thrice on the child's head, at each perfusion calling on one of the persons of the Holy Trinity. The priest concludes the ceremony of baptism with an exhortation. It may be added, that the Romish church allows midwives, in cases of danger, to baptize a

Baptism. child before it comes entirely out of its mother's womb; but it is to be observed, that as some part of the body of the child must appear before it can be baptized, it is baptized on that which first appears: if it be the head, it is not necessary to rebaptize the child; but if only a foot or hand appears, baptism must be repeated. A still-born child thus baptized may be buried in consecrated ground.

The Greek church differs from the Romish as to the rite of baptism, chiefly in performing it by immersion, or plunging the infant all over in the water.

The forms of administering baptism among us being too well known to require a particular description, we shall only mention one or two of the more material differences between the form as it stood in the first liturgy of King Edward, and that in the English Common Prayer Book at present. First, the form of consecrating the water did not make a part of the office in King Edward's liturgy, as it does in the present, because the water in the font was changed and consecrated but once a month. The form itself likewise was something different from that now used, and was introduced with a short prayer, that Jesus Christ, upon whom (when he was baptized) the Holy Ghost came down in the likeness of a dove, would send down the same Holy Spirit, to sanctify the fountain of baptism; which prayer was afterwards left out at the second review. By King Edward's first book the minister was required to dip the child in the water thrice; first, the right side; secondly, the left; and, lastly, the face toward the foot. This triple immersion was a very ancient practice in the Christian church, and used in honour of the Holy Trinity; though some later writers say that it was done to represent the death, burial, and resurrection of Christ, together with his three days' continuance in the grave. But afterwards, when the Arians made an improper use of it, persuading the people that it denoted a distinct substantiality of the three persons in the Trinity, the orthodox left it off and used only one single immersion.

By the first common prayer of King Edward, after the child was baptized, the godfathers and godmothers were to lay their hands upon it, and the minister was to put on him the white vestment, commonly called the *chrysome*, and to say, "Take this white vesture as a token of the innocency which, by God's grace, in this holy sacrament of baptism, is given unto thee, and for a sign whereby thou art admonished, so long as thou livest, to give thyself to innocence of living, that after this transitory life thou mayest be partaker of the life everlasting." As soon as he had pronounced these words he was to anoint the infant on the head, saying, "Almighty God, the father of our Lord Jesus Christ, who hath regenerated thee by water and the Holy Ghost, and hath given unto thee remission of all thy sins, may he vouchsafe to anoint thee with the unction of his Holy Spirit, and bring thee to the inheritance of everlasting life."

The custom of sprinkling children instead of dipping them in the font, which at first was allowed in case of the weakness or sickness of the infant, has so far prevailed that immersion is now quite excluded. What principally tended to confirm the practice of affusion or sprinkling was, that several of our Protestant divines flying into Germany and Switzerland during the bloody reign of Queen Mary, and returning home when Queen Elizabeth came to the crown, brought back with them a great zeal for the Protestant churches beyond sea where they had been sheltered and received; and having observed that at Geneva and other places baptism was administered by sprinkling, they thought they could not do the church of England a greater piece of service than by introducing a practice dictated by so great an authority as Calvin. This, together with the coldness of our northern climate, was what contributed to banish entirely the practice of immersing infants in the font. Baptism.

The different notions which have been entertained concerning the effects of baptism, it would be endless to enumerate. The Remonstrants and Socinians reduce baptism to a mere sign of divine grace. The Romanists, on the contrary, exalt its power, holding, that thereby all sin is entirely taken away by it; that it absolutely confers justification, and consequently grace *ex opere operato*. Some also speak of an indelible character impressed on the soul by it, called *character dominicus*, and *character regius*; but others hold this a mere chimera, maintaining that the spiritual character conferred in regeneration may easily be effaced by mortal sins. Dodwell contends that it is by baptism that the soul is made immortal, and that those who die without it cannot rise again; but he limits this effect to episcopal baptism alone. From the effects ordinarily ascribed to baptism, even by ancient writers, it would seem that the ceremony is as much of heathen as Jewish origin, since Christians do not restrain the use of it, like the Jews, to the admission of new members into the church, but hold, with the heathens, that it contains a virtue for remitting and washing away sins. The Brahmins are still said to baptize with this latter view at certain seasons in the river Ganges, to the waters of which they ascribe a cleansing or sanctifying quality; and hence it is that people flock from all parts, even of Tartary, in expectation of being thus eased of their load of sins. But in this point many Christians seem to have gone beyond the folly of the heathens. It was only the smaller sins of infirmity which these latter held to be expiable by washing; for crimes of a blacker dye, they allowed, no water could efface, no purgation discharge them. The Christian doctrine of a total remission of sins by baptism could not fail, therefore, to scandalize many amongst the heathen, and furnished the apostate Julian with an occasion for ridiculing Christianity itself: "Whoever," says he, "is guilty of rapes, murders, sacrilege, or any abominable crime, let him be washed with water, and he will become pure and holy."

In the ancient church, baptism was frequently conferred on Jews by violence; but the church itself never seems to have allowed of force on this occasion. By a canon of the fourth council of Toledo, it is expressly forbidden to baptize any one against his or her will. That which looks most like force in this case is to be found in two orders of Justinian; one of which appoints the heathen, and the other the Samaritans, to be baptized, with their wives and children and servants, under pain of confiscation. By the ancient laws, baptism was not to be conferred on image-makers, stage-players, gladiators, *aurigæ* or public drivers, magicians, or even strolling beggars, until they quitted such professions. Slaves were not allowed the privilege of baptism without the testimony and consent of their masters; excepting the slaves of Jews, heathens, and heretics, who were not only admitted to baptism, but, in consequence of the rite, had their freedom conferred on them.

Baptism by Fire, spoken of by John the Baptist, has given rise to much conjecture. The generality of the fathers held that believers, before they enter paradise, must pass through a certain fire, which is to purify them from all pollutions remaining unexpiated. But some, with St Basil, understand it of the fire of hell; others, of that of tribulation and temptation; while a few, with St Chrysostom, will have it to denote an abundance of graces. Some suppose it to mean the descent of the Holy Ghost on the apostles, in the form of fiery tongues; others maintain, that the word *fire* here is an interpolation, and that we are only to read the text, "He that shall come after me will baptize you with the Holy Ghost."

Baptism. The ancient Selucians and Hermians, understanding the passage literally, maintained that material fire was necessary in the administration of baptism. But we do not find how or to what part of the body they applied it, or whether they were satisfied with obliging the person baptized to pass through the fire. Valentinus rebaptized all who had received water-baptism, and conferred on them the baptism of fire.[1] Heracleon, cited by Clemens Alexandrinus, says that some applied a red-hot iron to the ears of the person baptized, as if to impress some mark upon him.

Baptism of the Dead, a custom which anciently prevailed among some people in Africa, of giving baptism to the dead. The third council of Carthage speak of it as a thing which ignorant Christians were fond of. Gregory Nazianzen also takes notice of the same superstitious opinion prevailing among some who delayed to be baptized. In his address to this kind of men, he asks, whether they stayed to be baptized after death. Philastrius also notices it as the general error of the Montanists or Cataphrygians, that they baptized men after death. The practice seems to have been grounded on a vain opinion, that when men had neglected to receive baptism in their life-time, some compensation might be made for this default by receiving it after death.

Baptism of the dead was also a sort of vicarious baptism, formerly in use, when, in the case of a person dying without baptism, another was baptized in his stead. This, St Chrysostom tells us, was practised among the Marcionites with a great deal of ridiculous ceremony. When a catechumen happened to die, they hid a living man under the bed of the deceased: then coming to the dead man, they asked him whether he would receive baptism; and he making no reply, the other answered for him, and said he would be baptized in his stead; and so they baptized the living for the dead. Epiphanius assures us the like was also practised amongst the Corinthians. This practice they pretended to found on the Apostle's authority, alleging that text of St Paul for it, "If the dead rise not at all, what shall they do who are baptized for the dead?" a text which has given occasion to a great variety of different systems and explications. Vossius enumerates no less than nine different opinions among learned divines concerning the sense of the phrase, being "baptized for the dead."

Hypothetical Baptism was that formerly administered in certain doubtful cases, with the formula, "If thou art baptized, I do not rebaptize; if thou art not, I baptize thee in the name of the Father," &c. This sort of baptism, enjoined by some ancient constitutions of the English church, has now fallen into disuse.

Solemn Baptism was that conferred at stated seasons. Such, in the ancient church, were the paschal baptism, and that at Whitsuntide. This is sometimes also called general baptism.

Lay Baptism we find to have been permitted both by the common prayer-book of King Edward and by that of Queen Elizabeth, when an infant is in immediate danger of death, and a lawful minister cannot be had. This was founded upon the mistaken notion of the impossibility of salvation without the sacrament of baptism; but afterwards, when they came to have clearer notions of the sacraments, it was unanimously resolved, in a convocation held in the year 1575, that even private baptism, in a case of necessity, was only to be administered by a lawful minister.

Baptism is also applied abusively to certain ceremonies used in giving names to things inanimate. The ancients knew nothing of the custom of giving baptism to inanimate things, as bells, ships, and the like, by a superstitious consecration of them. The first notice we have of this is in the capitulars of Charles the Great, where it is mentioned with censure; but afterwards it crept by degrees into the Roman offices. Baronius carries its antiquity no higher than the year 968, when the great bell of the church of Lateran was christened by Pope John III. At last it grew to such superstitious height as to form a ground of complaint in the *Centum Gravamina* of the German nation, drawn up in the public diet of the empire held at Nuremberg in the year 1581; where, after describing the ceremony of baptizing a bell, with godfathers, who made responses as in baptism, and gave it a name, and clothed it with a new garment as Christians were used to be clothed withal, and all this to make it capable of driving away tempests and devils, they conclude against it as not only a superstitious practice, but contrary to the Christian religion, and a mere seduction of the simple people. Baptismal Vow ‖ Baptists.

BAPTISMAL Vow or Covenant, a profession of obedience to the laws of Christ, which persons in the ancient church made before baptism. It was an indispensable part of the obligation on catechumens before they were admitted to the ceremony of regeneration. The vow was made by turning to the east, for what mystical reason is not well agreed on.

Baptismal *Presents*, in use in Germany, were made by the sponsors to the infant, and consisted of money, plate, or even sometimes fiefs of lands, which by the laws of the country were to be kept for the child until he became of age; the parents having only the trust, not the right of disposing of them.

BAPTISTE, or Jean Baptiste Monnoyer, a painter of flowers and fruit, was born at Lisle in 1635, and educated at Antwerp. It was his first intention to become a painter of history; but finding that his genius more strongly inclined him to the painting of flowers, he applied his talents to those subjects, and in that style became one of the greatest masters. His pictures are not so exquisitely finished as those of Van Huysum, but his composition and colouring are in a bolder style. He was employed by William III. to decorate Kensington Palace. He died in 1699, leaving a son, Anthony, who followed his father's profession, and had great merit.

BAPTISTS, in *Ecclesiastical History*, a denomination of Christians, distinguished from other Christians by their particular opinions respecting the mode and the subjects of baptism.

Instead of administering the ordinance by sprinkling, they maintain that it ought to be administered only by immersion. Such, they insist, is the import of the word βαπτιζω; so that a command to baptize is a command to immerse. And thus it was understood by those who first administered it. John the Baptist and the apostles of Christ administered it in Jordan and other rivers and places where there was much water. Both the administrators and the subjects are described as going down into and coming up again out of the water; and the baptized are said to be buried in baptism, and to be raised again; which language could not, they say, be properly adopted on supposition of the ordinance being administered in any other manner than by immersion. Thus also, they affirm, it was in general administered in the primitive church; thus it is now administered in the Russian and Greek church; and thus it is at this day directed to be administered in the church of England to all who are thought

[1] Bis docuit tingi, transducto corpore flamma. (Tertull. *Carm. contr. Marc.* lib. i.)

Baptists. capable of submitting to it in this manner. With regard to the subjects of baptism, the Baptists say that this ordinance ought not to be administered to children or infants at all, nor to grown up persons in general; but to adults only of a certain character and description. Our Saviour's commission to his apostles, by which Christian baptism was instituted, is to go and teach all nations, baptizing them; that is, say they, not to baptize all they meet with, but first to instruct them, to teach all nations, or to preach the gospel to every creature, and whoever receives it, him to baptize in the name of the Father, and of the Son, and of the Holy Ghost. To such persons, and to such only, baptism appears to have been administered by the apostles and the immediate disciples of Christ. They are described as repenting of their sins, as believing in Christ, and as having gladly received the word. Peter acquaints those who were converted by his sermon, that without these qualifications he could not have admitted them to baptism; Philip holds the same language in his discourse with the Ethiopian eunuch; and Paul treats Lydia, the jailer, and others, in the same manner. Without these qualifications Christians in general think it wrong to admit persons to the Lord's supper; and for the same reasons, without these qualifications, or at least a profession of them, the Baptists think it wrong to admit any to baptism. Wherefore they withhold it, not only from the impenitently vicious and profane, and from infidels, who have no faith, but also from infants and children, who have no knowledge, and are incapable of every action civil and religious. They further insist that all positive institutions depend entirely upon the will and declaration of the founder; wherefore, that reasoning by analogy from abrogated Jewish rites is to be rejected, and the express commands of Christ respecting the mode and subjects of baptism ought to be our only rule.

The Baptists in England form one of the denominations of Protestant dissenters. They separate from the establishment for the same reasons as their brethren of the other denominations do; and an additional motive is derived from their particular tenets respecting baptism. The constitution of their churches, and their mode of worship, is congregational or independent; and in the exercise of it they are protected, in common with other dissenters, by the act of toleration. Before this act they were liable to pains and penalties as nonconformists, and often for their peculiar sentiments as Baptists. A proclamation was in fact issued out against them, and some of them were burnt in Smithfield in 1538. They bore a considerable share in the persecutions of the seventeenth and preceding centuries, and, as it should seem, in those of even an earlier date; for among the Lollards and the followers of Wickliffe there were several who disapproved of infant baptism, and there were many of this persuasion among the Protestants and reformers abroad. In Holland, Germany, and the North, they went by the names of Anabaptists and Mennonites; and, in Piedmont and the south, they were found among the Albigenses and Waldenses.

The *Baptists* subsist under two denominations; the Particular or Calvinistical, and the General or Arminian. The former is by far the most numerous. Some of both denominations allow of *mixed communion*, that is, with persons who have been sprinkled in their infancy, and therefore unbaptized in the view of the Baptists. Others, again, disallow it; and a few of them observe the seventh day of the week as the Sabbath, apprehending the law that enjoined it not to have been repealed by Christ or his apostles. But a difference of opinion respecting these and other matters is not peculiar to the Baptists, being common to all Christians, and to all bodies of men who think and judge for themselves.

BAPTISTERY, in ecclesiastical language, the name of a place in which the ceremony of baptism is performed. Baptistery ‖ Bar-le-Duc.

In the ancient church it was one of the exhedræ or buildings distinct from the church itself, and consisted of a porch or anti-room where the persons to be baptized made their confession of faith, and an inner apartment where the ceremony of baptism was performed. Thus it continued till the sixth century, when the baptisteries began to be taken into the church-porch, and afterwards into the church itself. The ancient baptisteries were commonly called φωτιστηρια, *photisteria*, or places of illumination, because they were the places of instruction preceding baptism; and in these the catechumens seem to have been trained up, and instructed in the first rudiments of the Christian faith.

Those baptisteries were anciently very capacious, because the stated times of baptism returning but seldom, there were usually great multitudes to be baptized at the same time; and also because the manner of baptizing by immersion or dipping under water made it necessary to have a large font. In Venantius Fortunatus it is called *aula baptismatis*, the large hall of baptism; which was indeed so large, that we sometimes read of councils meeting and sitting therein. This hall, or chapel, was always kept shut during Lent, and the door sealed up with the bishop's seal, not to be opened till Maunday-Thursday. The baptistery was always reputed a sacred place. In the Roman order baptisteries were built of a round figure, and distinguished with the image of St John the Baptist, while over the basin or font was a figure of a dove in gold or silver, to represent the Holy Ghost.

The name *baptistery* is sometimes also given to a kind of chapel in a large church, which served for the same office. It is an observation of some learned men, that anciently there was but one baptistery in a city, namely, at the bishop's church; and that afterwards they were set up in parish churches, with the special allowance, however, of the bishop.

BAR, in courts of justice, denotes an inclosure made with a partition of timber, where the counsel are placed to plead causes, and where prisoners are brought to answer to indictments, &c. It corresponds to what among the Romans was denominated *tribunal*. The French call it *barre d'audience*. In England, lawyers who are called to the bar, or licensed to plead, are termed *barristers*, an appellation equivalent to *licentiate* in other countries.

BAR, in *Heraldry*, an ordinary in form of the fess, but much less. See HERALDRY.

BAR, in *Music*, a stroke drawn perpendicularly across the lines of a piece of music, including between each two a certain quantity or measure of time, which is various as the time of the music is either triple or common. The use of bars is not to be traced higher than 1574; the time when the English translation of Adrian le Roy's book on the Tablature was published, and it was not until some time after that the use of bars became general. Barnard's cathedral music, printed in 1641, is without bars; but bars are to be found throughout in the *Ayres and Dialogues* of Henry Lawes, published in 1653; from which it may be conjectured that we owe this improvement to Lawes.

BAR, in *Hydrography*, denotes a bank of sand or other matter, whereby the mouth of a river is in a manner choked up. The term is also used for a strong beam wherewith the entrance of a harbour is secured; but this is more commonly called *boom*.

BAR-LE-DUC, or BAR-SUR-ORNAIN, a town of France, department of Meuse, and capital of an arrondissement of the same name. It occupies the declivity and base of a hill, on the river Ornain, a tributary of the Marne, 125 miles E. of Paris. Lat. 48. 46. 8. N. Long. 5. 9. 47. E. It has a college,

Bar-sur-Aube. ‖ Baralipton.

normal school, society of agriculture and arts, and public library. By the Ornain a considerable traffic is maintained in wood, wine, wool, &c. The manufactures of cotton stuffs, hats, hosiery, leather, and confections, are considerable. Pop. in 1851, 14,303. The arrondissement contains 8 cantons and 128 communes: pop. 86,358.

BAR-SUR-AUBE, an arrondissement of the department of the Aube, in France, comprehending 4 cantons and 88 communes. Area, 410 square miles. Pop. in 1851, 44,347. The chief place is the city of the same name, in a picturesque district, the wine of which is much esteemed. Pop. 4380. Long. 4. 44. E. Lat. 48. 13. N.

BAR-SUR-SEINE, an arrondissement of the department of the Aube, in France, comprehending 5 cantons and 85 communes. Area, 357 square miles. Pop. in 1851, 53,447. The chief place of the same name has a population of 2656 persons, employed in manufactures and the wine trade. In the middle ages this was a place of considerable importance. Long. 4. 24. E. Lat. 48. 5. N.

BARA, the name of a festival formerly celebrated with much magnificence at Messina, and representing the assumption of the Virgin. Though used as the general denomination of this festival, bara signifies more particularly a vast machine 50 feet high, at the top of which a young girl of fourteen, representing the Virgin, stood upon the hand of an image of the Saviour.

BARABA, a steppe or tract of land in Siberia, lying between the rivers Irtisch and Obi, in the province of Tobolsk. The soil is excellent for tillage, and part of it might also be laid out in meadows and pastures. It is interspersed with forests, and a great number of lakes which abound with a species of carp called by the people *karauschen;* and the country produces great numbers of elks, deer, foxes, ermines, and squirrels. Between the Irtisch and Obi are some rich copper mines, particularly on a mountain called Pictowa, from the *picta* or white firs that grow upon it. The ore, besides being rich in copper, yields a considerable portion of silver; and this, again, affords as much gold as makes a sufficient return for the trouble and expense of extracting it. The native population of this country are called Barabinzians.

BARACOA, a seaport town in the N.E. of Cuba. Long. 74. 30. W. Lat. 20. 22. N.

BARAHAT, a town of Northern Hindustan, situated among the Himalaya Mountains in the native state of Gurwhal. This town was almost destroyed by an earthquake in 1803; and from the houses having been built of large stones with slated roofs, the calamity was greatly aggravated. From its central position, it maintains a free communication with all parts of the hills, and those who make the pilgrimage to Gangautre generally halt here and lay in a stock of provisions for their journey. In the neighbourhood there is a curious trident, set up no doubt in honour of Siva, of whom, according to Hindu mythology, it is the proper equipment. The pedestal is of copper, the shaft of brass about 12 feet, and the forks about 6 feet in length. There is no tradition to show the origin of this curious relic of antiquity; and although it bears a legible inscription which most probably contains the information, no one has yet succeeded in deciphering the characters. The temple in which it was formerly inclosed was destroyed by the earthquake of 1803. The town is in Lat. 30. 43. Long. 78. 29. (E. T.)

BARALIPTON, in the *Old Logic*, a term denoting a syllogism of the first indirect mode of the first figure. Hence a syllogism in baralipton is when the first two propositions are universal affirmatives, the third a particular affirmative, and the middle term the subject in the first proposition, and the predicate in the second. For example,

BA. Every evil ought to be feared;
RA. Every violent passion is an evil;
LIP. Therefore something that ought to be feared is a violent passion.

Barangi ‖ Baratière.

BARANGI, officers among the Greeks of the lower empire. Cujacius calls them in Latin *protectores*, while others give them the name of *securigeri*. It was their business to keep the keys of the city gates where the emperor resided.

BARANYA, a province in the Austrian kingdom of Hungary, extending over 1960 square miles. It lies at the S.E. angle formed by the Danube and the Drave, and comprehends one city, 11 market-towns, and 341 villages, with about 260,000 inhabitants. The greater part of the land is fertile, but a portion of it is marshy and unhealthy. The chief products are corn, wine, flax, tobacco, aud potash. There are some valuable quarries of marble and millstones, and many mines of fossil coal. It is subdivided into six circles. The capital is Fünfkirchen.

BARANZANO, surnamed *Redemptus*, an eminent natural philosopher, born in Piedmont in 1590, was a Barnabite monk. His principal works are *Campus Philosophicus; Uranoscopia; Novæ Opiniones Physicæ.* He was greatly esteemed by Lord Bacon, with whom he corresponded. He died at Montargis in 1622.

BARATARIA, an island in the Gulf of Mexico, at the entrance of the bay of the same name.

BARATHRUM (*βάραθρον*, also called *ὄρυγμα*) in *Antiquity*, a deep dark pit at Athens, lined with sharp spikes, into which malefactors were cast. The *κεάδας* or *καιάδας* at Sparta was similar.

BARATIÈRE, or BARETTIER, JOHN PHILIP, an extraordinary instance of the early and rapid expansion of the mental faculties. This surprising genius was the son of Francis Baratière, minister of the French church at Schwabach, near Nuremberg, where he was born on the 10th January 1721. The French was his mother tongue; but in consequence of his father talking Latin to him, it became as familiar to him as his native idiom; and at four years of age, without knowing the rules of grammar, he talked French, Latin, and High Dutch, without mixing or confounding the respective languages. About the middle of his fifth year he acquired Greek in like manner; so that in fifteen months he perfectly understood all the Greek books in the Old and New Testament, which he readily translated into Latin. When he was five years and eight months old, he entered upon Hebrew, and in three years became so expert in the Hebrew text, that from a Bible without points he could give the sense of the original in Latin or French, or translate extempore the Latin or French versions into Hebrew, almost word for word; and he also acquired by heart all the Hebrew psalms. He composed at this time a dictionary of rare and difficult Hebrew words, with critical and philological observations; and, about his tenth year, amused himself for twelve months in reading the rabbinical writers. With these he intermixed the study of the Chaldaic, Syriac, and Arabic; and acquired a taste for divinity and ecclesiastical antiquity, by studying the Greek fathers, and the councils of the first four ages of the church. In the midst of these occupations a pair of globes having come into his possession, he was able in eight or ten days' time to resolve all the problems on them; and in about three months (January 1735) devised his project for the discovery of the longitude, which he communicated to the Royal Society of London and the Royal Academy of Sciences at Berlin. In June 1731 he was matriculated in the university of Altorf; and at the close of the year 1732 he was presented by his father at the meeting of the reformed churches of the circle of Franconia, which, astonished at his wonderful talents, admitted him to assist in the deliberations of the synod; and in order to preserve the memory of so singular an event, it was ordered to be registered in their acts. In 1734 the margrave of Brandenburg-Anspach granted this young scholar the use of whatever books he wanted from the Anspach library, together with a pension of fifty florins, which he enjoyed for three years. His father having received a call from the French church at Stettin in Pomerania,

Barbacan || Barbadoes.

young Baratière was, on the journey, admitted master of arts, with universal applause, at the university of Halle. While at Berlin he was honoured with several conversations with the king of Prussia, and received into the Royal Academy. Towards the close of his life he acquired a taste for the study of medals, inscriptions, and antiquities, which he relieved with metaphysical inquiries, and investigations in experimental philosophy. He wrote several essays and dissertations; made astronomical remarks and laborious calculations; prepared materials for a history of the heresies of the Anti-trinitarians, and of the Thirty Years' War in Germany; and, lastly, wrote a treatise, which appeared in 1740, on the succession of the bishops of Rome. The final work he engaged in, and for which he had accumulated large materials, was *Inquiries concerning Egyptian Antiquities*. But the substance of this blazing meteor was now almost exhausted. He had always been weak and sickly, and he died on the 5th October 1740, aged 19 years, 8 months, and 16 days. He published eleven different pieces, and left twenty-nine manuscripts on various subjects, the contents of which may be seen in his biography by Formey, Utrecht, 1741.

BARBACAN, or BARBICAN, a kind of watch-tower, or outer defence of a city or castle, used especially as a fence to the city or walls: also an aperture made in the wall of a fortress to fire through upon the enemy. It is also used to denote a fort at the entrance of a bridge or the outlet of a city, having a double wall with towers.

History.

BARBADOES, or BARBADOS, is one of the West India islands belonging to Britain, and the oldest of her settlements in that part of the world. The exact date of its discovery is unknown, but it was probably not later than the early part of the sixteenth century. The Portuguese are supposed to have been the first Europeans that visited this island, as it lay almost directly in their course to and from Brazil. They, however, had not regarded it as holding forth sufficient inducements for colonizing, as when first visited by the English in 1605 it was destitute of inhabitants, and covered with thick forests. The first English vessel that arrived there was the "Olive Blossom," the crew of which took possession of the island in the name of King James, by erecting a cross upon the spot where Jamestown was afterwards built, and cutting upon the bark of a tree that stood near, "James K. of E. and this island," James king of England and this island. The favourable accounts which Sir William Courteen, a London merchant, afterwards received of the island from one of his ships that had touched there, induced him to attempt a settlement. He accordingly fitted out two large vessels under the protection of Lord Ley, afterwards Earl of Marlborough, who had obtained a grant of this island from James I. One only of these ships arrived at its destination on 17th February 1625, and landed 40 English, and 7 or 8 negroes, who laid the foundation of a town, which, in honour of their sovereign, they called Jamestown.

The Earl of Carlisle, who had previously obtained from James I. a grant of all the Caribbean islands, disputed with Marlborough the possession of Barbadoes. This was at length settled by Carlisle agreeing to pay to Marlborough and his heirs an annuity of L.300, on which the island was made over to him by patent, dated 2d June 1627. Courteen was displeased at this arrangement, and accordingly applied to the Earl of Pembroke, who, during the temporary absence of Carlisle, obtained a grant of the island from Charles I. in 1628. On his return, however, Carlisle obtained the revocation of Pembroke's patent, and his own reinstatement in the possession. The insecure nature of his tenure now induced the earl to offer his lands in Barbadoes for sale, stipulating that each settler should pay him 40 lb. of cotton annually. On this condition a company of nine London merchants obtained a grant of 10,000 acres. They accordingly nominated as governor Charles Wolferstone, a native of Bermuda, who, with 64 settlers, to each of whom were allotted 100 acres, set out for Barbadoes, where they arrived in July 1628. The new colonists settled to the windward of the former settlers, and founded Bridgetown. The Pembroke men refused to submit to the authority of Lord Carlisle, in consequence of which disputes arose between them, which at length had to be referred to the two earls. These appealed to the king, who issued a second patent, dated 7th April 1629, confirming Carlisle as proprietor of the island. During the civil war that raged in England, a great number of families attached to the royal cause took refuge in Barbadoes. About the year 1647, Lord Carlisle, son of the original patentee, entered into an agreement with Francis Lord Willoughby, in terms of which the latter was to receive all the profits arising from the colony for twenty-one years, upon condition of paying one-half to the earl. This agreement received the sanction of the king, and Lord Willoughby was appointed governor of Barbadoes, and the other Caribbee islands. He accordingly arrived in Barbadoes in May 1650, where his first step was to convene the legislature, and to proclaim His Majesty's right to the dominion of the island. Soon after this the parliament sent out a strong force against the colony, under the command of Sir George Ayscue, and prohibited all foreign vessels from trading with the English colonies. Several attempts were made to get possession of the island, but without success, until a part of the inhabitants declared for the commonwealth, on which Lord Willoughby was obliged to treat for peace. Upon the restoration of the king, Lord Willoughby was again appointed governor, but, from the number of claimants on the island, the planters were apprehensive that the validity of their rights might sooner or later be disputed, and accordingly applied to His Majesty to have the grant to the Earl of Carlisle declared void. Carlisle, who died about this time, had bequeathed his West India possessions to the Earl of Kinnoul. Besides Lord Willoughby's claim for the moiety of the revenue during the remaining years of his lease, the creditors of the Earl of Carlisle now put in claims to a large amount, and the heirs of the Earl of Marlborough claimed the arrears of their annuity of L.300, which had never yet been paid. To satisfy these claims, Mr Kendall, in name of the planters, offered to consent to a tax of 4½ per cent. on all the exported produce of the island. An immediate settlement of the claims of the Earl of Kinnoul and the heirs of the Earl of Marlborough was proposed, and the division equally between Lord Willoughby and the earl's creditors of the net revenue during the remaining years of his lordship's lease, after which period, the remainder, after deducting as much as His Majesty should consider necessary for the support of the governor, was to be divided among the creditors. On the settlement of their claims, the whole revenue was to be at the disposal of the crown. The inhabitants of the island, however, denied the authority of Mr Kendall to offer the 4½ per cent., and at first refused to agree to it, but were at length induced to comply. This tax, for a long period, pressed heavily upon the planters of Barbadoes, and it was only repealed in the reign of Her present Majesty (1838). A fruitless attempt to get possession of this island was made in 1665 by the Dutch, under the command of Admiral De Ruyter. Bridgetown was nearly destroyed by fire in 1668, but was afterwards rebuilt in a more substantial manner. In 1669, the governor of Barbadoes was appointed governor-in-chief of all the Caribbee islands to the windward of Guadaloupe. An awful hurricane devastated the island in 1675. The following year a plot among the negroes to take possession of the island, was discovered in time to prevent much bloodshed. Two great fires in 1766 and 1767 nearly reduced Bridgetown to ashes. A tremendous hurricane in October 1780 destroyed almost every building on the island, and killed many of the inhabitants. The loss of human life has been estimated at 4326 souls, and of property at

Barbadoes.

Barbadoes. L.1,320,564. According to Poyer, however, 3000 persons perished, and the loss of property amounted to L.1,018,928. Between that and the last great hurricane of 1831, there were several others, the severest of which was that of October 1819, but these were less disastrous. The dreadful hurricane which desolated the island in August 1831 exceeded in violence any of the former. The number of persons who lost their lives is said to have amounted to upwards of 2000, and by some to upwards of 5000; and the loss of property to nearly L.1,602,800. There was an insurrection of the negroes in 1816, which involved a great sacrifice of life, and much destruction of property.

Physical description. Barbadoes is the most eastern of the Caribbee islands, lying 78 miles due E. of the island of St Vincent, between Lat. 13. 2. and 13. 19. N., and Long. 59. 26. and 59. 39. W. It presents almost the form of an irregular triangle; its greatest length in a direction N. by W. is nearly 21 miles, and its extreme breadth from E. to W. is 14½ miles. Its circumference, excluding the sinuosities of the bays, is 55 miles, and its area 106,470 acres, or about 166 square miles. In size, and in some measure in its outline, it bears a considerable resemblance to the Isle of Wight. It is almost encircled by coral reefs, which, in some parts, extend seaward for nearly three miles, and prove very dangerous to navigation.

Notwithstanding its small extent, Barbadoes presents considerable variety of surface, as valley, hill, table-land, &c. A deep valley running almost due E. from Bridgetown divides the island into two parts, of which the northern is by much the larger. Near the centre of the latter Mount Hillaby, the highest point of the island, rises to the height of 1147 feet. From the west coast the ground rises in distinct successive terraces, interrupted by ravines, to the central ridge; from which, and principally from Mount Hillaby, hills of a conical form radiate in a north-eastern direction toward the sea-shore: these are rugged and worn by the heavy rains and torrents which pour down their sides.

Geology. The north, west, and south parts of the island consist of rocks of coralline limestone, with beds of calcareous marl, containing numerous recent shells of various species: the east is composed of strata of siliceous sandstone, intermixed with ferruginous matter, calcareous sandstone passing into siliceous limestone, different kinds of clay, selenite, earthy marls, frequently containing minute fragments of pumice, strata of volcanic ashes, seams of bitumen, and springs of petroleum.

The rivers are all small, except during the rainy season, when they are much increased. There are several chalybeate springs, the principal of which are the Spa and the Cheltenham, so called from the fancied resemblance of their waters to the celebrated mineral springs of that name in Europe. These springs contain chiefly iron, carbonic acid, and fixed alkali, in different proportions. The "Boiling Spring" is a small spot where carburetted hydrogen escapes; and when the shallow excavation is filled with water, it has the appearance of being in a boiling state, though its temperature is not in the least changed. On the application of a flame, it burns with a whitish light.

Climate. Barbadoes is considered to be one of the healthiest islands of the West Indian archipelago. The climate, though warm, is very salubrious. In the forenoon, the mean temperature during the year is about 80°, and in the afternoon 82° Fahr.; the minimum being 75°, and the maximum 87°.

Population. Soon after its first settlement in 1625, the accounts of its great fertility attracted many immigrants from the mother country; and during the civil war in England, great numbers took refuge there. The accounts of its progress, however, are so contradictory, that they cannot be relied upon. In the report of the privy council in 1788, the population of the preceding year is stated to have been 16,127 whites, 2229 free coloured, and 64,405 negroes. According to the census of 1844, it contained 122,198 inhabitants, of whom 56,004 were males, and 66,194 females. This census, however, had been very carelessly taken, and the governor stated in his despatch, that the population was not less than 130,000. Even according to the census, there were 734·8 persons to each square mile, a denseness of population exceeding that of China. According to a census taken on the 25th of June 1851, the population (exclusive of the troops) was 135,939, of whom 62,272 were males, and 73,667 females; 15,824 white, 30,059 coloured, and 90,056 black. This gives 817·4 inhabitants to each square mile; yet notwithstanding this, it is stated in the government report, that so long as the seasons continue favourable, there is abundance for all its present population, and that "unless there should happen some material change for the worse in the returns of property here, the demand for labour will always rather exceed the quantity offering in the market than the contrary."

Barbadoes.

The island is divided into eleven parishes or districts, the area and population of which, according to the last-mentioned census, were as follows:—

	Area.	Population in 1851.		
		Male.	Female.	Total.
St Michael.....	9,580	16,071	21,395	37,466
Christ Church...	14,310	7,259	8,516	15,775
St Philip.....	15,040	6,550	7,348	13,898
St George.....	10,795	5,384	5,876	11,260
St John.....	8,600	4,235	4,660	8,895
St Thomas.....	8,500	4,679	5,131	9,810
St Peter.....	8,330	4,477	5,329	9,806
St Joseph.....	6,010	3,321	3,687	7,008
St Lucy.....	8,725	3,849	4,571	8,420
St James.....	7,800	3,168	3,716	6,884
St Andrew.....	8,780	3,279	3,438	6,717
	106,470	62,272	73,667	135,939

Bridgetown the capital, in the parish of St Michael, contained 20,026 inhabitants.

Religion. The Church of England is the established form of religion. The bishop has an income of L.4000; and in 1851 there were eleven rectors, who, besides a glebe and parsonage, and compensation in lieu of marriage and burial fees, had each a stipend of L.320; 18 curates at L.150; and two legislative chaplains. The dissenting bodies are not numerous, the Wesleyans and Moravians alone having missions here. The former have 8 churches, 4 preaching stations, with 3 missionaries, 14 local preachers, and about 2000 members; and the latter have 4 stations and 5 missionaries. There is a small Roman Catholic chapel, with one priest, principally for the soldiers of the garrison, the other adherents probably not exceeding 35 or 40. The Jews have a very handsome synagogue, erected in 1833; the congregation, however, numbers only about 70.

Education. Attached to almost all the churches and chapels there are Sunday-schools. Connected with the Established church are about 60 day-schools, almost all primary, in several of which the children are both clothed and fed. Harrison's free school was established in 1733 for the education of 24 poor children. The central school of Bridgetown was founded in 1819 for the maintenance and education of poor white children; and in 1846 it had 80 boarders and 71 day-scholars. The private schools are very numerous. The island is indebted to the munificence of General Codrington for the grammar school and college which bear his name. The course of studies pursued there embraces the classics, logic, mathematics, physics, surgery, theology, &c.

Public Institution. A small public library has been formed, which seems to be fully appreciated by the people; and the trustees accordingly have been encouraged to make exertions for its enlargement. There are also a literary and several agricultural societies. A general hospital was opened in 1844, and is attended gratuitously by six medical practitioners of

Barbara || Barbarossa

the first standing. There are also a leper and a lunatic asylum, an alms-house, and a number of charities for widows and orphans; and in Bridgetown a common jail, besides three houses of correction in the rural districts.

Commerce.

The chief staple articles produced in Barbadoes for export are sugar, arrow-root, aloes, and cotton. The following table gives the value of the imports and exports for the years 1849, 1850, and 1851:—

	Imports.	Exports.	Tonnage.
1849,	L.591,478	L.791,740	85,731
1850,	734,358	831,534	96,381
1851,	789,977	887,627	95,272

Carlisle Bay, the port or harbour of Barbadoes, forms an open roadstead, which is much exposed to the wind when blowing from the S. and S.W. It is spacious, and capable of containing upwards of 500 vessels of all sizes. It affords, however, no protection during gales; and at such times vessels at anchor generally prefer putting to sea, to running the risk of being driven ashore.

Government.

The local government consists of a governor-in-chief, assisted by a council and a house of assembly. The council consists of twelve members, appointed by mandamus of the sovereign, generally upon the recommendation of the governor, and holding office during the royal pleasure. The house of assembly is composed of 24 delegates, elected annually by the body of the people, two for each parish and two for the city of Bridgetown. The courts for the administration of civil justice are, the court of chancery, the court of common pleas, the court of exchequer, the court of ordinary, the court of admiralty, the court of error, and the court of escheat. The criminal courts are the court of grand sessions and the court of admiralty sessions. For dealing summarily, both in civil and criminal cases, police magistrates are appointed.

See Poyer's *History of Barbadoes;* Schomburgk's *History of Barbadoes*, 1848; *Colonial Reports*, &c.

BARBARA, in the *Old Logic*, the first mode of the first figure of syllogisms. A syllogism *in barbara* is one of which all the propositions are universal affirmatives, the middle term being the subject of the first proposition, and the predicate in the second.

BAR. All wicked men are miserable;
BA. All tyrants are wicked men;
RA. Therefore all tyrants are miserable.

BARBARIAN, a name given by the ancient Greeks and Romans to all who were not of their own country, or were not initiated in their language, manners, and customs. In this sense the word signified with them a foreigner; not, as among us, a rude or uncivilized person.

BARBARISM, in a general sense, a rudeness of language or behaviour.

BARBARISM, in *Grammar*, an offence against the purity of style or language, or a form of speaking or writing contrary to the true idiom of any particular language.

BARBAROSSA, ARUCH and HAYRADDIN, two famous corsairs in the sixteenth century, sons of a potter in the Isle of Lesbos. Having taken to piracy, they carried on their depredations with such success, that they soon became possessed of twelve galleys besides smaller vessels. Of this fleet Aruch, the elder brother, called *Barbarossa* from the redness of his beard, was admiral, and Hayraddin the second in command. They called themselves the "friends of the sea," and the "enemies of all who sailed upon it;" and their names became terrible from the straits of the Dardanelles to those of Gibraltar. They acquired territorial power in 1516, in consequence of an unwise application made to them by Eutemi, ruler of Algiers, for assistance against the Spaniards. Aruch, leaving his brother to command the fleet, carried 5000 men to Algiers, where he was hailed as a deliverer; but having secretly murdered the prince he had come to aid, he caused himself to be proclaimed king. To this usurpation he added the conquest of Tremecen, when his exploits and piracies induced the Emperor Charles V. to furnish the Marquis de Comares, governor of Oran, with troops to put him down; and in the contest which ensued he was defeated and killed near Tremecen, A.D. 1518. His brother, Hayraddin, known also by the name of Barbarossa, assumed the sceptre at Algiers with the same abilities, and with better fortune; for the Spaniards being too much employed in Europe to give him any disturbance, he regulated the interior police of his kingdom with great prudence, carried on his naval operations with vigour, and extended his conquests on the continent of Africa. He put his dominions under the protection of the Grand Signior, Suleiman the Magnificent, and obtained the command of the Turkish fleet. With so powerful a protector he acquired the kingdom of Tunis, in a manner similar to that by which his brother obtained Algiers. See ALGIERS.

Barbary || Barbauld.

BARBARY, the general designation of that part of Northern Africa which is bounded on the E. by Egypt, W. by the Atlantic, S. by the Sahara, and N. by the Mediterranean; comprising the states of Marocco, Algeria, Tunis, and Tripoli. See AFRICA, ALGIERS, MAROCCO, TRIPOLI, TUNIS, &c.

BARBASTRO, a city of Spain, in the province of Huesca, on the River Vero, near its junction with the Cinca. It is fortified, and has a cathedral and seven other churches, with several hospitals. Pop. 6200, chiefly employed in tanning and currying leather. Long. 0. 20. W. Lat. 41. 54. N

BARBATELLI, BERNARDINO, otherwise called *Pochetti*, a painter of fruit, animals, and flowers, was born at Florence in 1542. He was the disciple of Ridolfo Ghirlondaio at Florence. His touch was free, light, and delicate, and his colouring true. The historical subjects also which he designed from sacred or profane authors were much admired. He died in 1612.

BARBAULD, ANNA LETITIA, was born at Kibworth, in Leicestershire, on the 20th June 1743. She was the daughter of the Rev. John Aikin, LL.D., a minister of the Presbyterian denomination, who had a private seminary at Kibworth, and removed in 1758 to Warrington, in Lancashire, to superintend the public academy in that place. His daughter was remarkable for the abilities she displayed at a very early age; and, beside the usual female accomplishments, she soon acquired a knowledge of the Latin and Greek tongues. She was distinguished in the literary society of Warrington for the variety of her attainments and the elegance of her taste, which were rendered still more attractive by her personal beauty, vivacity, and amiable disposition. In 1774 she married the Rev. Rochemont Barbauld, who was descended of a French Protestant family, and had studied under her father. They opened a school at Palgrave, in Suffolk, which they carried on successfully during eleven years. Among the number of their pupils were Sir William Gell and Lord Denman. Mrs Barbauld's *Hymns in Prose*, which are poetry in everything but metre, were composed for the instruction of her pupils; as were also the *Early Lessons*, one of the standard works for children, published in 1775. Her *Devotional Pieces* appeared during the same year. Besides various other literary productions, she engaged with her brother, Dr Aikin, in the popular work entitled *Evenings at Home*, which appeared in 1793. After a sojourn of two years on the continent with her husband to recruit their health, Mr Barbauld accepted an invitation to become the pastor of a dissenting congregation at Hampstead, where they resided from 1787 till 1802. They then took up their residence at Stoke-Newington, in consequence of Mr Barbauld's having accepted a similar charge at Newington Green. Mrs Barbauld lost her husband in 1808; and her brother, Dr Aikin, died in 1822. Her own death followed on the 9th March 1825. She left no children. Her collected works, with a memoir of her life by her niece,

Barbe ‖ Barbezieux.

Miss Lucy Aikin, were published soon after her death, in 2 vols. 8vo.

BARBE, Barb, or Barde, is an old word, denoting the armour of the horses of the ancient knights and soldiers, who were accoutred at all points. It consisted of iron and leather, and defended the neck, breast, and shoulders of the horse.

BARBER, one whose occupation it is to shave or trim beards. In former times the barber's craft was dignified with the title of a profession, being conjoined with the art of surgery. In France the barber-surgeons were separated from the perruquiers, and incorporated as a distinct body in the reign of Louis XIV. In England the barbers and surgeons were not separated till the 18th of Geo. II. The functions of the barber-surgeon comprised the cure of wounds, simple surgical operations, and blood-letting, together with shaving, and the cutting and dressing of hair, technically termed *trimming*. The barber's shop in those days was a favourite resort of idle persons; and in addition to its attraction as a focus of news, a lute, viol, or some such musical instrument, was always kept for the entertainment of waiting customers. The barber's sign consisted of a striped pole, from which was suspended a basin, symbols the use of which is still preserved. The fillet round the pole indicated the ribbon for bandaging the arm in bleeding, and the basin the vessel to receive the blood. The setting of fractured limbs was confined to a distinct class of persons called *bone-setters*.

BARBERINI VASE. See Portland Vase.

BARBERINO, Francesco da, called by some authors Francesco Tafani, one of the best poets of his age, was born at Barberino, in Tuscany, in the year 1264. His mother was a native of Florence; and he settled in that city, where he followed the profession of the law, and became distinguished for the beauty of his poetry. The greater part of his works are lost; but that which is entitled *Documenti d'Amore*, a moral poem calculated to instruct those in their duty who have a regard for glory, virtue, and eternity, has had a better fate. It was published at Rome in quarto in 1640, by Frederic Ubaldini, who prefixed a life of the author; to which he added a glossary to explain the obsolete words it contains. Barberino died in 1348.

Barberino, a town of Tuscany, in Italy, situated at the foot of the Apennines. Lat. 43. 33. N. Long. 11. 18. E.

BARBERRY, *Oxyacanthus*, a spiny, shrubby plant, of the genus *Berberis*, which produces a berry, used in conserves, &c. The bark, especially that of the root, affords a fine yellow dye. It is remarkable for the irritability of its stamens.

BARBEYRAC, Jean, the son of Charles Barbeyrac a distinguished physician of Montpelier, was born at Beziers in Lower Languedoc, in 1674. He was successively professor of belles lettres at Berlin, of law and history at Lausanne, and of public law at Groningen. His death took place in 1729. He translated into French the two celebrated works of Pufendorf, his *Law of Nature and Nations*, and his *Duties of a Man and a Citizen*; to both of which he added excellent notes, and to the former an introductory preface. He translated also Grotius's treatise *De Jure Belli ac Pacis*, with large and excellent notes; several of Tillotson's *Sermons*; Cumberland's treatise on the *Law of Nature*; and various other works. He compiled a supplement, in five vols. folio, to the collection of treatises named *Grand Corps Diplomatique*; and was the author of an original work entitled *Traité de Jeu*, 2 vols. 8vo.

BARBEZIEUX, an arrondissement of the department of Charente, in France, extending over 400 square miles, and comprehending six cantons and eighty-seven communes, with 56,557 inhabitants. The town from which it takes its name is in a mountainous situation. Pop. in 1851, 3516. It is famous for its truffled capons. Long. 0. 11. W. Lat. 45. 29. N.

Barbieri ‖ Barbour.

BARBIERI, Giovanni Francesco (otherwise called Guercino, from his squinting), an eminent historical painter, was born at Cento, a village not far from Bologna, in 1590. At first he was a disciple of Benedetto Gennari; but he afterwards studied in the school of the Caracci, though he did not adopt the manner of that famous academy. He seemed to prefer the style of Caravaggio to that of Guido or Albano, imagining it impossible to imitate nature truly, without the assistance of strong lights and shadows; and on that principle the light was admitted into his atelier from above. His taste in design was natural, easy, and frequently grand. Towards the decline of his life he observed that the clearer and brighter style of Guido and Albano had attracted the admiration of all Europe; and he, accordingly, altered his manner, even against his own judgment. But he apologized for this conduct by declaring that formerly he had painted for fame and to please the judicious, but that now he painted to please the ignorant and enrich himself. He executed no fewer than 106 altar-pieces for churches, and 144 historical pictures, besides numerous works in fresco. His best performance is the history of Sta. Petronilla, which is considered one of the ornaments of St Peter's at Rome. He died in 1666.

Barbieri, *Paolo Antonio*, da Cento, painter of still life and animals, was the brother of Guercino, and born at Cento in 1596. He chose for his subjects fruits, flowers, insects, and animals, which he painted after nature with a lively tint of colour, great tenderness of pencil, and a strong character of truth and life. He died in 1640.

BARBITOS (Βάρβιτος), an ancient stringed instrument of music, said to have been invented by Anacreon. It resembled the *lyra*, but greatly exceeded it in the number of its strings. Yet Anacreon himself indiscriminately uses the two names for this instrument in his first ode.

Ἁ βάρβιτος δὲ χορδαῖς
Ἔρωτα μοῦνον ἠχεῖ.
——— λύρη δὲ
Ἔρωτας ἀντεφώνει.

BARBOUR, John, the contemporary and in some respects the rival of Chaucer, is the author of a poem which may justly be described as a national work: it relates the exploits of a very heroic monarch, whose memory is still cherished by his countrymen, and it displays so conspicuous a union of talent and patriotism, that, after the lapse of nearly five centuries, it has not ceased to attract an uncommon degree of attention. The orthography of this poet's name is very unsettled; it is to be found under the different forms of Barber, Barbere, Barbar, Barbare, and Barbour. It evidently belongs to that very numerous class of names originally derived from trades or occupations; but as *Barbour* appears to have been the ancient orthography of the word denoting this particular trade, there is sufficient propriety in adhering to the form now so generally adopted, and writing the name Barbour instead of Barber. Those authors who aver that he was born at Aberdeen, and educated in the abbey of Aberbrothick, seem to have substituted conjecture for evidence: no document which can enable us to ascertain the place of his birth or education has yet been discovered. His birth has been referred to the year 1316. When he describes the person of Randolph, says Lord Hailes, he seems to speak from personal observation; and as Randolph died in 1331 and Barbour in 1396, the poet, if we suppose him to have reached the age of 80, would have been 15 years old at the period of that illustrious warrior's death.[1] This however is but a vague calculation, resting on no solid basis; for he neither professes to describe the person of Randolph from actual observation,

[1] Hailes's *Annals of Scotland*, vol. ii. p. 3.

Barbour. nor is his description so minute and graphic as to justify the inference that he must have acquired his knowledge in this manner. It has been suggested by Dr Jamieson, that the strongest presumption of his having been born at so early a period, is to be found in the circumstance of his being a dignitary of the church in the year 1357. If we suppose him to have been born in 1316, he may have obtained this preferment about the age of forty; and the same learned writer remarks that it must have required very powerful interest to obtain it at a much earlier period. We are not however sufficiently acquainted with the details of his personal history, to be enabled to estimate the probability of his rapid promotion; but, according to the canon law, he could be regularly appointed an archdeacon at the age of twenty-five.[1] We must therefore be content to leave conjectural dates as we found them, without attempting to decide whether he was born in 1316, 1326, or 1330; but more authentic notices of this venerable archdeacon have fortunately been preserved. On the 13th of August 1357, Edward III., on the application of the Scottish king, granted Barbour a safeconduct to visit the university of Oxford, accompanied by three students.[2] This instrument expressly mentions that they are to repair thither for the purpose of study, and of performing scholastic exercises; and it has been stated by a distinguished ornament of the university that Barbour studied there during the years 1357 and 1365.[3] But as the safeconduct describes him as archdeacon of Aberdeen, we cannot so easily admit that he comes under the common denomination of an academical student, if by this term we understand a person subjected to college discipline, and following a prescribed course of study; nor is it unreasonable to conclude that the scholastic exercises were solely to be performed by the three scholars who accompanied him. That he completed his studies in this celebrated university, is however sufficiently probable, though it must apparently have been at an earlier period of life. We may venture to infer, that on the present occasion he repaired to Oxford, as many individuals still repair to it, for the purpose of conferring with learned clerks, and of consulting books which he had no opportunity of consulting at home; and such a document may therefore be regarded as an honourable testimony of his love of learning. Nor is it the only document of this kind. There is another safeconduct, dated on the 6th of November 1364, and authorizing the archdeacon of Aberdeen to visit England with four horsemen, in order to study at Oxford or elsewhere, as he may judge expedient;[4] and a third, dated on the 30th of November 1368, authorizes him to travel through England with two servants and two horses, on his way towards France for the same purpose of study.[5] On the 13th of September 1357, the bishop of his diocese had nominated him one of the commissioners who were to meet at Edinburgh, to deliberate concerning the ransom of the captive king;[6] but as he must then have received his passport for Oxford, it is conjectured that this nomination was only intended as a compliment, and that the actual duty was to devolve on a coadjutor, who is named in the same instrument. On the 16th of October 1365, Edward had granted him permission to travel through England, with six companions on horseback, towards St Denis and other sacred places;[7] an expression which seems to indicate that the object of his expedition was of a religious nature. After an interval of several years, his name occurs in another authentic record; namely, in the list of the auditors of exchequer, appointed on the 18th of February 1373, or, according to our present computation, 1374. Here he is described as archdeacon of Aberdeen, and "clericus probacionis domus domini nostri Regis;" and in the same commission we find the name of Sir Hugh Eglintoun.[8]

Barbour.

About this period, he was engaged in the composition of the work which has transmitted his name to posterity; for it appears from his own statement that in the year 1375 his work was more than half-finished.[9] Dr Henry has stated, but apparently without any competent authority, that it was undertaken at the request of David II., the son and successor of the heroic monarch whose actions the author commemorates; and that a considerable pension was granted to him as an encouragement to prosecute this design.[10] It is to be recollected that David died in 1371, several years before Barbour had written one half of his poem. The history of his pension was involved in much obscurity, which has at length been removed by the researches of Dr Jamieson. Hume of Godscroft had affirmed that his merit as the author of this poem was rewarded by a pension from the exchequer during his life, that he transferred this pension to the hospital of Aberdeen, and that it still continued to be paid in his own lifetime.[11] The terms of this statement are evidently at variance with each other; but the fact of his having received a pension, or rather two different pensions, from the crown, rests on unquestionable authority; and this fact cannot but be regarded as creditable to the government of his country, nor must the extent of such liberality be estimated by so fallacious a standard as the present value of money. At a much later period, Hector Boyce enjoyed a revenue of forty marks, as principal of King's College, Aberdeen. Barbour's pensions consisted of ten pounds payable from the customs of Aberdeen, and twenty shillings payable from the rent of the lands and fisheries which that city held of the crown.[12] The first was merely an annuity for his life, but the other was granted to him and his assignees, with an express permission to dispose of it in mortmain; and it appears from the records to have been granted by Robert II. as a reward for the composition of his historical poem.[13] This sum he did not bequeath to the hospital, but to the dean and chapter of Aberdeen, under the condition that they

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[1] *Decretales Gregorii IX.* lib. i. tit. vi. cap. vii. §. 2.
[2] Rymer, *Fœdera*, tom. vi. p. 31. *Rotuli Scotiæ*, tom. i. p. 808.
[3] Warton's *Hist. of English Poetry*, vol. ii. p. 154. Price's edit.
[4] *Rotuli Scotiæ*, tom. i. p. 886.
[5] *Rotuli Scotiæ*, tom. i. p. 926.
[6] Rymer, *Fœdera*, tom. vi. p. 39.
[7] Rymer, tom. vi. p. 478. *Rotuli Scotiæ*, tom. i. p. 897.
[8] *Accounts of the Great Chamberlains of Scotland*, vol. ii. p. 19.
[9] And in the tyme of the compiling
Off this buk, this Robert wes king,
And off his kynrik passit was
Fyve yer; and wes the yer off grace
A thousand, thre hundyr, sevynty
And fyve, and off his eld sixty. (Barbour's *Bruce*, p. 274, Jamieson's edit.)
[10] Henry's *Hist. of Great Britain*, vol. iv. p. 472.
[11] Hume's *Hist. of the Houses of Douglas and Angus*, p. 31. Edinb. 1644, fol.
[12] *Accounts of the Great Chamberlains of Scotland*, vol. ii. p. 128. 153.—With respect to these pensions, many subsequent entries occur.
[13] *Ibid.* vol. iii. p. 269. Jamieson's *Memoir of the Life of Barbour*, p. viii.

Barbour. should say a yearly mass for the repose of his soul.[1] His larger pension seems likewise to have been conferred by the same king; and although this circumstance has not been traced in any record, it was probably conferred for the same reason.

Although the *Bruce* is the only work of Barbour that is known to be extant, it is not the only work of which he was the author. He appears to have written another book, doubtless in rhyme, comprising a genealogical history of the kings of Scotland, and deducing their origin from the Trojan colony of Brutus.[2] We may venture to conclude that his principal materials were drawn from very dubious sources; but although the historical value of this production may not have been very conspicuous, it would undoubtedly have been regarded as a curious relique of the literature of the middle ages. The existence of such a work is fully established by various passages in Winton's chronicle.

> This Nynus had a sone alsua,
> Sere Dardane lord of Frygia.
> Fra quham Barbere sutely
> Has made a propyr Genealogy,
> Tyl Robert oure secownd kyng,
> That Scotland had in governyng.[3]
>
> Of Brutus lyneage quha wyll her,
> He luk the tretis of Barbere,
> Mad in-tyl a Genealogy
> Rycht wele, and mare perfytly
> Than I can on ony wys
> Wytht all my wyt to yowe dewys.[4]

It is apparently the same book which the prior of Lochleven repeatedly quotes under the title of the Brute; and we agree with Dr Jamieson in thinking it highly probable that this book is quoted by Barbour himself in the subsequent passage.

> Als Arthur, that throw chevalry
> Maid Bretane maistres and lady
> Off twelf kinrykis that he wan;
> And alsua, as a noble man,
> He wan throw bataill Fraunce all fre,
> And Lucius Yber wencusyt he,
> That then of Rome was emperor
> Bot yeit, for all his gret valour,
> Mordreyt his systir son him slew
> And gud men als ma than inew,
> Throw tresoune and throw wikkitnes;
> The Broite beris thairoff wytnes.[5]

The archdeacon, as has already been hinted, died in 1396;[6] and as he had enjoyed his preferment for at least thirty-nine years, he must evidently have reached an advanced period of life. His character, if we may be allowed to form a conjecture from the general strain of his work, was of an amiable kind; and his name has long been respected by his countrymen. The earliest edition of the *Bruce* which has hitherto been traced was published at Edinburgh in 1616; but, as Patrick Gordon, whose poem was licensed in 1613, describes it as "the old printed book,"[7] there is reason to believe that the first impression is of a much earlier date. Several other editions appeared in the course of the seventeenth century; "and there are many later editions of no value, published by different booksellers, to answer the demand of the common people for this book; which, to the credit of their good sense, is very great."[8] A more elaborate edition was at length published by Mr Pinkerton, from a manuscript in the Advocates Library; but as the transcript was neither executed by himself, nor under his immediate inspection, many gross inaccuracies were suffered to escape.[9] After an interval of thirty years, another edition, the best that has yet appeared, was published by Dr Jamieson from a more careful collation of the same manuscript.[10] This appears from the colophon to have been transcribed in 1489, by John Ramsay, who is supposed to be the same person that was afterwards prior of the Carthusian monastery at Perth. The transcript was executed at the request of Simon Lochmalony, vicar of Moonsie; and thus every individual more immediately concerned, the poet, the copyist, and his employer, belonged to the church.

When we endeavour to appreciate the literary merit of Barbour, we must at the same time endeavour to transport ourselves to the remote and unrefined age in which he lived; we must recollect the general barbarism of many preceding centuries, the difficulty of acquiring liberal knowledge, the rude and grotesque taste of almost all his contemporaries. When all these circumstances are duly considered, his poem will be found entitled to an ample share of our approbation. Fortunate in the choice of a subject, he has unfolded a series of remarkable events, and has diffused over a very long narrative that lively interest which an ordinary writer is incapable of exciting. Here we are not to expect the blandishments of modern poetry: the author stands conspicuous amid the ruins of time, and, like an undecayed Gothic tower, presents an aspect of majestic simplicity. The lively strain of his narrative, the air of sincerity which he always exhibits, his earnest participation in the success or sufferings of his favourite characters, as well as the splendid attributes of the characters themselves, cannot fail of arresting the attention of every reader familiarly acquainted with the language in which he writes. The age of the great King Robert was the age of Scottish chivalry, and the monarch himself presented the most perfect model of a valiant knight. Whatever inconsistencies may have appeared in his early conduct, the best portion of his life was undoubtedly spent in the exercise of heroic valour or of political wisdom. Such a hero and such a crisis were a most fortunate selection; and although the intrinsic merit of the poet is very conspicuous, yet the attraction of the poem is partly to be ascribed to his judicious choice of a subject.

Barbour was evidently skilled in such branches of knowledge as were then cultivated, and his learning was so well regulated as to conduce to the real improvement of his mind: the liberality of his views, and the humanity of his

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[1] *Accounts*, vol. ii. p. 402.

[2] With respect to the story of the Trojan origin of another nation, "Ueber die Sage von der Trojanischen Abkunft der Franken," some curious notices may be found in W. C. Grimm's *Adtdänische Heldenlieder, Balladen, und Märchen*, S. 431. Heidelberg, 1811, 8vo.

[3] Winton's *Cronykil of Scotland*, vol. i. p. 26.

[4] *Ibid.* vol. i. p. 54.—Another early poet mentions Barbour as the author of different works.

> Master Barbour, quhilk was a worthi clerk,
> He said the Bruce amang his othir werk. (Henry's *Wallace*, p. 353.)

[5] Barbour's *Bruce*, p. 20.

[6] *Chartulary of Aberdeen*, f. 115.

[7] Gordon's *Famous Historie of the renowned and valiant Prince Robert, surnamed the Bruse, King of Scotland.* Dort, 1615, 4to.

[8] Pinkerton's *List of the Scottish Poets*, p. lxxxiii.

[9] *The Bruce; or, the History of Robert I. King of Scotland:* written in Scottish verse by John Barbour. The first genuine edition, published from a manuscript dated 1489; with notes and a glossary by J. Pinkerton. Lond. 1790, 3 vols. 8vo.

[10] *The Bruce and Wallace;* published from two ancient manuscripts preserved in the Library of the Faculty of Advocates: with notes, biographical sketches, and a glossary. Edinb. 1820, 2 vols. 4to.

Barbour. sentiments, appear occasionally to have been unconfined by the narrow boundaries of his own age. He has drawn various illustrations from ancient history and from the stories of romance, but has rarely displayed his erudition by decking his verses with the names of ancient authors: the distichs of Cato,[1] and the spurious productions of Dares Phrygius and Dictys Cretensis are the only profane books to which he formally refers. He has borrowed more than one illustration from Statius, who was the favourite classic of those times, and who likewise appears to have been the favourite of Barbour: the more chaste and elegant style of Virgil and Horace was not so well adapted to the prevalent taste, as the strained thoughts and gorgeous diction of Statius and Claudian. The manner in which he has incidentally discussed the subject of astrology and necromancy, may be specified as not a little creditable to his good sense. It is well known that these branches of divination were assiduously cultivated during the ages of intellectual darkness. The absurdity of astrology and necromancy he has not openly attempted to expose; for as the opinions of the many, however unfounded in reason, must not be too rashly stigmatized, this might have been too bold and decided a step. Of the possibility of predicting events he speaks with the caution of a philosopher*; but the following passage may be considered as a sufficient indication of his deliberate sentiments:

> And sen thai ar in sic wenyng,
> For owtyne certante off witting,
> Me think quha sayis he knawis thingis
> To cum, he makys gret gabingis.[2]

To form such an estimate, required a mind capable of resisting a strong torrent of prejudice; nor is it superfluous to remark, that in an age of much higher refinement, Dryden suffered himself to be deluded by the prognostications of judicial astrology.[3] It was not however to be expected that Barbour should on every occasion evince a decided superiority to the general spirit of the age to which he belonged. His terrible imprecation on the person who betrayed Sir Christopher Seton, "In hell condampnyt mot he be!" ought not to have been uttered by a Christian priest. His detestation of the treacherous and cruel King Edward induced him to lend a credulous ear to the report of his consulting an infernal spirit. The misfortunes which attended Bruce at almost every step of his early progress, he attributes to his sacrilegious act of slaying Comyn at the high altar. He supposes that the women and children who assisted in supplying the brave defenders of Berwick with arrows and stones, were protected from Barbour. injury by a miraculous interposition. Such instances of superstition or uncharitable zeal are not to be viewed as marking the individual: gross superstition, with its usual concomitants, was the general spirit of the time; and the deviations from the ordinary track are to be traced in examples of liberal feeling or enlightened judgment.

His encomium on political freedom is distinguished by a manly and dignified strain of sentiment:

> A! fredome is a noble thing!
> Fredome mayss a man to haiff liking
> Fredome all solace to man giffis:
> He levys at ess that frely levys.
> A noble hart may haiff nane ess,
> Na ellys nocht that may him pless,
> Gyff fredome failyhe; for fre liking
> Is yharnyt our all othir thing.
> Na he that ay hass levyt fre,
> May nocht knaw weill the propyrte,
> The angyr, na the wrechyt dome
> That is cowplyt to foule thyrldome
> Bot gyff he had assayit it,
> Than all perquer he suld it wyt,
> And suld think fredome mar to pryss
> Than all the gold in warld that is.[4]

From the satisfaction with which the poet seems to contemplate any example of the gentler virtues, we may venture to draw a favourable inference respecting the native benevolence of his disposition. The subsequent passage cannot be passed without particular notice: the annals of heroes furnish but few instances of so pleasing a nature, whether it be that heroes seldom stoop to actions of mere benevolence,[5] or that their historians do not think it of much importance to transmit such actions to posterity.

> The king has hard a woman cry;
> He askyt quhat that wes in hy.
> "It is the layndar, Schyr," said ane,
> "That her child-ill rycht now has tane,
> "And mon leve now behind ws her;
> "Tharfor scho makys yone iwill cher."
> The king said, "Certis it war pite
> "That scho in that poynt left suld be;
> "For certis I trow thar is na man
> "That be ne will rew a woman than."
> Hiss ost all thar arestyt he,
> And gert a tent sone stentit be,
> And gert hyr gang in hastily,
> And othyr wemen to be hyr by,
> Quhill scho wes deliuer, he bad,
> And syne furth on his wayis raid:
> And how scho furth suld caryit be,
> Or euir he furth fur, ordanyt he.

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[1] And Catone sayis ws in his wryt,
That to fenyhe foly quhile is wyt. (Barbour's *Bruce*, p. 13.)
This passage evidently refers to the collection of distichs which bears the name of Dionysius Cato, whom Chaucer likewise calls Caton or Cathon; a circumstance which, as Mr Warton remarks, shews that he was more familiarly known from the French translation than from the Latin original.

Insipiens esto quum tempus postulat aut res:
Stultitiam simulare loco, prudentia summa est. (Catonis *Disticha*, lib. ii. 18.)

This work of Cato was held in the highest estimation during the middle ages, and it has been translated into Greek, Anglo-Saxon, German, French, and English. It comprehends a series of moral lessons, which are often conveyed with a considerable degree of terseness and compression. The author possesses so much purity of diction, that Joseph Scaliger supposes he cannot have flourished subsequently to the reign of Commodus or Severus; and Hen. Cannegieter, who was alike conversant with philology and the civil law, has employed several arguments, drawn from the history of the Roman jurisprudence, to prove that this poet must at least have preceded the reign of Constantine. (*Rescripta Boxhornii de Catone*, cap. xviii.) Cato, for example, speaks of divorcing a wife, if she should become troublesome, "si cœperit esse molesta." (Lib. iii. 13.) But after the law of divorce had been modified by that emperor, it was not competent for a husband to dismiss his wife, merely because he did not find her agreeable. (*Codex Theodosianus*, lib. iii. tit. xvi.) The most complete edition of Dionysii Catonis *Disticha de Moribus ad Filium*, is the second published by Otto Arntzenius. Amst. 1754, 8vo. It contains the notes of many learned commentators, the Greek versions of Planudes and Scaliger, with the dissertation of Boxhornius, and the very copious reply of Cannegieter.

[2] Barbour, p. 88.

[3] Johnson's *Lives of English Poets*, vol. ii. p. 109.

[4] Barbour, p. 10.

[5] Οἱ γαρ ἡρωες——
Κακουν ἑτοιμοι μαλλον ἡ ευεργετειν. (Menandri *Fragmenta*, p. 158. edit. Meineke.)

Barbour.

This wes a full gret curtasy,
That swilk a king, and sa mighty,
Gert his men duell on this maner
Bot for a pouir lauender.[1]

Barbour seems to have been acquainted with those nicer springs of human action which elude vulgar observation; he catches the shades of character with a delicate eye, and sometimes presents us with instances of nice discrimination. His work is not a mere narrative of events; it contains specimens of that minute and distinct delineation which marks the hand of a skilful artist. An illustration of this remark may perhaps be found in the following incident. When Bruce has with his single arm defended a narrow pass against a party of two hundred Gallovidians, his soldiers are represented as flocking around him with the same eager curiosity as if they had never had another opportunity of seeing him.

Syk wordis spak thai of the king,
And for his hey wndertaking
Farlyit, and yarnyt hym to se,
That with hym ay wes wont to be.[2]

In the opinion of an exquisite critic, Barbour has adorned the English language by a strain of versification, expression, and poetical imagery, far superior to the age.[3] And Dr Nott remarks that he "had given his countrymen a fine example of the simple energetic style, which resembled Chaucer's best manner, and wanted little to make it the genuine language of poetry."[4] The best method of estimating the merit of his versification, will be to compare it with that of some English poet who flourished about the same period; and, if placed in competition with the versification of Chaucer, Gower, or Lydgate, the most celebrated English poets of that era, it must certainly be admitted to appear with sufficient advantage. Although a general conclusion cannot safely be drawn from a particular instance, it may yet be worth while to compare the following quotations from Chaucer and Barbour:

The byrdes that han lefft her songe,
Whyle they han suffred colde full stronge
In wethers grylle, and derke to syght,
Ben in May, for the sunne bryght,
So glad that they shewe in syngyng
That in her herte is suche lyking,
That they mote syngen and ben lyght:
Than doth the nyghtyngale her myght
To maken noyse and syngen blythe;
Than is blysfull many a sythe
The chelaundre and the popyngay;
Than yonge folke entenden aye
For to ben gay and amarous,
The tyme is than so sauorious.[5]

This wes in ver, quhen wynter tid,
With his blastis hidwyss to bid,
Was our drywyn, and byrdis smale,
As turturis and the nychtyngale,
Begouth rycht sariely to synge,
And for to mak in thair singyng
Swete notis, and sownys ser,
And melodys plesand to her;
And the treis begouth to ma
Burgeans, and brycht blomys alsua,
To wyn the helyng off their hewid,
That wykkyt wyntir had thaim rewid.[6]

Here the versification of Barbour is certainly not inferior to that of Chaucer; but we have no intention to aver that the general merit of the two poets is equal. Chaucer has attempted a great variety of subjects, and, for the most part, with eminent success. His measures are also varied; and, if we compare his versification with that of preceding poets, or indeed with that of his immediate successors, it will be found entitled to high commendation. He reformed the taste and improved the language of his native country. The merit of Barbour, though more circumscribed, is yet so eminent as to entitle him to a very honourable place in the history of British poetry.

Barbour ‖ Barbuda.

The style of this poet is distinguished by its terseness, and he often exhibits a happy brevity of expression. His work contains a greater proportion of French idioms than we discover in the writings of the preceding Scottish poets, though their positive number is far from being considerable. Fiction is not inseparably connected with verse. The historical merit of Barbour's poem has been admitted by very competent judges; and, among others, Lord Hailes has repeatedly acknowledged the general fidelity of his narrative. King Robert died in 1329; and, as Barbour was employed in writing his poem within forty-six years from that period, he must have enjoyed many opportunities of collecting information. He might himself have conversed with warriors who fought at Bannockburn; and on one occasion he quotes the authority of a valiant knight, Sir Allan Cathcart, who was personally engaged in a particular exploit which he is about to relate.

A knycht, that then wes in his rowt,
Worthi and wycht, stalwart and stout,
Curtaiss and fayr, and off gud fame,
Schyr Alane off Catkert by name,
Tauld me this taile, as I sall tell.[7]

Of the general merit of Barbour's work, so favourable an estimate has been formed by Mr Pinkerton, that it may not be improper here to produce his testimony. "Perhaps the editor may be accused of nationality, when he says, that, taking the total merits of this work together, he prefers it to the early exertions of even the Italian muse, to the melancholy sublimity of Dante, and the amorous quaintness of Petrarca, as much as M. Le Grand does a *fabliau* to a Provençal ditty. Here indeed the reader will find few of the graces of fine poetry, little of the Attic dress of the muse; but here are life, and spirit, and ease, and plain sense, and pictures of real manners, and perpetual incident, and entertainment. The language is remarkably good for the time, and far superior in neatness and elegance even to that of Gawin Douglas, who wrote more than a century after. But when we consider that our author is not only the first poet, but the earliest historian of Scotland, who has entered into any detail, and from whom any view of the real state and manners of the country can be had; and that the hero whose life he paints so minutely, was a monarch equal to the greatest of modern times; let the historical and poetical merits of his work be weighed together, and then opposed to those of any other early poet of the present nations in Europe."[8] (D. I.)

BARBUDA, one of the Caribbee islands, is 15 miles in length by about 8 in breadth, presenting a very flat surface, covered to a great extent with forests of small trees, in which excellent deer abound. Many varieties of very fine shell and other fish are found on the coast, which is

[1] Barbour, p. 320. [2] Barbour, p. 118. [3] Warton's *History of English Poetry*, vol. ii. p. 164.
[4] Nott's *Dissertation on the State of English Poetry before the sixteenth Century* (p. cxc.), prefixed to the Works of Surrey and Wyatt. Lond. 1815, 2 vols. 4to.
[5] Chaucer's *Romaunte of the Rose*: Workes, f. cxxviii. edit. Lond. 1542, fol.
[6] Barbour, p. 89. [7] Barbour, p. 183. [8] Pinkerton's *Preface to Barbour*, p. x.

Barca ‖ Barcelona.

also frequented by large flocks of water-fowl. The part of the island cultivated is fertile, but there is no sugar raised, nor are there any plantations of importance. The climate is very salubrious. Pop. about 1000. Long. 61. 46. W. Lat. 17. 36. N.

BARCA (the ancient *Cyrenaica*), a maritime district of Northern Africa, forming the eastern portion of Tripoli, and extending from the Gulf of Sert (the ancient Syrtes) to Egypt, between Lat. 30° and 33° N and Long. 20° and 25° E. Its name is derived from Barce or Barca, an ancient city of Cyrenaica, and which probably was originally a Libyan settlement, but afterwards colonized by Greeks from Cyrene, about B.C. 560. This territory is traversed from east to west by a mountain chain varying in height from 400 or 500 to upwards of 1800 feet. A great part of Barca, particularly towards the coast, is very fertile, abounding with excellent pasturage, and producing large supplies of corn. The chief town is Bengazi. See CYRENAICA.

BARCAROLLE (from the Italian *barcarola*, a bargeman), a popular song sung by the Venetian gondoliers.

BARCELONA, one of the four provinces into which the ancient Spanish principality of Catalonia was divided in 1833. It is bounded N.E. by Gerona, N.W. by Lerida, S.W. by Tarragona, and S.E. by the Mediterranean. Area, about 220 square leagues. Pop. (1849) 533,695. See CATALONIA.

BARCELONA, capital of the above province, and formerly the capital of Catalonia, is a strongly fortified city and seaport on the shore of the Mediterranean, between the mouths of the rivers Besos and Llobregat. Lat. 41. 22. N. Long. 2. 9. E. It stands in a plain of great fertility, which is covered with villas and gardens. The Montjuich hills lie to the west, and on the other side the view is bounded by the sea. On the north-east the city is defended by the citadel, fortified on Vauban's plan; and on the south-east by the fortress of Montjuich, which occupies a commanding position. The ramparts embrace about three-fourths of the town, forming a terrace from which there is a magnificent view of the city and its environs. A fine promenade called *La Rambla* divides the city into two parts, the high and the low town. The buildings, chiefly of brick, are irregular, and usually from four to five stories in height, with numerous windows and balconies; and the fronts are occasionally decorated with fresco-painting. The streets are generally narrow, but some of the *plazas* or squares are handsome, especially that of the Palacio, which contains the governor's palace, the exchange, and the custom-house. Among the more remarkable of the other public edifices, may be mentioned the cathedral, an ancient and majestic building in the later Gothic style; the churches of Sta Maria del Mar, S^{tos} Justo y Pastor, and San Miguel; the Casa de la Diputacion, or court of the chief justice, which contains the archives of Aragon, a most precious collection of historical documents; the Casa Consistorial; the Palacio Real, or ancient palace of the kings of Aragon; the Palacio de la Reina; the palace of the marquises of Aitona; the theatre, and the prison. At the highest part of the city, in the Calle del Paradis, are some magnificent columns and other Roman remains, which, however, are almost hidden by the surrounding buildings.

The public institutions of Barcelona are numerous and important. The university, originally founded in 1430, was suppressed in 1714 by Philip V., and transferred to Cervera; but it was restored in 1841, and is now in a flourishing condition. The education comprises languages, philosophy, jurisprudence, and medicine. There are two academies of literature and science, and several public libraries. The Museo-Salvador, besides a fine collection of objects in natural history, contains a valuable library with a considerable number of scientific MSS., and an archæological collection comprising a rich cabinet of coins and medals; forming altogether the most complete establishment of its kind in Spain. Besides this, there are two smaller museums, and several colleges and educational seminaries. Among these is an admirable institution, with a most extensive scheme of education, comprehending arithmetic and mathematics, modern languages, navigation, experimental philosophy and chemistry, practical agriculture and botany, architecture, painting, sculpture, engraving, mechanics, and commerce. This institution, which is liberally supported by the Board of Trade, affords gratuitous instruction to upwards of 2000 pupils. Among the other important institutions are the *Casa de Caridad* or house of industry, a foundling and deaf and dumb institution, and several hospitals for the sick. The *Montes de Piedad*, or pawnbroking establishments of Barcelona, are, in fact, mutual benefit societies. The *Monte de Piedad de N. Sra. de la Esperanza* has this peculiarity, that loans on deposits are made without interest to necessitous persons. In 1849 the number of persons that availed themselves of its benefits was 5686.

Barcelona ‖ Barclay.

Barcelona is the see of a bishop, the seat of the captain-general of Catalonia, and of an audiencia. It is an important military station, and possesses a naval arsenal, a cannon foundry, and barracks. In a commercial point of view it is the industrial centre of Catalonia. Its trade declined greatly after the emancipation of the Spanish American colonies, but afterwards revived; and notwithstanding the disastrous consequences of the French invasion, it is still the chief commercial emporium of Spain. According to Mr Ford, it is the "Manchester of Catalonia, which is the Lancashire of the Peninsula." The exports consist chiefly of wrought silks, laces, ribbons, calicoes, hats, paper, soap, steel and iron-ware, fire-arms, &c. The chief imports are the produce of America, consisting of cotton, sugar, coffee, cinnamon, indigo, bees' wax, horns, hides, &c. The number ef vessels that entered its port in 1849 was 1896, with a tonnage of 140,369: of these 1372 were Spanish vessels. The harbour is protected on the south by a mole, with a lighthouse and a battery at its extremity. The depth of water within the mole is from 18 to 20 feet; but a bar, which has frequently but ten feet of water, prevents the entrance of large ships. There are consuls here from all the principal states of Europe and America. Population by census of 1842, 121,815. Steamers ply regularly to Marseilles and Cadiz.

The Spaniards ascribe the founding of Barcelona to the Carthaginians under Hamilcar Barca, after whom it was called *Barcino*. It was the theatre of hostilities, both during the Moorish sway in Spain, and in the wars subsequent to that period. During the War of the Succession it adhered to the house of Austria. The seizure of Montjuich, and the subsequent capture of Barcelona by the Earl of Peterborough, formed one of the most brilliant achievements of that remarkable man. At the close of the war it was reluctantly reconciled to the dynasty of the Bourbons. At the commencement of Buonaparte's attempt to seize on the government of Spain, the French troops obtained possession of the fortress; and thus, during the continuance of that war, the city was held in unwilling subjection to the enemies of the cause which its inhabitants most zealously espoused.

Barceloneta, a large suburb to the S.E. of the city, contains 11,000 inhabitants. (Madoz, *Diccionario de España*.)

BARCELONA, *New*, a seaport town, capital of the province of the same name, in Venezuela, South America, founded in 1634. It stands on the left bank of the Neveri, about three miles from the sea. The town is ill-built and unhealthy, but has a considerable trade in horses and cattle. Lat. 10. 6. 52. N. Long. 64. 47. W.

BARCLAY, ALEXANDER, an English poet, generally believed to have been a native of Scotland, though most of his life was spent in England. He is said to have been partly educated in the university of Oxford, and on one occasion makes an allusion to what he had observed at Cambridge. He spent some of his earlier days at Croydon in Surrey; and in 1508 he was a prebendary of the collegiate church of St Mary Ottery

Barclay. in Devonshire. He afterwards became a Benedictine monk of the monastery of Ely, and at length assumed the habit of St Francis at Canterbury. Having survived the dissolution of the monasteries, he became successively vicar of Much-Badew in Essex, and, in 1546, of Wokey in Somersetshire; and was finally presented by the dean and chapter of Canterbury to the rectory of All-Saints in Lombard-street. As he retained some of his preferments in the reign of Edward VI., it is presumed that he must have complied with the changes of the times. Having reached a very advanced age, he died in the year 1552, and was interred at Croydon.

Barclay wrote at a period when the standard of English poetry was extremely low; and, as excellence is always comparative, this circumstance may partly enable us to account for the high reputation which he enjoyed among his contemporaries. If not entitled to the name of a poet, he is at least a copious versifier. His most conspicuous performance is the *Ship of Fooles*, first printed by Pinson in the year 1509. The original design, and many of the details, were derived from Sebastian Brandt,[1] a civilian of Strasburg, who in 1494 published a poem entitled *Das Narren Schyff*,[2] which was so well adapted to the taste of the age that a Latin and a French version appeared in 1497, and another French version in 1498. Barclay professes to have translated "oute of Laten, Frenche, and Doche;" but to the original cargo he has added many fools of English growth. Under the representation of a ship freighted with fools of various denominations, the poet exposes the prevalent vices and follies of the age; and although, as Warton remarks, the poem is destitute of plot, and the voyage of adventures,[3] the general design was found to possess many attractions. Another publication of Barclay is the *Mirrour of good Manners*, translated from the poem of Mancini *De quatuor Virtutibus*. His *Eglogues* chiefly excite curiosity as the earliest specimen of pastoral poetry in the English language, but their other attractions are not very powerful. They are of a more recent date than Henryson's *Robene and Makyne*, and are certainly very inferior in poetical merit. Among his prose works we find a version of Sallust's history of the war with Jugurtha: it was twice printed by Pinson, and is an early specimen of an English translation from the classics. (D.I.)

Barclay, *William*, M. D. was the brother of Sir Patrick Barclay of Tolly,[4] and was likewise related to his learned namesake mentioned in the next article. This latter fact is ascertained by the hendecasyllables subjoined to his notes on Tacitus, and bearing the subsequent inscription: "Nobili et clarissimo viro Guil. Barclayo cognato meo, pro explicato Taciti Agricola, Joannes Barclayus Guil. F. scripsi." The writer of these verses, we may remark, must then have been only seventeen years of age. Barclay prosecuted his studies in the university of Louvain under Justus Lipsius, a great master of Roman literature; and to him this distinguished professor has Barclay. addressed two of his printed letters.[5] He describes himself as A. M. and M. D.; but where he took those degrees we are not informed. Having been appointed a professor in the university of Paris, he there taught humanity for several years, and acquired a considerable share of reputation by his talents and learning. He afterwards visited his native country, where he appears to have followed the medical profession; but it may be inferred from Dempster's brief notice, that, in consequence of his adherence to popery, his situation was rendered uncomfortable by the clergy, and having returned to France, he resumed his former occupation at Nantes in Bretagne.[6] The same literary historian mentions, that, at the period of his writing, Barclay was residing in Scotland, and, according to his information, was pursuing the practice of physic.

The following is a list of all the publications of Dr Barclay with which we are acquainted.

1. Guilielmi Barclayi Oratio pro Eloquentia. Ad v. cl. Ludovicum Servinum, Sacri Consistorii Regii Consiliarium, et in amplissimo Senatu Parisiensi Regis Advocatum. Paris. 1598, 8vo.

2. C. Cornelii Taciti Opera quæ exstant, ad exemplar quod J. Lipsius quintum recensuit. Seorsim excusi commentarii ejusdem Lipsii meliores plenioresque cum curis secundis, et auctariolo non ante adjecto. Guil. Barclayus Præmetia quædam ex Vita Agricolæ libavit. Adjecti sunt indices aliquanto ditiores. Paris. 1599, 8vo.—Menage, in his *Remarques sur la Vie de Pierre Ayrault*, p. 230, has ascribed these *Præmetia* to the civilian, and the same error has been committed by other writers.

3. Nepenthes, or the Vertves of Tabacco. By William Barclay, Mr of Art, and Doctor of Physicke. Edinb. 1614, 8vo.—This tract is dedicated to the author's nephew, Patrick the son and heir of Sir Patrick Barclay of Tolly; and the dedication is preceded by "A merie Epistle of the Author to the Printer," who is no other than "good Master Hart." To this worthy friend he makes the following communication: "If I find fauour in this essay, I shal send you shortly, Godwilling, a scholasticall subiect, and a curious litle worke, fit onely for those which aspire to the top of Pindus. The one wil bring to your shop the common sort of people, the other the most learned." At the end of the tract he has inserted six little poems, the first of which is addressed to Alexander Craig.

4. Guil. Barclayi, Amœniorum Artium, et Medicinæ Doctoris, Judicium de Certamine G. Eglisemmii cum G. Buchanano, pro Dignitate Paraphraseos Psalmi ciiii. Non violandi Manes. Adjecta sunt, Eglisemmii ipsum Judicium, ut editum fuit Londini, typis Eduardi Aldæi, an. Dom. 1619; et, in gratiam studiosæ juventutis, ejusdem Psalmi elegans paraphrasis Thomæ Rhædi. Lond. 1620, 8vo.—Dr Eglisham, like a fair as well as a bold critic, exhibited his own verses in competition with those of Buchanan,

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[1] Sebastian Brandt, doctor of laws, was born at Strasburg about the year 1458. He studied in the university of Basel; and after having publicly taught there, as well as in his native city, he became syndic of Strasburg, where he died in the year 1520. (Adami *Vitæ Germanorum Jureconsultorum et Politicorum*, p. 5. edit. Francof. ad Moen. 1706, fol.) He is extolled by his contemporary Trithemius as "utriusque juris professor insignis, et tam in divinis Scripturis, quam aliis sæcularis literaturæ disciplinis egregie doctus, poeticam non mediocriter callens, ingenio subtilis, eloquio disertus, consilio ac actione præcipuus." (*De Scriptoribus Ecclesiasticis*, f. ccii. a. edit. Paris. 1512, 4to.) His writings embrace a considerable variety of subjects. We have a copy of one of his professional works, entitled *Titulorum omnium Juris tam Civilis quam Canonici Expositiones*. Lugduni, 1608, 8vo.

[2] See Dr Ebert's *Allgemeines bibliographisches Lexikon*, Band i. S. 230.

[3] Warton's *Hist. of English Poetry*, vol. iii. p. 74.

[4] Dr Barclay has himself mentioned the place of his birth. "Nam Collonia (sic castrum vocatur in quo primum terram tetigi) sita est in littore quod 'tam vasto atque aperto mari pulsatur.' Quo loco, ut obiter dicam, non pauca sunt vestigia veterum bellorum, cum Anglis præsertim. Est in eodem littore, in territorio gentis Barclayanæ, portus quidam, qui nostra lingua *Auld-heauen* appellatur." (*Præmetia*, p. 561.)

[5] Lipsii *Epist. select.* cent. iii. ep. xxxiii. *Epist. cent. ad Germanos et Gallos*, ep. lvi.

[6] "Inde in Scotiam profectus aliquantisper substitit, donec ministri illi Sathanæ magna eum molestia afflicientes solum vertere coegerunt, qui in Galliis iterum docere bonas artes sustinuit Nanneti in Britannia Minore." (Dempster. *Hist. Ecclesiast. Gentis Scotorum*, p. 120.)

Barclay. and had no reason to congratulate himself on the issue. He was likewise assailed by another learned physician, Arthur Johnston, who, in two sarcastic and elegant poems, treated his case as one of decided insanity.

5. Guil. Barclaii, M. D. Poemata. *Delitiæ Poetarum Scotorum*, tom. i. p. 137.—These poems only occupy four pages and a half. (D. I.)

Barclay, *William*, LL. D. a distinguished civilian, was born in Aberdeenshire in the year 1541. He spent the early part of his life, and much of his fortune, at the court of Mary queen of Scots, from whose favour he had reason to expect preferment. In 1573 he went over to France, and at Bourges commenced student of the civil law under the famous Cujacius. He continued some years in that seminary, where he took his doctor's degree; and was soon after appointed professor of the civil law in the university of Pontamousson, recently founded by the duke of Lorraine. That prince afterwards made him counsellor of state and master of requests. In the year 1581 Barclay married Anne de Malleville, a French lady, by whom he had a son, who became a celebrated author, and of whom the reader will find an account in the next article. This youth the Jesuits would gladly have received into their society; but his father refused his consent, and for that reason these disciples of Jesus soon contrived to ruin him with the duke his patron. Barclay now embarked for Britain, where King James offered him a considerable preferment, provided he would become a member of the church of England; but not chusing to comply with this condition, he returned to France in 1604, and, soon after his arrival, was appointed first professor of the civil law in the university of Angers, where he died the year following, and was buried in the Franciscan church.

Barclay was a man of superior talents, and still maintains a conspicuous place among civilians.[1] In his political opinions he was directly opposed to his illustrious countryman Buchanan, and was a strenuous defender of the rights of kings: his own speculations on the principles of government are best known to some readers from an incidental confutation by Locke, in his *Treatises on Government*. A list of his publications shall close this very brief notice.

1. De Regno et Regali Potestate, adversus Buchananum, Brutum, Boucherium, et reliquos Monarchomachos, libri sex. Paris. 1600, 4to.—This volume contains, or ought to contain, a portrait of the author, which however has in many instances been transferred to the portfolio of some collector.

2. In Titulum Pandectarum de Rebus creditis et Jurejurando Commentarii. Paris. 1605, 8vo.—This commentary is reprinted in Otto's *Thesaurus Juris Romani*, tom. iii.

3. De Potestate Papæ; an et quatenus in Reges et Principes seculares jus et imperium habeat: Liber posthumus. Mussiponti, 1610, 8vo.—This work may likewise be found in Goldasti *Monarchia*, tom. iii. p. 621. It was translated into French; and an English version is printed with the treatise of Sheldon, *Of the Lawfulness of the Oath of Allegiance*. Lond. 1611, 4to. Barclay's two treatises, *De Regno* and *De Potestate Papæ*, have repeatedly been printed in the same volume. Hanoviæ, 1612, 8vo. Ha- Barclay. noviæ, 1617, 8vo.

Barclay, *John*, son of the eminent civilian mentioned in the last article, was born at Pontamousson on the 28th of January 1582. He was there educated in the College of the Jesuits, and excited in his instructors so favourable an opinion of his capacity, that they made an attempt to entice him into their order; an attempt which was indignantly resisted by his father. At the age of nineteen, he evinced his literary ambition by publishing annotations on the Thebais of Statius. In 1603, when his father resigned his professorship in disgust, the young and aspiring scholar accompanied him to London; and at the beginning of the following year he presented his *Kalendæ Januariæ* as a poetical offering to King James, to whom he soon afterwards dedicated the first part of his work entitled *Euphormionis Lusini Satyricon*. Both the father and the son were willing to accept of employment, and no doubt they both expected preferment. But, as Lord Hailes has remarked, "William Barclay was conscientiously attached to the church of Rome, and his son professed the religion of his forefathers. In those days a pension bestowed upon a Scottish Papist would have been numbered among the national grievances; and the vulgar would not have distinguished between favour shown to genius or learning, and partiality for the opinions of the person favoured."[2] In the year 1604 they both returned to France, and Dr Barclay was again placed in a situation suited to his talents and learning, having been appointed first professor of the civil law in the university of Angers. His taste for external magnificence appears to have been somewhat prominent: when he went to read his lecture, he was dressed in a superb gown, with a massy chain of gold about his neck, and was followed by his son and two valets.[3]

The younger Barclay, whose hopes of advancement had begun to revive, returned to England in 1605; but after a further residence of twelve months, he still found himself unsuccessful in his pursuit. His father died towards the close of the same year; and he afterwards removed to Paris, where he married Louise, the daughter of Michael Debonnaire, "Trésorier des Vieilles Bandes." He speedily fixed his abode in London, and there his wife bore him a son and two daughters, William, Anne, and Louise. M. de Peiresc, who was himself a man of learning, and was very extensively connected with the learned, found him in this metropolis in the year 1606, and their acquaintance was succeeded by an intimate friendship. During this year he published the second part of his *Satyricon*, which he dedicated to the earl of Salisbury; and likewise a brief narrative of the gunpowder plot, bearing the title of *Series patefacti divinitus Parricidii, in ter maximum Regem Regnumque Britanniæ cogitati et instructi*. In 1610 he published an apology for his *Satyricon*, which had excited so much resentment that he found it necessary to attempt some palliatives and explanations. A tract was published at Paris in 1620, under the title of *Censura Euphormionis*;[4] and this was answered in a *Censura Censuræ Euphormionis*, written by Pierre Musnier, canon of Vezelay.

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[1] See Dr Browne's *Remarks on the Study of the Civil Law*, p. 25. Edinb. 1828, 8vo.

[2] Hailes's *Sketch of the Life of John Barclay*, p. 2. 4to edit.

[3] Menage, *Remarques sur la Vie de Pierre Ayrault*, p. 230.

[4] "On croit, pour le marquer icy en passant, que Séton, Ecossois, est l'auteur de ce petit livre." (Menage, p. 233.) The writer apparently alludes to Dr Seaton, a learned civilian, whom Tomasini enumerates among the eminent scholars of the age. (*Parnassus Euganeus, sive de Scriptoribus ac Literatis hujus Ævi claris*, p. 8. Patavii, 1647, 4to.) Balzac celebrated him in his Latin verses; Scioppius addressed the second epistle of his *Paradoxa Literaria* "Guilhelmo Setonio Scoto Jurisconsulto;" and his name is mentioned with much respect by various other writers of the same period. He is highly extolled in Sir Thomas Urquhart's *Discovery of a most exquisite Jewel*, p. 177. Lond. 1652, 8vo.

Barclay. During the same year, 1610, he published an able work of his father, *De Potestate Papæ*, to which he prefixed a preface of nine pages, concluding with a clear intimation of his purpose to defend his father's memory against any unseemly attack. "Quod si aliquis hoc opus refellere instituet, velim ne oratoria fraude tantum levia quædam carpat, in quibus nec ipse author multum subsidii posuerit; sed ipsam vim rationum excutiat, diluendi aut asserendi vitia accuset. Si quis aliter faxit, sciat Guilielmi Barclaii cineres loqui posse." It was not the object of this treatise to controvert the spiritual supremacy of the pope, which the author was ready to admit in its most orthodox sense; but while he acknowledged his power and jurisdiction in things spiritual, he strenuously contended against his usurped power over sovereign princes in things temporal. The work, which is written with learning and ability, excited no small degree of attention; and it was soon attacked by Cardinal Bellarmin, one of the most formidable defenders of the doctrines of the church, and of the pretensions of its visible head. The son was anxious to evince that the ashes of his revered father were yet capable of speaking. He had not neglected to study the law under so excellent a preceptor; and as he was by no means diffident of his own abilities, he did not shrink from a contest with so redoubtable an antagonist. He accordingly published a large volume bearing the title of *Joannis Barclaii Pietas; sive publicæ pro Regibus ac Principibus, ac privatæ pro Guilielmo Barclaio Parente Vindiciæ, adversus Roberti S. R. E. Cardinalis Bellarmini Tractatum de Potestate Summi Pontificis in Rebus Temporalibus.* Parisiis, 1612, 4to. To this work the cardinal did not himself reply, but an answer was speedily published under the name of *Andreæ Eudæmon-Johannis Epistola monitoria ad Joannem Barclaium de Libro ab eo pro Patre suo contra Robertum Bellarminum S. R. E. Cardinalem scripto.* Col. Agrip. 1613, 8vo.

In 1614 Barclay published at London his *Icon Animorum*, which forms the fourth part of his *Satyricon*. This work is written with talent and vivacity, and may still be perused with pleasure. It is, as Lord Hailes has correctly stated, a delineation of the genius and manners of the European nations, with remarks, moral and philosophical, on the various tempers of men. For the land of his forefathers the author has not failed to testify a sufficient degree of affection. He duly extols the antiquity of the royal line, "inclyto sceptro supra fidem et ætatem regnorum cæterorum." Nor is the literary character of the people left without its share of commendation. "Animi illis in quæcunque studia inclinant, mirifico successu inclyti, ut nullis major patientia castrorum, vel audacia pugnæ, et Musæ nunquam delicatius habeant quam cum inciderunt in Scotos."[1] Some of his sketches of the national character are happy and graphic.

After a residence of ten years in England, Barclay found himself without any sufficient inducement to prolong his stay. To some extent or other, he had experienced the bounty of the earl of Salisbury; and although it does not appear that he obtained any regular provision from the king, we may perhaps suppose that he at least received occasional gratuities; but his resources continued to be scanty, and his situation precarious. Towards the close of the year 1615 he proceeded to Paris, where he had the pleasure of meeting his friend M. de Peiresc, and the honour of being introduced by him to the keeper of the seals, Guillaume du Vair. Having been invited to Rome by Pope Paul V., he there fixed his residence in the beginning of the ensuing year, and by the publication of his next work he endeavoured to prove himself a worthy denizen of this pious city. The work to which we allude is entitled *Joannis Barclaii Parænesis ad Sectarios, libri ii.* Romæ, 1617, 8vo. "It is probable," says Lord Hailes, "that by this exhortation to the sectaries, he meant to give evidence of his own orthodoxy, and to atone for the liberties, almost heretical, which he had taken, as well with the papal court, as with its most faithful adherents. But that court, which had Cardinal Bellarmin for its champion, required not the feeble and suspicious aid of the author of Euphormion.—Although Barclay found much civility at Rome, yet it does not appear that he obtained any emolument. Incumbered with a wife and family, and having a spirit above his fortune, he was left at full leisure to pursue his literary studies. It was at that time that he composed his Latin romance called *Argênis*. He employed his vacant hours in the cultivating of a flower-garden. Rossi (or Erythræus) relates, in the turgid Italian style, that Barclay cared not for those bulbous roots which produce flowers of a sweet scent; and that he cultivated such as produced flowers void of smell, but having variety of colours. Hence we may conclude that he was amongst the first of those who were infected with that strange disease, a passion for tulips, which soon after overspread Europe, and is still remembered under the name of the *Tulipo-mania*. Barclay had it to that excess, that he placed two mastiffs as centinels on his garden; and, rather than abandon his favourite flowers, chose to continue his residence in an ill-aired and unwholesome habitation." The preceding account of his success at Rome is not reconcilable with that of Erythræus, who avers that from Cardinal Barberini he obtained riches as well as civility;[2] but as these benefits are said to have been conferred after the cardinal's elevation to the papal chair, the narrative is liable to some degree of suspicion. The election of Urban VIII. did not take place till the year 1623, and Barclay was then beyond the reach of preferment. It is not however probable that a writer of high reputation, who had been invited by the pope, and was caressed by cardinals, was left without some substantial mark of favour. Bellarmin, whom he had formerly undertaken to refute, was so far from cherishing any resentment, that he honoured him with various marks of kindness.

Barclay died at Rome on the twelfth of August 1621, in the fortieth year of his age. The disease which proved fatal to him was the stone; a disease for which, in his *Satyricon*, he had pronounced the plant called golden rod to be a specific remedy. His remains were interred in the church of S. Onufrio; and at the church of S. Lorenzo, on the road to Tivoli, his widow erected for him a monument, with his bust in marble; but on learning that Cardinal Francesco Barberini had there erected a similar monument in honour of his preceptor, she indignantly caused the bust to be removed. The inscription on Barclay's monument was soon erased; but by whom, or for what reason, is not very clearly ascertained. There is however no improbability in the reason assigned by Freherus, who imputes this act to the vindictive feelings of the Jesuits, an order of men very frequently subjected to his satire.[3]

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[1] Joannis Barclaii *Icon Animorum*, p. 92. Lond. 1614, 8vo.

[2] "Qui deinde, ad Deo proximum, in terris, dignitatis locum evectus, Urbani VIII. nomine, non modicæ illi utilitati et commodo fuit; nam et divitias et opes ac gratiam contulit, filiumque ejus majorem natu et pingui sacerdotio locupletavit, et honorarii intimi cubicularii titulo cohonestavit." (Erythræi *Pinacotheca*, tom. iii. p. 79.) See likewise Imperialis *Musæum Historicum*, p. 170.

[3] Freheri *Theatrum Virorum Eruditione clarorum*, tom. ii. p. 1515.—"Inscriptionem ac statuam," says an earlier writer, "cautiore patres consilio sublatam ac deletam voluerunt." (Imperialis *Musæum Historicum*, p. 171. Venet. 1640, 4to.)

Barclay. At the time of his death, the romance of *Argenis* was printing under the superintendence of Peiresc,[1] and was soon afterwards given to the public. Paris. 1621, 8vo. Besides a son and two daughters born in England, Barclay had a son who was born at Rome. His elder son is represented by Erythræus as having obtained a rich benefice from Urban VIII. With one of his sons Menage was acquainted at Paris in the year 1652; and, in his opinion, "ce n'estoit pas un grand personnage." Like his father, he was a writer of Latin verses, and at this period he there printed an elegy. We are not aware that the descendants of Barclay are at present to be traced either in France or Italy.

This ingenious writer, who was thus arrested in the middle of his literary career, left an unpublished history of the conquest of Jerusalem by the Franks, and some fragments of a general history of Europe. Erythræus informs us that he had himself transcribed a manuscript tract of his, relating to the defection of M. Ant. de Dominis, archbishop of Spalato; and that from his knowledge of the national character, as well as of the disposition of the king, the author foretold that he could not long remain in England.

The ambition of Barclay was greater than his fortune; nor did his propensity to satirize one class of individuals prevent him from offering abject flatteries to another. But at that period few men of letters knew how to blend self-respect with a proper deference to their superiors in the artificial scale of society. His personal character, with an ample allowance for his vanity as an author, appears to have been respectable. "Some very indecent descriptions in Euphormion," as Lord Hailes has remarked, "lead us to form an unfavourable conjecture as to the manners of Barclay. There is however no proof that he was a loose man; and indeed it is probable that he wrote loosely because Petronius, whom he had chosen for his model in satire, affected that style. Barclay entered into the married state at a very early period of life; and he appears to have continued the fond husband of his *Aloysia*.... There is a presumption, at least, that he who was a good son and a good husband, was also a virtuous man in other respects; and if there had been any remarkable blemish in the morals of Barclay, some of his numerous and virulent adversaries would have pointed it out." He appears to have been subjected to considerable annoyance in consequence of the jealousy of his wife; but in many cases jealousy is a wayward passion, and proceeds from the mere excess of affection, as well as from the knowledge or suspicion of specific and painful facts.

Barclay was evidently a man of genius, and with a vigorous imagination he united a competent share of learning. His literary efforts were sufficiently varied; quitting the regions of poetry and romance, he ventured to discuss subjects of jurisprudence and theology. His Latin poems exhibit marks of fancy and ingenuity, nor is his skill as a versifier less conspicuous.[2] The *Satyricon* is formed on the model of Petronius, and includes occasional verses interspersed with the prose. The talent displayed in this work would alone have been sufficient to secure him a high reputation among the writers of the age; but the fame of all his other productions has in a great measure been eclipsed by that of his *Argenis*, which, after the lapse of two centuries, still finds readers and admirers. "*Argenis*," says Lord Hailes, "is generally supposed to be a history under feigned names, and not a romance. Barclay himself contributed to establish this opinion, by introducing some real characters into the work. But that was merely to compliment certain dignitaries of the church, whose good offices he courted, or whose power he dreaded. The key prefixed to *Argenis* has perpetuated the error. There are no doubt many incidents in it that allude to the state of France during the civil wars in the seventeenth century; but it requires a strong imagination indeed to discover Queen Elizabeth in Hyanisbe, or Henry III. of France in Meleander. On the whole, *Argenis* appears to be a poetical fable, replete with moral and political reflections." This is a sober and correct account of the work; but Cowper has expressed his approbation in more glowing terms. "The work I mean is Barclay's *Argenis;* and, if ever you allow yourself to read for mere amusement, I can recommend it to you (provided you have not already perused it) as the most amusing romance that ever was written. It is the only one indeed of an old date that I ever had the patience to go through with. It is interesting in a high degree, richer in incident than can be imagined, full of surprizes, which the reader never forestalls, and yet free from all entanglement and confusion. The stile too appears to me to be such as would not dishonour Tacitus himself." In another letter he expresses himself thus:—"I have also read Barclay's *Argenis*, a Latin romance, and the best romance that was ever written."[3] This romance was a special favourite with Cardinal Richelieu, and also with Leibnitz, a much greater man than the cardinal. Barclay.

Cowper appears to have been struck with the point and vivacity of his style, which indeed are sufficiently distinguishable; but for the purity of his Latin diction Barclay is not entitled to equal commendation. Being probably impelled by the rapid current of his fancy, he adopts a variety of words and idioms which well express his meaning, but which nevertheless do not belong to the best ages of Latinity. The distich of Grotius, engraved under Barclay's portrait, seems therefore to contain a compliment which must not be too literally interpreted:

Gente Caledonius, Gallus natalibus, hic est
Romam Romano qui docet ore loqui.

Joseph Scaliger, whose literary judgments were frequently severe, and not unfrequently capricious, mentions Barclay's *Satyricon* in terms of great disparagement; but whether his censure is chiefly directed against the Latinity or against the general strain of the work, is not altogether certain.[4] This book, whatever may be its demerits, has passed through many editions, and has been translated into the French and German languages.[5] It has likewise had the advantage of being illustrated with notes. Lugd. Bat. 1674, 8vo. The fourth part, the *Icon Animorum*, has repeatedly been printed in a separate form. One edition bears this inscription: "Joannis Barclaii Icon Animorum, celeberrimi viri Augusti Buchneri notis, adjecto rerum indice, illustrata." Dresdæ, 1680, 8vo. The book soon appeared in an English dress: "The Mirror of Minds, or Barclay's *Icon Animorum;* Englished by Tho. May, Esq." Lond. 1633, 12mo. Of this translation there is another edition in the same form; but the only copy

[1] Gassendi *Vita Nicolai Claudii Fabricii de Peiresc*, p. 176. Paris. 1641, 4to.

[2] Joannis Barclaii *Poematum libri duo.* Lond. 1615, 4to. Oxon. 1636, 12mo.—His poems may likewise be found in the *Delitiæ Poetarum Scotorum*, tom. i. p. 76. "Sed quid Joanne Barclaio Scoto, etiam in hoc genere Musarum, exactius, numerosius, et quandoque sublimius?" (Borrichii *Dissertationes academicæ de Poetis*, p. 149. Francof. 1683, 4to.)

[3] Hayley's *Life of Cowper*, vol. i. p. 243, 247. 4to edit.

[4] "Quanti Euphormionem Barclæi faciam, ex eo cognoscere potes, quod vix sex folia ejus legere potuerim." (Jos. Scaligeri *Epistolæ*, p. 657. Lugd. Bat. 1627, 8vo.) See Colomesii *Opuscula*, p. 157, and Menage's *Remarques sur la Vie de Pierre Ayrault*, p. 238.

[5] *Biographie Universelle*, tom. iii. p. 360. Ebert's *Allgemeines Bibliographisches Lexikon*, Band i. S. 137.

Barclay. to which we have access contains a mutilated title, and we therefore cannot discover the date. Two French versions had appeared in the course of one year. "Le Pourtrait des Esprits de Jean Barclai, mis en François." Paris, 1625, 12mo. "Le Tableau des Esprits de M. Jean Barclay: par lequel on cognoist les humeurs des Nations, leurs advantages et defaux, les inclinations des hommes, tant à cause de leurs propres naturels que des conditions de leurs charges. Nouvellement traduict de Latin en François." Paris, 1625, 8vo. The dedication of the duodecimo is subscribed Nantevil de Boham; and he has taken such liberties with the original, that his work can scarcely claim the name of a translation. There is a German translation of a very recent date: "Johann Barklai's Gemälde der menschlichen Charaktere nach Verschiedenheit der Alter, Zeiten, Länder, Individuen und Stände: aus dem Lateinischen übersetzt, und mit Anmerkungen und geschichtlichen Nachweisungen begleitet, von Anton Weddige, Pastor zu Lippborg." Münster, 1821, 8vo. A continuation of the *Satyricon* had been published by Claude Morisot, under the title of *Alitophili Veritatis Lachrymæ;* and Lord Hailes describes it as a masterpiece of absurdity.

The editions and versions of the *Argenis* are much more numerous. An edition with notes appeared under the title of "Joannis Barclaii Argenis, nunc primum illustrata." Lugd. Bat. et Roter. 1664, 8vo. This was followed in 1669 by a uniform edition of the continuation: "Archombrotus et Theopompus, sive Argenidis secunda et tertia pars, ubi de Institutione Principis." The notes, which are not held in much estimation, were written by Bugnot, a Benedictine who taught rhetoric in the abbey of Tiron. Lord Hailes mentions a French translation published at Paris, 1622, 8vo; and another with the subsequent title now lies before us: "L'Argenis de Jean Barclay: traduction nouvelle, enrichie de figures." Paris, 1625, 8vo. There are other two French versions of a more recent date, one by the Abbé Josse, a canon of Chartres, 1732, 3 tom. 12mo; and another by M. Savin, Paris, 1776, 2 tom. 8vo. Barclay's romance soon appeared in Spanish; and a copy of this rare version belongs to the Astorga collection in the Advocates Library: "Argenis, por Don Joseph Pellicer de Salas y Tobar. A Don Antonio de Negro, Noble de la Serenissima Republica de Genoua." Madrid, 1626, 4to. Don Joseph has somewhat unfairly excluded Barclay's name from the title-page. An English version was speedily published by Sir Robert Le Grys and Thomas May, Esq. Lond. 1628, 4to. And another was executed by Kingsmill Long, Esq. Lond. 1636, 4to. After a long interval appeared "The Phœnix, or, the History of Polyarchus and Argenis. By a Lady." London, 1772, 4 vols. 12mo. The preface of this publication states that "the editor has made use of both the former translations occasionally, and, whenever a doubt arose, had recourse to the original." Lord Hailes has judiciously enough suggested that "the lady would have done as well had she made use of the original, and only consulted the translations when any doubt arose." The *Argenis* was at an early period translated into German: "Joan. Barclai Argenis, verdeutscht durch Martin Opitzen." Amsterdam, 1644, 12mo. In this country, the version of Opitz is extremely rare; and the only copy that has fallen under our inspection belongs to the writer of the present notice. Another German translation was published by J. Ch. L. Haken. Berlin, 1794, 2 Bde. 8vo. An Italian version was executed by Francesco Pona; and this celebrated romance has even been translated into the Polish, Swedish, and Icelandic languages. Among the northern manuscripts in the Advocates Library there is a *Saga af Argenide*, translated in the year 1694 by a schoolmaster named Einarson.[1] (D. I.) Barclay.

Barclay, *Robert*, one of the most eminent members of the Society of Friends, was born at Gordonstown, in Morayshire, in 1648. He was educated under an uncle at Paris, where every effort was used without success to draw him over to the Popish religion. In 1669 he joined the Quakers, and distinguished himself by his zeal and abilities in defence of their doctrines. In 1676 he published, in Latin, at Amsterdam, his *Apology for the Quakers*, which is the most celebrated of his works, and esteemed the standard of the doctrine of the Quakers. The *Theses Theologicæ*, which were the foundation of this work, and addressed to the clergy generally, were published before the *Apology*, and printed in Latin, French, German, Dutch, and English. The dedication of his *Apology* to King Charles II., is very remarkable for the uncommon frankness and simplicity with which it is written. Amongst many other extraordinary passages, we meet with the following: "There is no king in the world who can so experimentally testify of God's providence and goodness; neither is there any who rules so many free people, so many true Christians; which thing renders thy government more honourable, thyself more considerable, than the accession of many nations filled with slavish and superstitious souls. Thou hast tasted of prosperity and adversity; thou knowest what it is to be banished thy native country, to be over-ruled as well as to rule and sit upon the throne; and being oppressed, thou hast reason to know how hateful the oppressor is both to God and man: if, after all those warnings and advertisements, thou dost not turn unto the Lord with all thy heart, but forget Him who remembered thee in thy distress, and give thyself up to follow lust and vanity, surely great will be thy condemnation." He travelled with the famous William Penn through the greater part of England, Holland, and Germany, and was everywhere received with the highest respect; for though both his conversation and behaviour were suitable to his principles, there was so much liveliness and spirit in his discourse, and such serenity and cheerfulness in his deportment, that he made himself agreeable to all sorts of people. When he returned to his native country, he spent the remainder of his life in a quiet and retired manner. He died at his own house at Ury, on the 3d of October 1690, in the 42d year of his age.

Barclay, *John, M.D.*, a distinguished anatomist, was born in Perthshire in 1760, and died at Edinburgh in 1826. After the usual routine of parochial education, he completed his academical course at the United College of St Andrews. He subsequently studied divinity there, and was licensed as a preacher by the presbytery of Dunkeld. Having repaired to Edinburgh in 1789, as tutor to the family of Sir James Campbell of Aberuchill, he began to give his attention to the study of medicine, and particularly to anatomy, both human and comparative. He became assistant to the late Mr John Bell, and took the degree of M.D. in 1796, after having defended an inaugural dissertation, *De Anima, seu Principio Vitali*, a subject which occupied his maturer powers toward the close of his life. Immediately after his graduation, he repaired to London, and studied for some time under the late Dr Marshall of Thavies Inn, at that time a very distinguished teacher of anatomy in the metropolis. Soon after his return to Edinburgh, he commenced his lectures on anatomy in November 1797; and by his

[1] This translator of Barclay was "Joh. Einari, scholæ primum Skalholtinæ hypodidascalus, deinde rector scholæ Holensis designatus." (Halfdani Einari *Sciagraphia Historiæ Literariæ Islandicæ*, p. 66. Havniæ, 1777, 8vo.) He appears to have been a writer of verse as well as prose.

Bar-cochebas || Bard.

punctual attention to his engagements, and assiduous devotion to the instruction of his pupils, he speedily attracted a respectable audience, which continued gradually to increase in numbers until the period of his retirement, a short time before his death.

Of Dr Barclay's professional writings, the earliest, we believe, was the article PHYSIOLOGY, which he furnished for the third edition of this work.

In 1803, six years after he commenced his career as a teacher, Dr Barclay attempted a reform in the language of anatomy, with a view to render it more accurate and precise; a task for which his acquirements as a classical scholar rendered him peculiarly fit. Although the *Nomenclature* which he published upon that occasion has not been generally adopted, we believe that the profession, with one voice, acknowledges the importance of the object which he had in view, and the talent and learning with which it was executed.

In 1808, he published his *Treatise on the Muscular Motions of the Human Body*, and in 1812 his *Description of the Arteries of the Human Body;* a work displaying much acute observation and laborious research, and which may perhaps be considered the most practically useful of all his writings. His last publication, completed only a few years before his death, was *An Inquiry into the Opinions, Ancient and Modern, concerning Life and Organization;* a work replete with learning and sound original criticism. His introductory lectures, published after his death, contain a valuable abridgment of the history of anatomy.

As a testimony of gratitude to the Royal College of Surgeons of Edinburgh, Dr Barclay bequeathed to that learned and public-spirited body his anatomical collection, now known as the Barclayan Museum, which contains many valuable specimens in comparative anatomy, and some of the finest vascular preparations which are anywhere to be found.

BAR-COCHEBAS, or BAR-COCHAB, a celebrated Jewish impostor, in the second century, whose real name was Simeon. See JEWS and PALESTINE.

BARD, a word denoting a poet by profession. Anciently bards were necessary persons at every festival and at every solemnity. Their songs, which, by recording the achievements of kings and heroes, animated the soul of the hearer, were the entertainment of every warlike nation. We have Hesiod's authority, that in his time bards were as common as potters or joiners, and as prone to envy:—

> Bard, potter, joiner, beggar, 'tis decreed,
> Each with his kind shall never be agreed.

Cicero tells us that anciently at Roman festivals the virtues and exploits of their great men were celebrated in song. The same custom prevailed in Peru and Mexico, as we learn from Garcilaso and other authors. But in no part of the world did the profession of bard appear with such lustre as in Gaul, in Britain, and in Ireland. Wherever the Celtæ or Gauls are mentioned by ancient writers, we seldom fail to hear of their druids and their bards, the institution of which two orders was the capital distinction of their manners and policy. The druids were their philosophers and priests, the bards their poets and recorders of heroic actions; and both these orders of men seem to have subsisted among them as chief members of the state from time immemorial. The Celtæ possessed, from very remote ages, a regular system of discipline and manners, which appears to have had a deep and lasting influence. Ammianus Marcellinus expressly declares, that there flourished amongst them the study of the most laudable arts, introduced by the bards, whose office it was to sing in heroic verse the gallant actions of illustrious men; and by the druids, who lived together in colleges or societies after the Pythagorean manner, philosophizing upon the highest subjects, and maintaining the immortality of the soul. Though Julius Cæsar, in his account of Gaul, does not expressly mention the bards, yet it is plain that under the title of druids he comprehends that whole college or order, of which the bards, who, it is probable, were the disciples of the druids, undoubtedly made a part. According to his account, the druidical institution first took its rise in Britain, and passed from thence into Gaul; so that they who aspired to be thorough masters of that learning were wont to resort to Britain. He adds, too, that such as were to be initiated among the druids were obliged to commit to memory a great number of verses, insomuch that some employed twenty years in this course of education; and that they did not think it lawful to record these poems in writing, but handed them down by tradition from race to race.

Bardas || Bardili.

So strong was the attachment of the Celtic nations to their poetry and their bards, that amidst all the changes of their government and manners, even long after the order of the druids had been extinct, and the national religion altered, the bards continued to flourish, not as a set of strolling songsters, like the Greek ἀοιδοι or *rhapsodists* in Homer's time, but as an order of men highly respected in the state, and supported by a public establishment. According to the testimonies of Strabo and Diodorus, they existed before the age of Augustus Cæsar; and we find them flourishing under that sovereign, and exercising the same functions as of old, in Ireland and in the north of Scotland, almost down to our own times. It is well known that, in both these countries, every *regulus* or chief had his own bard, who was considered an officer of rank and consequence in his little court.

The bards, as well as the druids, were exempted from taxes and military services, even in times of the greatest danger; and when they attended their patrons in the field to record and celebrate their great actions, they had a guard assigned them for their protection. At all festivals and public assemblies they were seated near the person of the king or chieftain, and sometimes even above the greatest nobility and chief officers of the court. Nor was the profession of the bards less lucrative than it was honourable. For, besides the valuable presents which they occasionally received from their patrons when they gave them uncommon pleasure by their performances, they had estates in land allotted for their support. Nay, so great was the veneration which the princes of these times entertained for the persons of their poets, and so highly were they charmed and delighted with their tuneful strains, that they sometimes pardoned even their capital crimes for a song.

BARDAS, the brother of the Empress Theodora, and uncle of the famous Photius. He is said to have had no good quality besides that of loving the sciences and polite literature, which he established in the eastern empire; for otherwise he was treacherous, cruel, and ambitious. In the year 856 he assassinated Theoctistus, general of the Emperor Michael's forces, and obtained his post. At length he caused the disgrace of the Empress Theodora; and when St Ignatius, patriarch of Constantinople, reproached him for his vices, he had the prelate deposed, in 858, in order to make room for Photius. Bardas was assassinated by Basilius the Macedonian in 866.

BARDESANES, a Syrian of Edessa, in Mesopotamia, born about A.D. 154. After his conversion to Christianity he became eminent for his zeal against heretics, and wrote many books against them. He at first embraced the errors of Valentinus, but afterwards laboured to refute them. His followers, who were called Bardesanists, went further than their master, and denied the incarnation of Christ, and the resurrection. His dialogues against Marcion, and his treatise *On Fate*, are much commended. (Euseb. iv. 30; Jerome, c. xxxix.)

BARDILI, CHRISTOPH GOTTFRIED, a German metaphysician, distinguished by his opposition to the system of Kant, was born at Blaubeuren in Wurtemburg, in 1761, and died at Stuttgard in 1808. Of his numerous works the principal is his *Elements of Logic* (*Grundriss der ersten Logik*,

Bardsey ‖ Baretti.

&c.) Stuttgard 1800; in which he has developed his own peculiar views.

BARDSEY, a small island on the Welsh coast, at the northern extremity of Cardigan Bay. It is 2½ miles long by 1 in breadth, with an area of about 370 acres, of which one-third is hilly. The island produces barley and oats. Pop. 90. Its only harbour is on the S.E. side, and admits vessels of 40 tons. The lighthouse has a fixed light 129 feet above high water, in Lat. 52. 45. N. Long. 4. 47. W.

BARÈGES, a small town situated between two mountain chains in the department of Hautes Pyrénées in France, celebrated for its warm sulphurous springs. Their temperature varies from 24° to 36° Reaumur. Upwards of a thousand visitors annually repair to the baths, most of them military men, the benefit of the waters being granted to the army at the expense of government. Their chief value is in cutaneous diseases.

BAREILLY, a large and populous city of Hindustan, and the capital of a district of the same name, is situated on the left bank of the Jooah, a tributary of the Ramgunga. It is a place of some importance with respect both to commerce and manufactures, and, according to the census taken in 1848, has a population of 92,208. The cantonment for the troops is at the south side of the town, and forms the head-quarters for the military division of Rohilcund. Elevation of Bareilly above the sea, 470 feet. Distance from Delhi 152 miles, from Calcutta 788. Lat. 28. 22. Long. 79. 28.

The district of Bareilly is bounded on the N. by Kumaon; on the E. by Oude and Shahjehanpore; on the S. by Budaon, and on the W. by the native state of Rampore and the British district of Moradabad. Its principal rivers are the Gogra, the Western Ramgunga, the Gurrah, and the Goula. The area is 2937 square miles. There are only two cities in the district, viz. Bareilly and Pilleebheet; Aoulah, formerly a larger place than Bareilly, being now in ruins. According to official return, the population amounts to 1,143,657, of which number 883,795 are Hindus, and 259,862 Mahometans and others not Hindu. In summer, notwithstanding the high latitude of Bareilly, the heat is intense; but in winter, water sometimes freezes in the tents. After the devastation of Rohilcund in 1774 by Surajah Dowlah the vizier of Oude, aided by the British troops, the country became a complete waste. Subsequent disturbances called for the renewed interference of the British, and in 1796 the Rohillas were again defeated by the troops under the command of Sir Robert Abercrombie. These events resulted in the transfer of the district of Bareilly to the vizier, by whom in 1802 it was ceded to the East India Company, in commutation of the annual payment agreed to be made to the British government for the maintenance of a subsidiary military force.

The city of Bareilly was in 1816 the seat of a serious outbreak against the British government, which for a time threatened disastrous consequences. It originated in discontent created by certain fiscal arrangements, but was speedily converted by Mahometan fanaticism into a religious quarrel. It was however happily suppressed; but not without a conflict between the government troops and the insurgents, which was followed by the dispersion of the latter. (E. T.)

BARETTI, GIUSEPPE, a native of Turin, was born in 1716. He came to London in 1751, where he became known by the publication of his *Italian Library*, and obtained the appointment of secretary to the Royal Academy, which he retained till his death in 1786. He was the author of an excellent Italian and English grammar, and a valuable dictionary of the same languages; and he afterwards compiled a Spanish and English dictionary. He had the misfortune, in a brawl in the streets of London, to stab a man, who died of the wound. He was tried for his life; and defended himself with great ability. He proved that the homicide had been committed in self-defence from an unprovoked attack; and was acquitted by the jury. On this trial Dr Johnson, Garrick, and Burke, gave favourable testimony to his character, and spoke of him as intimately known to them.

Barfleur ‖ Bark.

BARFLEUR, an ancient town of Normandy, in France, now in the department of Manche, 15 miles E. of Cherbourg. It was ruined and had its harbour filled up by the English in 1346. Cape Barfleur has a lighthouse 271 feet above the sea, in Long. 1. 16. W. Lat. 49. 40. N.

BARGE (*bargie*, Dutch, from *barga*, low Latin), a boat of state or pleasure, sometimes furnished with elegant canopies and cushions, equipped with a band of rowers, and decorated with flags and streamers. There are likewise barges of a smaller kind for the use of admirals and captains of ships of war. These are of a lighter frame, and may be easily hoisted into and out of the ships to which they belong. See BOAT.

BARI, TERRA DI, a province of the kingdom of Naples, bounded on the N. by the Adriatic, E. and S.E. by the province of Otranto, S.W. by Basilicata, and W. by Capitanata. It has an area of 1782 geographical square miles, and is divided into 3 districts and 53 communes. Pop. in 1845, 491,331. Except in the S. and S.W., where branches of the Apennines occur, the surface is generally level. The only considerable river is the Ofanto; this province, however, is the best cultivated in the kingdom, producing abundance of grain, flax, tobacco, cotton, wine, oil, almonds, &c. Swine, asses, goats, and sheep with a very fine wool, are numerous; and the salt and nitre works form important branches of industry.

BARI, the ancient *Barium*, capital of the above province, is situated on a tongue of land projecting into the Adriatic, in Lat. 41. 7. 41. N. Long. 16. 52. 16. E. The town is strongly fortified, but the houses are generally mean, and the streets narrow and filthy. It is the seat of an archbishopric, and has a cathedral, several parish churches, an old priory founded in 1087, a college for the education of nobles, a lyceum, a diocesan seminary, a theatre, arsenal, and several hospitals. The manufactures comprise cotton goods, cloth, hats, soap, glass, &c.; and the liquor called "acqua stomachica" is prepared here. The roads afford good anchorage, with a depth of from 16 to 18 fathoms, but the port is accessible to small vessels only. Pop. 20,000.

BARILLA, the commercial name of an impure carbonate of soda, which is produced by the incineration of several marine and other plants inhabiting the shores of Spain and the Levant, especially those of the genus *Salsola*, which for this purpose are extensively cultivated in the *huerta* of Murcia, and other places on the eastern shores of Spain. Barilla is largely used in the manufacture of glass and soap, and in bleaching. Kelp is an inferior alkali prepared from certain kinds of sea-weed in a similar manner. The manufacture of barilla was introduced into Europe by the Saracens, who called it *kali*; whence, by the addition of the Arabic prefix *al*, came the term *alkali*. Since the introduction of artificial soda (*soude factice*), the importation of barilla has greatly declined. (M'Culloch's *Com. Dict.*)

BARK, the exterior part or skin of trees. Several kinds of barks are met with in commerce, some being used exclusively and largely in the arts, others only in medicine, and a third class as spices. The chief barks met with in commerce are oak bark, mimosa or wattle bark; larch, willow, and alder barks, all chiefly, if not entirely, used in the process of tanning; quercitron bark, used in the production of a yellow dye; cork bark, for the manufacture of corks for bottles, &c.; Peruvian or cinchona bark, cascarilla, and some other barks used in medicine. From the Peruvian bark is prepared the valuable medicine sulphate of quinine, so efficacious in the cure of agues, &c. The other barks occurring in commerce are classed under the head of spices, being

Bark || Barlow.

the cinnamon and cassia barks. With the exception of cinnamon and cassia, barks now pay no import duty. The quantity of bark for tanners' or dyers' use imported in 1852 was 403,930 cwt. Of mimosa or wattle bark, both in its crude state and in the form of extract, we possess no certain information, the custom-house not having published separate and distinct accounts of the imports of each since 1832. In that year, however, the imports of this bark amounted to 28,410 cwt., and have been increasing since that period. Of quercitron bark, the average consumpt amounts to somewhere about 23,000 or 24,000 cwt. annually. In 1852 the quantity of cinchona bark imported amounted to 18,206 cwt., of which 10,092 were re-exported. The quantity of cork bark imported in 1850 amounted to 60,696 cwt. The quantity of cassia bark imported in 1852 amounted to 496,833 lb. It pays an import duty of 1d. per lb. The quantity of cinnamon imported into this country in 1852 amounted to 541,888 lb. Cinnamon pays a duty of 2d. per lb. In 1853 the distinctive colonial and foreign duties were equalized.

BARK, in *Navigation*, a general name given to small ships; it is, however, peculiarly appropriated by seamen to those which carry three masts without a mizentopsail. Our northern mariners who are trained in the coal-trade apply this distinction to a broad-sterned ship which carries no ornamental figure on the stern or prow.

BARKER, ROBERT, the inventor of the modern panorama, and a painter by profession, was born at Kells, in Ireland, in 1740. The first picture of this kind was a view of Edinburgh, which was first exhibited by Mr Barker in that city in 1788. Barker died at London in 1806, having realized a considerable fortune by his invention.

BARKER'S MILL. See HYDRODYNAMICS.

BARKING, a market-town of England, county of Essex, 7 miles E.N.E. of London, on the river Roding, not far from the Thames. It was celebrated for its nunnery, one of the oldest and richest in England, founded about 670, the abbess of which was a baroness *ex officio*. The church of St Margaret is an ancient edifice of considerable beauty, with some curious monuments. It has also an ancient market-house and an embattled gateway. Pop. in 1851, 4930, principally engaged in fishing and the cultivation of vegetables for the London market.

BARLÆUS, or BAERLE, *Gaspar*, professor of philosophy at Amsterdam, and one of the best Latin poets of the seventeenth century, was born in 1584. There was scarcely any event of importance while he lived that was not celebrated by him, when reasons of state opposed no obstacle to it. He was a great defender of Arminius, and showed his abilities in history by his relation of what passed in Brazil during the government of Count Maurice of Nassau, published in 1647. He died in 1648.

BARLETTA, a fortified seaport town of Naples, province of Terra di Bari, 33 miles N.W. of Bari. Lat. 41. 19. 26. N. Long. 16. 18. 10. E. The town is well built and handsome, the houses large, and the streets wide and well paved. It has a fine Gothic cathedral with a lofty spire, a number of churches and convents, an orphan asylum, college, theatre, and a colossal statue of the Emperor Heraclius. The harbour is formed by a mole on which a lighthouse is erected, and it is commanded by the citadel. It is only capable of admitting small vessels, but has a considerable trade in grain, wine, oil, fruit, salt, &c. Pop. 20,000.

BARLEY. See AGRICULTURE and BREWING.

BARLEY-Corn is used to denote a measure, containing in length the third part of an inch. The French carpenters also use barley-corn, *grain d'orge*, as equivalent to a line, or the twelfth part of an inch.

BARLOW, FRANCIS, an English painter, born in Lincolnshire about 1626. On his coming to London he was placed with a portrait painter; but his genius led him chiefly to the drawing of birds, fishes, &c. There are six books of animals from his drawings; and he painted some ceilings with birds for noblemen and gentlemen in the country. His etchings are numerous, but his best work is his illustrations of Æsop. He died in 1702. There is something pleasing in the composition and manner of this painter, though neither is excellent. His drawing is indifferent, nor does he characterize any animal justly. His birds in general are better than his beasts. Barlow.

BARLOW, *Joel*, an American literary and political character of considerable note, was born in the year 1756, in the village of Reading, in Connecticut, the youngest of ten children. His father died when he was yet a boy; and he was sent to the college of Newhaven, in his native state, in 1774. In the course of the prescribed exercises of composition he discovered a taste for poetry, and two productions crept into public view, one entitled *The Prospect of Peace*; the other *An Elegy on the Death of Mr Hosmer*, member of the American congress. It appears that Mr Barlow was destined for the clerical profession; and that his friends solicited and obtained for him the appointment of chaplain to a militia company of Massachusetts, the functions of which he performed till the peace.

At the conclusion of peace between the United States and Great Britain, he abandoned the ecclesiastical life, and settled at the village of Hartford, where, two years afterwards, he published the poem entitled *The Vision of Columbus*.

After quitting the service of the church, he appears for some time to have practised law; but in 1788 he abandoned that profession likewise, and came to Europe as the agent of the Scioto Land Company, a fraudulent association, of whose real character and designs he was ignorant.

Having during this period become deeply interested by the events of the French revolution, he published, in the years 1791 and 1792, several political pieces of a republican character, and in 1793, from motives of curiosity, accompanied the four commissioners of the National Convention who were sent to Mont Blanc to organize that department.

Objects of a commercial nature at length drew him to Hamburg, and afterwards to the coast of Africa, where he received the commission of consul-general of the United States, with instructions to enter into and conclude treaties with the Barbary powers for the purpose of procuring the ransom of the American citizens who were detained as slaves in those countries. The execution of this commission was prompt and successful; and, after residing for some time in Paris, to which he returned from Barbary, he, in 1805, proceeded to America, and purchased a neat habitation in the territory of Columbia, the seat of the general government, to which he gave the name of *Kalorama*. Here he formed an acquaintance with certain influential members of Congress, to whom he greatly recommended himself by the publication of a short sketch of a plan of national education, and an address to the citizens of Washington upon occasion of one of the anniversaries of American independence. He now also published the superb quarto edition of his national poem, to which he finally gave the name of *The Columbiad*. Having returned to the United States, in 1811 he received the appointment of minister-plenipotentiary to the court of France. This nomination met with powerful opposition in the senate, and passed only by a small majority.

The great object of his mission was to obtain compensation for the American property confiscated in virtue of the Berlin and Milan decrees. This arrangement was to be regulated in a manner the least onerous to the French treasury. American ships and cargoes were, at the same time, to be freed from unjust detention, and a new commercial treaty was to be formed on principles of national justice and reciprocity.

Barlow ‖ Barmen.

In pursuit of this object he followed the Emperor Napoleon to Wilna in the memorable winter of 1812; but this diplomatic journey was without advantage, and the failure was the more mortifying, as it was undertaken without the advice or instructions of the American government. Mr Barlow was returning to Paris, when he was seized with a violent inflammatory disease, of which he died on the 26th of December, in the fifty-eighth year of his age; and was interred at Zarnowitch, an obscure village near Cracow.

BARLOW, *Thomas*, was born at Orton in Westmoreland, in 1607. He was appointed fellow of Queen's College, Oxford, in 1633, and two years after chosen reader of metaphysics to the university. He was keeper of the Bodleian library, and in 1657 was chosen provost of Queen's College. After the restoration of Charles II. he was nominated one of the commissioners for restoring the members unjustly expelled in 1648. He wrote at that time *The Case of Toleration in Matters of Religion*, to Mr R. Boyle. In 1675 he was made bishop of Lincoln. After the popish plot he published several tracts against the Roman Catholic religion, in which he showed an uncommon extent of learning, and skill in polemical divinity. Nevertheless, when the Duke of York was proclaimed king, with expressions of affection for His Majesty he veered towards popery; but after the Revolution he as readily voted that the king had abdicated his kingdom, and zealously excluded from their benefices such of the clergy as refused the oaths. He died at Buckden, in Huntingdonshire, on the 8th of October 1691, in the 85th year of his age.

BARLOW, *William*, bishop of Chichester, descended of an ancient family in Wales, was born in the county of Essex. In his youth he favoured the Reformation, and travelled into Germany to be instructed by Luther and other preachers of the new doctrine. He was one of those who, in the transition state of religious opinion in England, veered as the wind blew from the court. In early youth a Protestant, when lured by the possession of rich priories, he was a Papist. In consequence of the readiness with which he resigned these, he was a favourite with Henry VIII., who, in 1547, made him bishop of Bath and Wells. On the accession of Edward VI., he found it convenient to return to his first faith. When Mary succeeded to the crown, he was not prepared for another turn, and was consequently deprived of his bishopric, and imprisoned in the Fleet, where he continued for some time. At length he found means to escape, and joined the English Protestants in Germany. When Queen Elizabeth ascended the throne, he was raised to the see of Chichester, and soon after made first prebendary of the collegiate church of Westminster. He died in 1568, and was buried in the cathedral of Chichester. His five daughters were all married to bishops. He wrote a book upon *Cosmography*, and several other works.

BARLOW, *William*, an eminent mathematician and divine, the son of the bishop of Chichester, was born in Pembrokeshire, whilst his father was bishop of St David's. In 1560 he was entered a commoner of Baliol College, Oxford; and in 1564 took a degree in arts, after which he left the university and went to sea, but in what capacity is uncertain. While at sea he acquired considerable knowledge in the art of navigation. About the year 1573 he entered into orders, and became prebendary of Winchester, and rector of Easton, near that city, and in 1614 he was appointed archdeacon of Salisbury. He was the first English writer on the nature and properties of the magnet, on which he published several treatises. Barlow died in the year 1625, and was buried in the church at Easton.

BARM, or YEAST. See BAKING and BREWING.

BARMEN, a town of Rhenish Prussia, in the government of Dusseldorf, and circle of Elberfeld. It is a long straggling town, stretching along the northern valley of the Wupper, and is formed of the town of Gemarke and several villages. Its manufactures are very extensive, and similar to those of the contiguous town of Elberfeld; which see. Pop. in 1849, 35,984.

Barmouth ‖ Barnard-Castle.

BARMOUTH, a small market-town in the county of Merioneth, North Wales. It is the only port in that division of the Welsh coast, and is much frequented in the summer as a bathing-place. The picturesque scenery in the neighbourhood largely contributes to its attractions.

BARNABAS, ST, one of the earliest apostles of Christianity, was born in Cyprus, and descended of the tribe of Levi. His proper name was *Joses* or *Joseph*, to which, after his conversion to Christianity, the apostles added that of *Barnabas*, signifying either "the son of prophecy" or "the son of consolation." He was educated at Jerusalem under Gamaliel. The time of his conversion is uncertain; but he is generally supposed to have been one of the seventy disciples chosen by our Saviour himself.

At Antioch Paul and Barnabas, in consequence of differing about the propriety of taking with them Mark as their minister on their second evangelizing journey, separated. The subsequent travels and acts of Barnabas are not related in the Acts of the Apostles. Some say that he went into Italy and founded a church at Milan. It is generally believed that he suffered martyrdom at Salamis, where some Jews from Syria set upon him as he was disputing in the synagogue, and stoned him to death. He was buried in a cave near that city by his kinsman Mark, whom he had taken along with him. The remains of his body are said to have been discovered in the reign of the Emperor Zeno, together with a copy of St Matthew's Gospel, written with his own hand, and lying on his breast. The festival of St Barnabas is celebrated on the 11th of June.

BARNABAS, Epistle of, an apocryphal work ascribed to Barnabas, and frequently cited by Clement of Alexandria and by Origen. It was first published in Greek, from a copy of Father Hugo Ménard, a Benedictine monk. An ancient version of it, nearly a thousand years old, was found in a manuscript of the abbey of Corbey. Vossius published it in the year 1646, together with the epistles of St Ignatius; and it has been several times reprinted.

BARNABAS, Gospel of, an apocryphal work ascribed to Barnabas, wherein the history of Jesus Christ is related in a manner very different from the account given us by the four evangelists. The Mahometans possess this gospel in Arabic, and it corresponds very well with those traditions which Mahomet followed in his Koran. It was probably a forgery of some nominal Christians, and afterwards altered and interpolated by the Mahometans, the better to serve their purpose. It has been translated into Italian, Spanish, and English.

BARNABITES, a religious order founded in the sixteenth century by three Italian gentlemen who had been advised by a famous preacher of those days to read carefully the epistles of St Paul. Hence they were called *Clerks of St Paul*, and also *Barnabites*, because they performed their first exercise in a church of St Barnabas at Milan. Their habit was black, and their office to instruct, catechize, and serve in mission.

BARNACLE. See BERNICLE.

BARNACLES, in *Farriery*, an instrument, composed of two branches joined at one end with a hinge, to put upon a horse's nose when he will not stand quietly to be shod, bled, or dressed.

BARNARD-CASTLE, a market-town in the parish of Gainford and Darlington Ward, county of Durham, 247 miles from London, on the banks of the Tees. The corn-market, which is one of the largest in the north of England, is held on Wednesday. The town consists chiefly of one long and spacious street, the chief ornament of which is a handsome octagonal market-cross. Its principal manufactures are carpets and thread. Pop. in 1851, 4357. This

Barhaul || Barnstaple.

town derives its name from a castle founded about the year 1180 by Barnard Baliol, an ancestor of the competitor with Bruce for the Scottish crown. The remains of the castle extend over a space of more than six acres.

BARNAUL, a mining town of Siberia, situated on a river of the same name, near its junction with the Obi. It is the capital of an extensive mining district, and the seat of a board of administration. Large quantities of gold, silver, copper, and iron ores are smelted here. Pop. about 10,000.

BARNES, JOSHUA, an eminent English scholar, was born about the middle of the seventeenth century. In 1695 he was chosen queen's professor of Greek, a language which he wrote and spoke with the utmost facility. His first publication was a whimsical tract entitled *Gerania*, or a new discovery of the little sort of people called Pygmies. He also wrote a *Life of Edward III.*, in which he introduces his hero making long and elaborate speeches, besides several other books, particularly *Sacred Poems;* the *Life of Oliver Cromwell the Tyrant*; some dramatic pieces; a poetical paraphrase on the history of Esther, in Greek verse, with a Latin translation, &c. He also published editions of Euripides, Anacreon, and Homer's Illiad and Odyssey, with notes and a Latin translation. He wrote with even greater facility in Greek than in English, and yet he is generally allowed not to have understood the niceties of that language. He died in 1712, in the 58th year of his age.

BARNET, or CHIPPING BARNET, a market-town in the hundred of Caisho, and county of Hertford, 11 miles from London, on the great northern road. Near it, in 1471, was fought the decisive battle between the houses of York and Lancaster, in which the great Earl of Warwick fell. The market, held on Monday, is large; as it has great cattle fairs. Pop. of parish in 1851, 2380.

BARNEVELDT, JAN D'OLDEN, a celebrated Dutch statesman, and one of the founders of the civil liberty of Holland, was born at Amersfoort in 1547. His patriotic zeal having led him to limit the authority of Maurice Prince of Orange, the second stadtholder of Holland, the partisans of that prince falsely accused him of a design to deliver his country into the hands of the Spanish monarch. On this absurd charge he was tried by 26 commissaries deputed from the Seven Provinces, condemned, and beheaded at the Hague in 1619. His sons, William and Réné, with the view of avenging their father's death, formed a conspiracy against the stadtholder, which was discovered. William fled, but Réné was taken and condemned to die; which fatal circumstance has immortalized the memory of his mother, of whom the following anecdote is recorded. She solicited a pardon for Réné; upon which Maurice expressed his surprise that she should do that for her son which she had neglected for her husband. To this remark she replied with indignation, "I would not ask a pardon for my husband, because he was innocent; I solicit it for my son because he is guilty."

BARNSLEY, or BLACK BARNSLEY, a town in the parish of Silkstone, of the wapentake of Staincross, in the West Riding of Yorkshire, 171 miles from London. It formerly had considerable manufactures in iron, but it has of late years become the seat of extensive factories of linen and other cloth. The trade has been greatly increased in consequence of the extension of canal navigation, which connects the town with Wakefield, and the other canals and navigable rivers which unite at that place. There is a large market every Wednesday for cattle and corn. Pop. in 1851, 13,437.

BARNSTAPLE, a market, seaport, and borough town of England, county of Devon, 34 miles N.W. of Exeter. It is a handsome and well-built town, standing on the river Taw, 6 miles from its mouth. This stream, which is only navigable for small craft, is here crossed by an ancient stone bridge of 16 arches. The town was incorporated in the reign of Henry I., and is governed by a mayor, 6 aldermen, and 18 councillors. It has returned two members to parliament since the time of Edward I. The woollen trade, for which it was once famous, has now much declined; but it has extensive potteries and tanneries, &c. The public buildings and institutions include a large church, guildhall, theatre, free grammar school, mechanics' institute, national and charity schools, an infirmary, and dispensary. The poet Gay was born in the vicinity, and received his education at the grammar school here. Pop. in 1851, 11,371.

Barnstaple || Baroco.

BARNSTAPLE, a seaport town, and capital of the county of the same name, in the state of Massachusetts, North America. It is situated on the south side of a bay of the same name, which opens into Cape Cod Bay. In 1848 it had 64,309 tons of shipping, of which about 30,000 tons were employed in the coasting trade, and about 16,000 in the cod and mackerel fisheries. Pop. 4301.

BARO, or BARON, PETER, professor of divinity in the university of Cambridge in the sixteenth century, was born at Estampes, in France, and educated in the university of Bourges, where he was admitted a licentiate in the law; but being of the Protestant religion, he was obliged to leave his native country in order to avoid persecution. After residing some time at Geneva, he came to England, and was kindly received by Lord Burleigh. He afterwards settled at Cambridge, and, by the recommendation of his noble patron, in 1574 was chosen Lady Margaret's professor there. For some years he enjoyed his professorship in quiet; but a restless faction was at last raised against him by his opposing the doctrine of absolute predestination; and this rendered his situation so uncomfortable that he chose to leave the university and settle in London. He wrote *In Jonam Prophetam Prælectiones xxxix.; De Præstantia et Dignitate Divinæ Legis;* and some other treatises. He died in London about the year 1600.

BAROCCHIO, or BAROZZI, *Giacomo da Vignola*, a celebrated architect, born at Vignola, in the Modenese territory, in 1507. He succeeded Michael Angelo as the architect of St Peter's, and executed various portions of that fabric, besides a variety of works in Rome and other parts of Italy. He is the author of an excellent work on the *Five Orders of Architecture*. His character as a man was worthy of his genius; for to his extensive acquirements and exquisite taste was superadded an amenity of manners and disposition, and a noble generosity, that won the affection and admiration of all who knew him. Da Vignola died in 1573, at the age of sixty-six.

BAROCCI, or BAROCCIO, FREDERIGO, a celebrated painter, born at Urbino, where the genius of Raphael inspired him. In his early youth he travelled to Rome, where he painted in fresco. He then returned to Urbino, and giving himself up to intense study, acquired great fame as a painter, particularly of religious subjects. He also etched from his own designs a few prints, which are highly finished, and executed with great softness and delicacy. He died a Urbino in 1612, aged 84.

BAROCO, in the *Old Logic*, a term given to the fourth mode of the second figure of syllogisms. A syllogism in baroco has the first proposition a universal affirmative, but the second and third particular negatives, and the middle term is the predicate in the first two propositions. For example,

Nullus homo non est bipes:
Non omne animal est bipes:
Non omne animal est homo.

BAROMETER.

Barometer. Our dictionaries contain such an account of the discovery and construction of this most valuable instrument, as can be drawn from the popular treatises of natural philosophy in the English language. But, unfortunately, the compilers of elementary works have seldom taken the trouble to remount to the original sources of information, and have frequently, by substituting their own fancies, or servilely copying the mistakes of others, contrived to disfigure egregiously the relation of facts, and the history of the progress of invention. We purpose, therefore, as far as our limits will admit, to discuss the subject with more careful research; but, passing rather lightly over the description of the different kinds of barometers and other practical details, to dwell more especially on the successive steps which led to the fine discovery of atmospheric pressure and its application to physical science.

Opinions of the ancients; The opinions entertained by the ancients concerning physical subjects appear at best only splendid visions. They speculated boldly in cosmological theories, but were easily satisfied with those conclusions which merely soothe the fancy. Many of the philosophical notions adopted in remote ages have, however, left a durable impression in the structure of language, and still continue to exercise a visible influence in moulding the current sentiments of mankind. The early sages of Greece distinguished matter into the four primary elements, of *earth*, *water*, *air*, and *fire*, which, by their various combinations, were supposed to produce the animated spectacle of the universe. With these elements were associated corresponding qualities, in a binary conjunction; *hot* and *cold*, *dry* and *moist*. *Earth* and *water* were considered as ponderous and inert; but *air* and *fire*, endued with elastic virtue, were imagined to possess lightness and activity. *Fire*, though extracted from all bodies by the operations of nature or of art, was yet conceived to be derived, by invisible emanation, from that diffuse lambent fluid which, under the name of *Æther*, occupied the highest heavens, and furnished the substance and nutriment of the celestial bodies. While the earthy matter would, therefore, naturally settle towards the centre, and the aqueous fluids roll along the surface of the solid globe, the air and fire soared aloft; the former occupying the whole of the region below the moon, and the latter streaming through the boundless extent of space. This *sublunary* scene is exposed to incessant change, calamity, and decay; but above it was supposed to reign a perpetual calm, the seat of bliss, and of divine and imperishable essence.

Aristotle and some other philosophers, viewing *æther* as altogether distinct from *culinary fire*, were disposed to consider it as a *fifth* element, of a pure, divine, and incor-
and of the schoolmen. ruptible nature; an opinion which afterwards gave occasion to the famous *Quinta Essentia*, or *Quintessence* of the schoolmen. The alchemists, who sprung up nearly about the same benighted period, in adopting these notions, modified them to suit their own peculiar views. To the elements commonly received, they joined the active auxiliaries of *mercury* and *sulphur*. For *quintessence* they substituted *spirit* and *elixir*; the former, drawn off by the application of fire, being conceived to represent the animating principle of each body; while the latter, extracted by the combined action of heat and moisture, was supposed to exhibit its concentrated and most select qualities.

Some of the ancient cosmologists imagined a vacuum beyond the shining expanse of æther, destined to receive the exhalations from this nether world. Others denied Barometer.
the existence of a separate void, but admitted small vacuities interspersed through bodies. Aristotle, however, Physical
maintained the necessity of a plenum, asserting that our tenets of
idea of space or extension is inseparable from that of Aristotle.
body. To this principle he ascribed the suspension of water in a tube, when the finger is applied to shut the upper end. Yet the very contempt in which that philosopher, from a consciousness of his own superiority, was accustomed to hold the received opinions, might have led him to take juster views. He rejected the notion that air has levity inherent in its nature; nor would he admit the more plausible idea, that a fluid so easily moved must possess the quality of perfect indifference, and be neither light nor heavy. Aristotle not only maintained that air is ponderous, but did not scruple to appeal to direct experiment in support of this assertion. A bladder, he says, will be found to gain some weight, on being blown or filled with air. But this was evidently a mere random assertion, betraying his ignorance of the constitution of fluids. A bag filled with air, and suspended in a like medium, it is obvious, from the laws of hydrostatics, must weigh exactly the same as before. If it be alleged that, in blowing up the bladder, a portion of air would be introduced immediately from the lungs, and containing therefore a small admixture of carbonic acid gas, which is specifically heavier than the common atmospheric fluid; the additional weight, amounting scarcely perhaps to a grain, would be too minute to be detected by any of the jewellers' balances constructed in ancient Greece.

The mutual opposition of the leading philosophical sects of antiquity had, in general, most fatally discouraged the application of mathematical reasoning to the system of the material world. The Academicians, or the disciples of Plato, who cultivated geometry with ardour and brilliant success, were disposed to regard that science as a pure intellectual contemplation; and resigning themselves to the illusion of their lofty dreams, they turned with disdain from the investigation of individual facts and all the vulgar realities of life. The mind of Aristotle was of a more sober and practical cast; acute, profound, and discriminating, it ranged with incredible industry over an immense field of inquiry. That judicious philosopher recommended a careful and constant appeal to external observation, as the only sure ground on which to erect the structure of physics; but unfortunately his scholars neglected too much the study of mathematics, the most powerful instrument for conducting physical research. The precepts of Aristotle, though excellent in some respects, were hence in the sequel unproductive of any genuine fruit. On the contrary, the weight of his opinions, during a long course of ages, repressed the efforts of human genius.

It must be gratefully acknowledged, that the alche- Modern
mists, styled also *philosophers by fire*, were the first among experi-
the moderns who dared to explore new paths of science. mentalists
Their projects were, indeed, highly chimerical, but they had the merit at least of setting the example of investigating the properties of matter by actual experiment. They likewise formed associations among individuals for the more effectual prosecution of such researches. Hence the origin of that obscure sect known by the fanciful title of *Rosicrucians*, who sprung up in Germany, and insensibly spread their influence over the Continent. Those principles were afterwards transplanted into the matured

Barometer. soil of Italy, where philosophy, succeeding to the cultivation of letters, wore a more attractive garb. Baptista Porta, a Neapolitan nobleman, who flourished about the latter part of the sixteenth century, was particularly distinguished by his zeal in promoting such pursuits. Having spent many years in travelling over Europe to gain information respecting natural objects, he invited a few individuals of a congenial taste to assemble at stated times in his house, and assist him in making new experiments. These meetings, however, gave umbrage to the watchful jealousy of the clergy, and they were soon suppressed by a mandate from the court of Rome. But the example was imitated in other parts of Italy, where the papal authority enjoyed less respect; and academies for the promotion of natural science were successfully instituted under the patronage of different princes, especially those of the illustrious house of Medici.

Galileo. In this ferment of inquiry, Galileo arose, a man fitted alike by the gifts of nature and the lights of education to be the founder of experimental science. His elegant genius was invigorated by the study of the Greek geometry; and he conceived the happy and prolific idea of employing that refined instrument to explore facts and combine the results. Archimedes, indeed, among the ancients, had anticipated this road of discovery, having most successfully applied the powers of geometrical analysis to the investigation of some parts of mechanics and hydrostatics. But his was a solitary instance, unheeded by succeeding ages. The ingenuity of Galileo prepared a complete revolution in science. By means of a few simple but striking experiments performed on the lagoons of Venice, he established the laws of motion, which he now transferred from the surface of our globe, to direct the revolutions of the heavenly bodies. The publication of his *Dialogues*, which unfold the right process of induction, and are not less distinguished by fineness of conception than beauty of diction, forms a new era in the annals of philosophy. He was the first who attempted to ascertain the weight of air by actual experiment; and considering the nicety of the operation, and the rudeness of the instruments constructed at that period, he made a very tolerable approach to the truth. It had been known for many ages that air is capable of being highly condensed; and Ctesebius of Alexandria had invented an engine, which, by the force of the sudden expansion of this compressed fluid, hurled missile weapons. This was afterwards improved into the wind or air-gun, which seems to have been not uncommon in Europe as early as the fifteenth century, though soon afterwards generally superseded in practice by the introduction of fire-arms. Galileo, being led by a different path from that pursued at present, set himself to examine the weight which air acquires by condensation. Having fitted a large copper ball with a valve, he injected air into its cavity by means of a syringe, and then suspended it to a balance. The additional increase of weight being thus found, he opened the valve under an inverted glass receiver full of water, and measured, by the displacement of this liquid, the surplus quantity of air which had been injected into the copper vessel.[1] He thence concluded that air is 400 times lighter than water, being about the double of the true estimate; an error probably arising from some imperfection of the valve that confined the air within the ball. Barometer.

After he had, by such researches, acquired celebrity in the scientific world, Galileo accepted an invitation, with a very handsome appointment, from Cosmo de' Medici; and devoting himself intensely to astronomical observations, aided by the telescope, which, from an obscure hint, he had recently constructed, yet occasionally unbending his mind with elegant recreation, he spent almost the whole of the evening of his life at the villa of Arcetri, near Florence, in a style of comfort and even splendour. But, while occupied with those delightful pursuits, exploring the planetary phases, and discovering new worlds, he was for a moment recalled to his early studies by an incident destined to form an epoch in the history of physical science. Some artisans, in the service of the grand duke, having been employed to construct a lifting or sucking pump for a very deep well, found, with equal surprise and vexation, that, in spite of all the pains they had taken in fitting the piston and valves, the water could by no effort be made to rise higher in the barrel than eighteen palms, or thirty-two feet. In this dilemma they applied to Galileo for an explication of the cause of a failure then so unexpected and perplexing. But the philosopher was not yet prepared to encounter such a discordant fact. The Aristotelian tenet of the impossibility of the existence of a void, was, at this period, universally received as an unquestionable truth. It had become a favourite axiom of the schoolmen, deceiving themselves, as Leibnitz did afterwards in proposing his principle of *sufficient reason*, by the glimmer of a metaphorical expression, the *fuga vacui*, or *nature's horror of a void*. To create a vacuum, they gravely maintained, would require the hand of Omnipotence, transcending the utmost power of men or even devils. But Galileo, though borne along by the current of opinion, saw the necessity of at least modifying the general principle. Without questioning nature's abhorrence of a vacuum, he supposed the influence of this horror to be confined within certain limits, not exceeding the pressure of a column of water eighteen palms in height. This was evidently evading, rather than meeting, the difficulty proposed for his solution. Yet, in the last of his Dialogues, he actually mentions an experiment to ascertain this power, or *virtù*, as he calls it, of a vacuum. A piston with a valve, exactly fitted into a smooth hollow cylinder, was rammed quite to the end, and this carefully shut up; then placing the cylinder in an upright but inverted position, successive weights were appended to the rod, till it was drawn from the close end, and pulled down. It may seem strange that the Tuscan philosopher, after advancing so far, should have stopt on the verge of a great discovery. He had already weighed the air, and it was only another small step thence to infer the effect of its incumbent mass. But the atmosphere was still believed to reach to the moon, and the pressure of columns of such enormous altitude seemed to mock all calculation, and overwhelm the imagination.[2] Yet, on reconsidering the subject, Galileo began to suspect the solidity of the explication which he had given; but it was now too late for

Incidental failure of a sucking pump.

Timid and imperfect explication of Galileo.

[1] From this remarkable experiment it is easy to perceive that Galileo was really the inventor of our pneumatic apparatus, though his title has been so long overlooked by chemists.

[2] This narrative, which marks so well the slow and timid steps whereby men, even of the highest intellectual endowments, usually advance in the search after truth, is drawn from the writings of Galileo himself. The carelessness of some authors in mis-stating facts, and imputing unworthy motives to those patriarchs of science who could not open their eyes all at once to the bright effulgence of day, deserves severe reprehension. We may remark, in passing, that M. Biot, who ranks among the first mathematicians and philosophers in France, has not scrupled, in an elaborate compilation on physics, to allege that Galileo merely joked with the artisans who asked him the reason of the failure of their pump; that he had an idea of the true explication, but chose to keep his secret, and suffer it to die with him. Such conduct would certainly have been a reproach to Galileo's acknowledged candour.

Barometer. him, in his advanced age, loaded with bodily infirmities, and dispirited by clerical persecution, to attempt any further innovation in science. Recommending it earnestly to his friend and pupil Torricelli to resume the investigation, this illustrious precursor of Newton expired in 1642, the very year in which the English philosopher was born. His uniform kindness and urbanity rendered him extremely beloved; and his disciples, particularly Torricelli, Viviani, and Ricci, venerating his memory, caught the same taste, and followed similar pursuits.

Torricelli's famous experiment.

Torricelli now conceived the happy idea of exhibiting the action of a pump on a contracted scale, by means of a column of mercury, which is nearly fourteen times heavier than water. This experiment he first communicated to his friend Viviani, who performed it with success in 1643; and he afterwards repeated and varied it himself. The method which he adopted brought very neatly under one view all the circumstances affecting the question. Having selected a tube about a quarter of an inch wide, and four feet long, he sealed one of the ends hermetically, or closed it under the flame of a lamp; he then filled the cavity of the tube with mercury, and applying his finger to the open end, he inverted it in a basin likewise containing mercury, though covered with a portion of water. The mercury instantly sunk to nearly thirty inches above the lower surface; but on raising the tube, till its orifice communicated with the layer of water, the mercury ran all out, and the water now sprung up to the top, and occupied the whole of the cavity. It was thus proved, that the water and mercury are each supported by the same equipoise, which Torricelli, after some hesitation, at last concluded to be the pressure of the external atmosphere. He next converted the mercurial column into a form adapted for observation, by bending the lower end of the tube, and constructing what has since received the name of the *siphon barometer*. (See fig. 1. Plate CIV.) Thus provided with a commodious instrument, he soon detected the variation of atmospheric pressure, which depends on the change of weather. These important results were published in the year 1645; but Torricelli did not live to enjoy the fame of his great discovery, for this most promising genius was snatched away by a putrid fever in the flower of his age.

The report of Torricelli's first experiments having been carried to France before he had ventured to draw his capital conclusion, set philosophers to speculate on the cause of such an unexpected fact. Descartes, with his usual rapidity and boldness of conception, did not hesitate, in his correspondence with Mersenne, to refer the suspension of the mercury in the tube at once to the pressure of the external atmosphere. But this inference appears not very consistent with his system, which assumed the existence of an absolute plenum, and only supplied the place of a void by the diffusion of subtile abraded particles of matter. He suspected, besides, the accuracy of Galileo's estimate of the weight of the air, which he thought could be scarcely appreciable by experiment.

Pascal's experiments.

But, in the same country, the subject was now pursued with deliberate caution, and through all its details, by another genius of the highest order; one of the finest and most original that France has ever produced. Pascal had shown premature and extraordinary talents, which were encouraged by his father, a man of learning, who lived in habits of intimacy with the literati of Paris. The young philosopher happened to be residing at Rouen, in 1646, when he was informed of the famous Italian experiment. Having access, fortunately, to a glass-house, he resolved immediately to repeat the observations on a large scale. He had already suspected the justness of the principle, that "nature abhors a vacuum," and thought that the condensation and rarefaction of the air point to a different, or at least a modified conclusion. With a view to clear up this subject, Pascal performed a number of satisfactory experiments, of which we shall cite a few of the more striking, nearly in his own language, tinctured evidently with the prevailing opinions of the age:—1. Having fitted a piston to an open glass tube, and rammed it quite down, he applied his finger close to the lower end, and plunged the whole under water; then drawing back the piston, which was done with ease, the finger felt strongly and rather painfully *attracted*, while an *apparent vacuity* was formed above it, and continued to enlarge; but instantly on removing the finger, the water, *contrary to its nature*, darted up and filled the whole of the cavity. 2. A glass tube, about fifty feet long, sealed hermetically at one end, and filled with water, or rather red wine, as a more visible fluid, was inverted perpendicularly in a basin of the same. The liquid immediately subsided, leaving a vacant space of thirty-five feet; but on gradually reclining the tube the liquid rose again, and continued to mount till it struck a sharp blow against the top of the glass. 3. A siphon, having one leg fifty-five feet high, and the other only fifty, being filled with water, and planted in two basins containing the same, such that the shorter branch had a perpendicular position, the water sunk in both to the same level, without being *attracted*, as usual in siphons, to the longer branch; but, on leaning the siphon back the columns rose till they united at the top, and then the water began to flow towards the lower basin. The same experiment was also performed with mercury, the siphon having one leg ten feet, and the other only nine feet and a half in length, the mercury being found to divide itself into two columns, which continued suspended at an altitude of about thirty inches. 4. Having nicely fitted a piston to a long glass syringe, and pushed it down to the end, he immersed this in a basin of mercury, and held the tube in a vertical position; on gently drawing up the piston, the mercury closely followed it to the height of twenty-nine inches, but then stopt, leaving the piston to form above it an apparent vacuity. In this state, also, the syringe weighed exactly the same, whatever was the magnitude of the vacant space.

His cautious induction.

From these and other similar experiments, Pascal led his inductive process, with a degree of caution that might seem to border on timidity. He inferred that all bodies have a *reluctance* to a visible separation, or that nature abhors an apparent void; that this reluctance is exactly the same for a small as for a great vacuity; and that the force is limited, and exceeds not the pressure of a column of water thirty-three feet in height. He next ventured one step farther, and concluded, that this apparent vacuity was not filled by air lodged in the pores of the glass, or derived from external filtration; that it contained no subtile matter secreted from the atmosphere, and was not occupied by mercurial vapours or spiritous exhalations; in short, that a real and absolute vacuum had been formed.

Attacked by Noël.

Pascal, then only twenty-four years of age, proposed to write a treatise on the subject of those inquiries; but thought proper, in the mean time, to publish a short abstract of it, which appeared in 1647, and involved him in a wretched controversy. Father Noël, rector of the Jesuits' College at Paris, keenly attacked it, armed with all the miserable sophisms of the schools, and the absurd dogmas of the Romish church. He contended, that the space above the mercurial column was corporeal, because it was visible and admitted light; that a void being a mere non-entity, cannot have different degrees of magnitude; that the separation produced in the experiments was violent and unnatural; and he presupposed that the atmosphere, like blood, containing a mixture of the seve-

Barometer. ral elements, the fire and the finer part of the air were detached from it, and violently forced through the pores of the glass, to occupy the deserted space. To enforce these puerile arguments, the reverend prelate did not scruple to employ the poisoned weapon which his order has often wielded with deadly effect, namely, hinting an oblique charge of heresy. This rude attack only roused Pascal, and disposed him boldly to throw off the fetters of inveterate opinion. He began to perceive that "*abhorrence*" cannot, in strict logic, be applied to nature, which is a mere personification, and incapable of passion; and was inclined, by degrees, to adopt the clear disembarrassed explication of Torricelli, referring the suspension of the mercurial column to the pressure of the external atmosphere. In stating this conclusion, he makes some remarks which would deserve the serious attention of philosophers in the present age. "When the weakness of men is unable to find out the true causes of phenomena, they are apt to employ their subtilty in substituting imaginary ones, which they express by specious names that fill the ear, without satisfying the judgment. It is thus that the sympathy and antipathy of natural bodies are asserted to be the efficient and unequivocal causes of several effects, as if inanimate substances were really capable of sympathy and antipathy. The same thing may be said of the antiperistasis, and various other chimerical causes, which afford only a vain relief to the avidity of men to know hidden truths, and which, far from discovering them, only serve to conceal the ignorance of those who invent such explications, and nourish it in their followers." These remarks, equally judicious and profound, are the more striking, since Lord Bacon, while he proposed to reform and new-model the whole structure of human learning, yet complied with the taste of his age in retaining much of the jargon and barbarous distinctions of the schools.

Pascal's decisive experiment.

But Pascal did not rest satisfied with mere reasoning, however strictly conducted; and he soon devised an experiment which should palpably mark, under different circumstances, the varying effects of atmospheric pressure. It occurred to him, that, if the mercury in the Torricellian tube were really supported by the counterpoising weight of the atmosphere, it would be affected by the mass of superincumbent fluid, and must therefore partially subside in the higher elevations. He was impatient to have his conjecture tried in a favourable situation; and, in November 1647, he wrote a letter communicating those views to his brother-in-law, Perier, who held an office of considerable trust in the province, and commonly resided at Clermont in Auvergne, in the immediate vicinity of the Puy de Dôme, a lofty conical mountain, which rose, according to estimation, above the altitude of 500 toises. Various avocations, however, prevented that intelligent person from complying with his instructions till the following year. Early in the morning of the 19th September 1648, a few curious friends joined him in the garden of a monastery, situated near the lowest part of the city of Clermont, where he had brought a quantity of mercury, and two glass tubes hermetically sealed at the top. These he filled and inverted, as usual, and found the mercury to stand in both at the same height, namely, 26 inches and $3\frac{3}{4}$ lines, or 28 English inches. Leaving one of the tubes behind, in the custody of the subprior, he proceeded with the other to the summit of the mountain, and repeated the experiment, when his party were surprised and delighted to see the mercury sink more than three inches under the former mark, and remain suspended at the height of 23 inches and 2 lines, or 24·7 English inches. In his descent from the mountain, he observed, at two several stations, that the mercury successively rose; and, on his return to the monastery, he found it stood exactly at the same point as at first. Encouraged by the success of this memorable experiment, Perier repeated it on the highest tower of Clermont, and noted a difference of two lines at an elevation of twenty toises. Pascal, on his part, as soon as the intelligence reached him at Paris, where he then chanced to be, made similar observations on the top of a high house, and in the belfry of the church of St Jacques des Boucheries, near the border of the Seine; and so much was he satisfied with the results, that he proposed already the application of the barometer for measuring the relative altitudes of distant places on the surface of the globe. Barometer.

The investigation of the existence and effects of atmospheric pressure was now completed, and it threw a sudden blaze over the whole contexture of physical science. The fame of the experiments performed in Italy and in France, quickly spread over Europe. Yet such is the force of habit and early prejudice, that, after the first moments of surprise and confusion, few of the learned at this period had the courage to open their eyes to the light which had so unexpectedly burst upon them; but, secretly cherishing their inveterate notions, they sought to comfort themselves by starting a variety of captious objections. Father Mersenne, though a man of some abilities, conceived that suction was occasioned by certain hooked particles dispersed through the atmosphere, which laid hold of any fluid in contact with them, and drew it towards the general mass. Father Linus, plunging still deeper in mysticism and absurdity, gravely proposed the *funicular hypothesis*, which attributes the suspension of the mercurial column to the agency of certain small invisible threads. But others of the clergy attacked Pascal with envenomed bitterness. The Jesuits of the college of Montserrand scrupled not, in their public theses, to pervert his expressions, and even contest the originality of his experiments. The philosopher was justly incensed at their base conduct; and those repeated provocations served, no doubt, to give a keener edge to his wit, when he afterwards directed it with such overwhelming force against that insidious and formidable order of priesthood. He composed in 1653, though they were not published till after his death, two short treatises, *On the Equilibrium of Liquors*, and *On the Weight of the Mass of Air*, remarkable for their neatness, perspicuity, and lucid order. The laws of the equilibrium of fluids are there beautifully deduced from a single principle, which suggests a variety of original views and admirable remarks. In those tracts he likewise gives a description of the Hydraulic Press, a most useful and powerful machine, which has lately been revived in this country, and by some considered as a new invention. Opposition which it experienced.

A similar discovery, which was made about the same time in Germany, came seasonably to support the triumph of innovation. Otto Güricke, a wealthy magistrate of Magdeburg, who amused his leisure by constructing pieces of mechanism, and instituting curious physical inquiries, finding that the belief in the impossibility of a vacuum, with other scholastic tenets, was on the gradual decline, had the boldness to conceive that the forming of a void was a task perhaps within the reach of human ingenuity. Fired with the idea of accomplishing what for ages had been deemed unattainable, he directed all his efforts to compass that end. In his first trials he failed, as might be expected; but, by perseverance, he was enabled to surmount every obstacle. Having filled a wooden cask with water, he attempted to extract this again, by means of a small sucking pump, introduced at the bottom of the cask, and worked vigorously by three stout men; a hissing noise was heard like that of boiling Discovery of the air-pump by Güricke.

Barometer. water, the air entered from above through the interstices of the wood, and the water flowed out. The more effectually to exclude the air, he next took a smaller cask, with a sucker attached to it, and placed it within a larger one, having filled up the space between them with water. On working the pump as before, the water was forced through the pores of the wood into the inner cask, but none was extracted by the action of the piston. Foiled in these attempts with wooden casks, he had recourse to a copper ball, to the under part of which he screwed an inclining sucker; and, with this apparatus, he at last succeeded in extracting the air. He continued the operation, till no further portion of air was perceived to issue from the vent. On opening the cock again, the air rushed into the cavity of the ball with violence; and the same effect took place, with scarcely any diminution of power, after an interval of a day or two. The construction of the machine was afterwards rendered more perfect, by substituting a large inclined metal sucker, with its joints secured by immersion in water.

Such was the origin of that most valuable addition to philosophical apparatus, the air-pump, which long retained its earliest rude and simple form on the Continent. By help of this new and powerful instrument, Gürické was enabled to perform some interesting and very important experiments. One of these, which demonstrates in a very striking way the pressure of the atmosphere, has since been deservedly styled the Magdeburg Experiment. It was performed with two hollow copper hemispheres, closely fitted together, and the air exhausted from their cavity. This singular experiment Gürické had the honour of exhibiting, in the year 1654, before the princes of the empire and the foreign ministers, assembled at the diet of Ratisbon. The force of two teams, each consisting of a dozen of horses, made to pull in opposite directions, was found insufficient to separate the hemispheres. It was now that the burgomaster of Magdeburg heard, for the first time, of Torricelli's great discovery, and the intelligence must have appeared quite delightful to him, who, by a path so different, had yet arrived at a similar conclusion.

After his return from this splendid assembly, Gürické pursued at home various pneumatical researches. He showed the diminished pressure of the atmosphere at an elevation above the surface, by means of a hollow ball fitted with a stop-cock; having carried this to a height, a portion of the contained air rushed out on turning the cock; but when it was brought down again and opened, the same measure of air apparently flowed into its cavity. He actually weighed the air by ascertaining, with the help of a nice balance, the loss which a large bottle sustained on being exhausted, and found that the air is 970 times lighter than water; a very near approximation, if allowance be made for the residuum of air still left in the bottle. He was the first who proposed the *Statical Balance* for measuring the variations of atmospheric density, consisting of a hollow glass ball about a foot in diameter, hermetically sealed, and freely suspended in the air, to indicate by its different buoyancy the changes which take place in the gravity of the external fluid.

Statical balance.

But Gürické took great pleasure in a huge water barometer erected in his house.[1] It consisted of a tube above thirty feet high, rising along the wall, and terminated by a tall and rather wide tube hermetically sealed, containing a toy, of the shape of a man. The whole being filled with water, and set in a basin in the ground, the column of liquid settled to the proper altitude, and left the toy floating on its surface; but all the lower part of the tube being concealed under the wainscoting, the little image, or weather-mannikin, as he was called, made its appearance only when raised up into view in fine weather. This whimsical contrivance, which received the name of *anemoscope*, or *semper vivum*, excited among the populace vast admiration; and the worthy magistrate was in consequence shrewdly suspected by his townsmen of being too familiar with the powers of darkness.

Barometer

Anemoscope.

Before the taste for experimental science was imported from the Continent into England, the great struggle for the security of public rights had called forth the national energy, and its triumphant success had infused among all classes of men a spirit of boldness and enterprise most favourable to the reception of the new philosophy. The parliamentary commissioners, by removing the more violent and bigoted members of the universities, contributed, on the whole, to encourage a more liberal tone of thinking in those opulent seminaries. Near the close of the civil war, and during the vigorous administration of Cromwell, the philosophy by experiment found some proselytes at last in the cloisters of Oxford, where the mass of antiquated opinions had lain so long embalmed and protected by religious awe. A small association was there formed, for combining together the efforts of individuals in the prosecution of such inquiries; and the fruits of this mutual compact were afterwards visible in the composition of various philosophical works. But the Restoration, by which the nation, in a burst of inconsiderate loyalty, surrendered the privileges which it had purchased with torrents of blood, threw the government of the universities again into the hands of men decidedly hostile to the very shadow of improvement. Experimental science withdrew to a more congenial soil, and sought shelter and support in the wider scope of the capital. The college, founded by the munificence of Sir Thomas Gresham, for the benefit of the citizens of London, though now unfortunately sunk in absolute neglect, had the merit of being the first to extend its protection to the pursuits of inductive philosophy. It produced a succession of professors, eminent in mathematical learning, which is so closely allied with experimental research. A more extensive association was accordingly formed in London, which regularly met at the apartments within the Exchange, and was afterwards, at the suggestion of Oldenburg, the resident from the city of Hamburg, and in imitation of the foreign academies, constituted by charter into the Royal Society. Such was the humble beginning of that illustrious body, and such all the countenance it received from a needy and profligate government. The institution, however, proved at first eminently useful, by its influence in directing public opinion, and the shelter it afforded to experimental philosophy against the jealousy and declared hostility of the clerical and scholastic seminaries. The union of rank, or wealth, or talent, though still very limited in its range, bestowed a degree of lustre on the infant society, that was quite necessary for its defence against the attacks of ignorance and the undermining of bigotry.

Introduction of experimenta. science into England.

Royal Society.

One of the most active members of the Royal Society was the honourable Mr Boyle, who having become acquainted with experimental researches in the course of

[1] It deserves perhaps to be mentioned, that the theatre of the natural philosophy class, in the University of Edinburgh, has for several years been furnished with a water barometer, constructed by Mr Adie. It consists of a fine drawn tube of tin, of half an inch bore, rising thirty feet from a copper basin inclosed under the benches of a class below, and cemented at the top to a glass cylinder two inches wide and about six feet high, exposed to view, but terminating in a small basin containing water. Both ends of this compound column are fitted with stop-cocks, which are opened or shut at pleasure by means of concealed wires. By this large apparatus the Torricellian experiment is likewise exhibited in a very striking manner.

Barometer. his travels, devoted, after his return home, his time and his fortune to such calm but engaging pursuits. In this occupation he derived the most essential aid from Dr Hooke, whom he had the discernment to engage as his assistant,—the most skilful mechanician, and one of the best practical philosophers, of the age. The same ingenious person was likewise employed as operator to the society, and undertook to produce at each meeting some new experiments for the instruction and entertainment of the members. One of the favourite subjects was to exhibit the properties of the atmosphere. Hooke, at the instance of Boyle, had given a more convenient form to the air-pump, and had materially improved its construction, especially by the application of oil to the joints and valves. With this improved machine, a more perfect vacuum was procured than Gürické had obtained; and the English philosophers were thus enabled to perform a variety of delicate and interesting experiments, which extended the influence of the original discovery.

In those early meetings, too, of the Royal Society, the suspension of the mercury in the Torricellian tube had still the attraction of novelty. The famous Italian experiment, as it was called, was frequently repeated and varied in the presence of a few of the more assiduous members, who, though delighted with the exhibition, still continued to argue and to doubt concerning the cause of the phenomenon. These doubts acquired new force from a singular experiment which the celebrated Huygens some years afterwards communicated, during a visit he made to London. Having filled a glass tube eighty inches long with mercury, and carefully expelled whatever air was lurking about the sides, he gently inverted it, as usual, in a basin; when the mercury notwithstanding remained still hanging from the top of the tube, and did not subside to the proper height till it was struck with a slight blow. This anomalous fact appeared then extremely puzzling. The experiment, indeed, requires great nicety and address on the part of the operator, and evidently depends on a concurrence of circumstances which have not yet been sufficiently explained. There can, at present, exist no doubt that this extraordinary suspension of the mercury is occasioned by its obstinate adhesion to the inside of the tube, which, in the process of purging the air, becomes probably lined with a very thin film of mercurial oxyd. But Huygens, who had embraced the leading principles of the Cartesian philosophy, was inclined to draw a very different conclusion. He thought that the fact proved the existence of another fluid besides the atmosphere, and one possessed of such extreme subtilty and power, as to be capable of permeating the grosser bodies. In ordinary cases, this fine ethereal substance might be supposed to escape through the pores of the glass, and leave the mercurial column to the pressure merely of the atmosphere. Such was the unfortunate introduction of that ideal being—an æther—into experimental science, which it has continued to infest with mysticism, and to dazzle with a false glare. Similar notions are perpetually renewed by a certain class of superficial inquirers, and have exercised a visible and most pernicious influence in retarding the progress of sound philosophy.

Huygens's experiments.

Cistern barometer. It was soon perceived that the siphon barometer of Torricelli has a disadvantageous form. Both branches of the tube being assumed to be of the same width, the mercury must evidently sink as much in the one as it will rise in the other; so that the variations in the height of the column are thus reduced to half the true quantity. A small basin, or semicircular wooden box, to hold the surplus mercury, was therefore attached to the frame of the instrument; and this construction, with very little change, was adopted, during the course of a century, by the makers of the ordinary barometer. But the syphon barometer itself was afterwards materially improved by having its lower branch blown into a wide bulb for holding the charge of mercury. (See fig. 2, Plate CIV.) This form of the barometer is not quite accurate, owing to the smallness and unequal shape of the round bulb; but being very convenient for carriage, it has grown into general use, at least for the cheaper and more common sort of instruments. Barometer.

As soon as the barometer came to be regarded as a weather-glass, ingenuity was set at work to devise the means of enlarging its scale of variations. Descartes first proposed a simple method for effecting that object, by combining a mercurial with a water barometer; which arrangement, though subject to imperfection, has led to many of the subsequent improvements. (See fig. 4.) He directed two short barometric tubes to be cemented, the one into the bottom, and the other to the neck of a phial; or, still better, that the tubes should be joined, by the flame of a lamp, to the opposite ends of a wide and regular cylinder. The lower tube, and a portion of the cylinder, were then to be filled with mercury, and above it was to be introduced pure water, reaching to the top of the upper tube, and there sealed close. When this compound tube was inverted in a basin of mercury, it is evident that the columns both of mercury and of water would sink, till their joint pressure became just equal to the superincumbent weight of the external atmosphere. But the variation of this weight would afterwards be indicated chiefly by the large motion of the water; since the mercurial column, spreading out above into a broad surface, must, in any case, experience a very slight difference of altitude. Thus, suppose the cylinder to have eight times the diameter of the upper tube, or a section sixty-four times greater, mercury being 13·6 times denser than water: for each inch of increase of altitude which the ordinary mercurial column gains, the top of the water would be raised in the tube 11·4 inches, its own rise being 11·18 inches, and that of the wide mercurial cylinder only ·18 of an inch, yet equal in pressure to 2·4 inches of water. But Descartes, generally satisfied with mere theory and speculation, did not live to see his construction of the barometer carried into effect; and Chanut, the French resident at Stockholm, to whom he had imparted his views, met with such difficulty in the execution of the project, that, after some fruitless attempts, he abandoned it altogether. Barometer of Descartes.

Huygens was more fortunate, and succeeded, by dint of perseverance and skill, in constructing the Cartesian barometer. But he had the mortification to find that, in spite of all the pains he could take, the water, after it was relieved from the pressure of the atmosphere by the sealing up of the tube, constantly discharged a portion of air, which collected at the top, and by its elasticity depressed the compound column below its due altitude. Convinced that this source of imperfection is irremediable, he sought to rectify the construction of the instrument, and produced his *Double Barometer*; a form of combination frequently used, especially when the object is rather to make the variations very sensible than to obtain delicate results. (See fig. 5.) He joined a barometric tube of the usual length, by the flame of a blow-pipe, to two wide cylinders, the one sealed at the top, and the other annexed likewise hermetically to a tall and narrow tube, open at its extremity; he then bent the thicker tube a little above the lower cylinder, and brought the two branches to be parallel. The instrument being thus formed, he filled the first branch with mercury, and introduced above, in the second branch, some liquid of comparative lightness. Alcohol would, in this respect, answer extremely well, if it were not so lia- Huygens's double barometer

Barometer. ble to waste by evaporation. An alkaline lye, or the deliquiate salt of tartar, which also readily admits of being coloured, was therefore, on the whole, preferred.

The principle of this construction is evidently the same as in that of Descartes; but the vacuum lying contiguous to the mercury itself, can have no admixture of disengaged air or of aqueous vapour. Since the cylinders are made very much wider than the bore of the annexed tube, the variation of pressure will be produced almost entirely by the change of altitude which the alkaline liquor undergoes, the mercury suffering only a very minute alteration of ascent or descent. The divisions of the ordinary scale will be about tenfold enlarged, if a section of each cylinder should exceed twenty times that of the tube in which the liquor plays.

Its advantages and defects. A barometer of this construction has decided advantages with respect to the extent of its variations, but still it is not exempt from considerable defects. The moisture on the inner surface of the cylindrical reservoir increases the adhesion of the mercury, and retards its movements. But a much greater source of error proceeds from the influence of heat in extending the volume of liquor contained in that reservoir, and rising into the narrow stem. This instrument, therefore, to a certain extent, blends the indications of the barometer with those of the thermometer, which are essentially different, and can seldom accord.

Hooke's double barometer. About the same period Dr Hooke likewise proposed a double barometer, of a similar construction. He afterwards resumed the subject, and with a view to correct the defect of the former arrangement, he produced, in 1685, an instrument of a more complex form, but very ingeniously conceived. (See fig. 6.) To the upper end of the open stem he joined a third cylinder of the same dimensions as the two former, but tapering away to a fine orifice at the top. The principal tube being filled as usual with mercury, extending to occupy the bottoms of both the connected cylinders, he introduced a liquor immediately over the mercury in the second cylinder, rising partly into the stem; above this, again, he poured another liquor specifically lighter and differently coloured, filling up the rest of the stem, and mounting into the third cylinder. By this artificial and delicate combination, the mercury is left perfectly stationary, and all the movements corresponding to the atmospheric pressure are performed by the counterpoising liquors, and marked by their line of mutual separation. Since the stem or narrow tube remains constantly full, the variation of its pressure must depend on the different proportions of its length occupied by the two fluids. If the weight of external atmosphere should, for instance, increase, the denser liquor will rise, and consequently cause the lighter liquor to contract its column. The action of this compound barometer, being thus produced merely by the difference of the gravity of the two fluids, might, therefore, be augmented indefinitely. Suppose the liquid resting on the mercury to be pure water, and the superincumbent liquid to be olive oil, which is about one twelfth part lighter; the scale would be enlarged no less than 163 times, or an alteration of one tenth in the altitude of the common mercurial column would be marked by a motion through $12 \times 1{\cdot}36$ inches, or 16·3 inches. But such a vast enlargement of the scale is far greater than would ever be desirable in practice. It were better, therefore, to introduce next the mercury some fluid which is denser than water. If oil of sassafras were combined with oil of oranges, the divisions of the scale would be augmented only sixty-eight times, and consequently the whole range might not exceed ten or twelve feet. Those oils, however, would move rather sluggishly, especially in cold weather, and might, from their incessant shiftings, during a lengthened period, become insensibly mixed. On the other hand, fluids of distinct characters are seldom free from chemical action; they expand differently with heat, and by coating with other traces the inside of the tube, they are the more apt to retard the motion of the column. In general, the advantage of any very great augmentation of the scale is counterbalanced, as the fluids then work by irregular starts; and the instrument loses in delicacy whatever it has gained in extent of action. Barometer

Wheel barometer. Another method of augmenting the variations of the barometer was invented by the same fertile genius, which has the advantage of uniting great simplicity with tolerable accuracy. (See fig. 7.) Resuming the siphon barometer, he made a small float of iron or glass to rest on the exterior surface of the mercury, and suspended by a slender thread passed round a small wheel or cylindrical axis that carried an index. Though the varieties of the height of the mercurial column are, in a tube of this form, reduced to half the ordinary measure, yet, from the great length of the index compared with the diameter of its axis, the divisions on the circumference of the circle in which it travels are much amplified. The little machinery being concealed within the frame of the instrument, the index only is brought into view, protected by a circular plate of glass. Thus fitted up, the whole forms rather a handsome piece of furniture. The *Wheel Barometer*, as it is called, has long maintained its reputation among ordinary observers.

Inclined barometer. A very simple method of enlarging the divisions of the barometer is commonly ascribed to Sir Samuel Morcland, the same speculative adventurer who invented, or rather introduced from abroad, the *Speaking Trumpet*. (See fig. 8.) It consisted in merely bending the upper part of the tube into a very oblique position. By this deflexion, however, the scale which depends on the perpendicular altitude cannot be augmented beyond three or four times without incurring evident risk of inaccuracy. The instrument is called the *Inclined* or *Diagonal Barometer*. The form has been sometimes varied by the fancy of artists, who, repeating the inclination of the tube, have occasionally given the upper part a zig-zag appearance.

Square barometer. The most ingenious barometer, filled with mercury only, and yet admitting a scale of any extent, was invented by Cassini and by John Bernoulli, who first gave the description of it in 1710. (See fig. 9.) A wide cylinder is annexed to the top of the main tube, at the bottom of which there is joined at the right angles another long and narrow tube. The mercury, in ascending or descending within the wide cylinder, must, therefore, run along this horizontal tube. If that cylinder have a diameter only four times greater than the bore of the tube, the scale of variation will be augmented sixteen times. This instrument is, from its shape, called the *Square Barometer*. It is not found in practice to answer so well as the theory might lead us to suppose. The mercury creeps along the horizontal tube with difficulty, and by desultory advances; and these irregularities increase when, from its motion and exposure, it becomes covered with dust and partial oxidation.

Conical barometer. The simplest of all the barometers with an enlarged scale, and at the same time one of the most ingenious, is the *Conical* or *Pendant Barometer*, invented and described in 1695 by Amontons, a French philosopher, who, being afflicted with total deafness in consequence of a fever in his infancy, had devoted himself to mechanical contrivances. (See fig. 3, Plate CIV.) This instrument consists merely of a tube, four feet or more in length, with a bore narrower than ordinary, and tapering regularly to the top. The width at the bottom must hardly exceed three twentieth parts of an inch, while near the

Barometer. top it may be contracted to about one tenth. A column of about thirty-one inches of mercury being introduced, the tube is gently inverted and held perpendicular; the cohesion of such a narrow column is sufficient to prevent it from dividing and admitting air unless it be shaken; but, overpowering the atmospheric pressure, it descends till it has contracted into the equiponderant altitude, by passing into a wider part of the tube. To obtain equal divisions on the scale, it is necessary that the tube should have a uniform taper. The most accurate construction of a barometer of this kind is, therefore, attained by joining together two tubes that have even but unequal bores, the longer and narrower one being uppermost. If the width of the upper tube were supposed to be to that of the under one as two to three, the scale would be enlarged three times, since, by descending three inches from the top, and consequently two at the bottom, the column would suffer a contraction of one inch in height.

This species of barometer is thus recommended by its simplicity and its ample range. But the bore of the tube being indispensably narrow, the mercury moves with difficulty, and resists the impression of minute changes of external action. When the conical-shaped tube is retained, the instrument is liable to some inaccuracy from the influence of the cohesion of the mercury, which varies with the diameter of the column in different parts of the tube.

Amontons likewise proposed another form of barometer, in which the mercurial column is subdivided among several short connected branches. (See fig. 10.) Suppose the instrument were to have only the third part of the usual height, the first, third, and fifth branches, enlarged above and below into very short cylinders, are filled with mercury; and the second, fourth, and sixth branches, which may have their bores narrower, are occupied with some light fluid, or simply with air. If the external pressure should suffer any diminution, the three mercurial columns which produce the counterpoise will each descend and push up the last fluid of the series by their combined effects. It is evident that, by multiplying those branches, the barometer will have its altitude proportionally reduced. But this construction, though specious in theory, is found to have no practical advantages. The instrument is, from its complication, very difficult to construct; its motions are sluggish, owing to the multiplicity of tubes and the conjunction of fluids, and they are subject to derangements from the variable influence of temperature. It has therefore been generally abandoned.

Sectoral. Barometer. These different forms of the instrument have been variously modified, and often brought forward with claims of novelty. We may notice, however, the *Sectoral Barometer* proposed by Magellan, in which the mercury is always made to rise to the same high point of the tube, by drawing this less or more aside from the vertical position. The arc thus described will indicate the deviation from the perpendicular, and consequently the actual descent of the mercury. But the difference between the vertical and the oblique line is not measured by the inclination merely, it is proportioned to the versed sine of this angle, or nearly to the square of the arc. The advantage of this mode of observing is, therefore, best perceived in small variations of the mercurial column. In the hands of a skilful observer, the best and most accurate barometer, after all, is that of the original construction, with a tube rather wide, and a broad cistern. To apply minute divisions is decidedly preferable to any enlargement of the scale. The measuring of such divisions has been since rendered extremely easy by the adaptation of the differential scale; a most valuable contrivance, proposed by Vernier early in the seventeenth century, but strangely neglected long afterwards. This delicate appendage being once adopted, it became the more desirable to improve the sensibility and regulate the correctness of the indications of the barometer. Barometer.

Effect of moisture within the barometric tube. The first object was carefully to cleanse the mercury, and to expel any portions of air or moisture adhering to the inside of the tube. The influence of aqueous vapour in depressing the mercurial column had been observed by Huygens; but other more evaporable fluids were afterwards found to occasion, by their presence, a still greater derangement. Homberg having, about the year 1705, washed a tube with alcohol to remove the impurities from its internal surface, remarked that the mercury introduced into it stood an inch and half lower than usual, a depression which this ingenious chemist was disposed to attribute to the elasticity of the spiritous exhalations collected above the mercurial column; though other academicians, and Amontons among the rest, misled by their Cartesian prejudices, sought to ascribe the effect to the different sized pores of the glass. These anomalies were removed by heating or rather boiling the mercury in the tube till it was completely purged of air and moisture, and brought into close contact with the inside of the tube But a new fact occurred which long puzzled the mechanical philosophers. The tube of a barometer, which had been filled with more than usual care, was observed to exhibit a luminous appearance when moved or slightly agitated in the dark. This curious phenomenon gave occasion to multiplied and prolonged controversies; it was attributed to the subtile matter of Descartes, or ascribed to a native phosphorescence, or a latent fire inherent in the mercury. Our countryman Hauksbee, in the year 1708, gave the first rational explanation of the fact, by referring it to electricity, which he had just begun to cultivate as a distinct science. It resembles exactly, indeed, the experiment of the exhausted flask, in which an electrical current flashes with a diffuse lambent flame, like the *aurora borealis* or the *northern streamers*. The friction of the mercury against the inside of the tube excites electricity, while the vacuity, or rather the very attenuated vapour in which the supposed fluid plays, facilitates its expansion. When the vacuum is rendered very perfect by the careful and accurate boiling of the mercury, the lambent flashing ceases for want of a fine medium to conduct and disperse the electrical influence. Luminous barometer.

Effects of the width of the tube. The next point to which experimenters were led to direct their attention, was the effect of the width of the tube on the altitude of the mercurial column. Plantade, a lawyer of Montpellier, appears to have been one of the first who remarked that the mercury stands always lower in narrow tubes. This fact he communicated about the year 1730 to Cassini, who was then occupied in the south of France with carrying on the great trigonometrical survey. But the discrepancies observed by Plantade, being unfortunately confounded with other collateral circumstances, were for a time overlooked. In tubes having a narrow bore, the depression of the mercury, however, is very considerable, as may be readily perceived in a small glass syphon, of which the one branch is about half an inch in diameter, and that of the other branch less than the tenth of an inch. Thus, if the narrow tube had a width of only the thirteenth part of an inch, the depression of the mercury would amount to half an inch, which is about the third part of the elevation to which water in similar circumstances would be raised by capillary action. This effect has not been sufficiently examined, but it appears to result from the attraction of the particles of the mercury to each other exceeding their attraction to the surface of the glass. Mercury, in contact with glass, therefore, tends to a spherical form, and always assumes a convex

Barometer. surface within a clean tube. Water and other liquids, again, manifest an opposite character, the mutual attraction of their particles being less than their adhesion to glass. Accordingly, they spread along a vitreous surface, instead of collecting into drops; and in narrow tubes they mount above the level, and invariably have a concave termination. If the bore be so small as to be reckoned capillary, the depression of mercury is, like the elevation of water, inversely as the diameter; but when the bore has a considerable width, the quantity of depression, depending on the curvature of the surface of the mercury, diminishes proportionally faster, and follows nearly the inverse duplicate ratio of the diameter. But on the subject of capillary action we refer our readers with the utmost confidence to a valuable paper communicated to the Royal Society of London, by Mr Ivory, late of the Military College at Sandhurst, one of the most original and profound mathematicians that our island has had the honour to produce.

Pure mercury has always a convex surface.

The influence of the predominating attraction of the particles of mercury to themselves, above their adhesion to the sides of a glass tube, has not been considered with so much attention as it demands. Nothing is more common than to remark that the mercury in the barometer is in the act of rising if it show a convex surface, but about to fall if it should appear concave. Now, the top of the mercurial column must always remain convex if the barometer be properly constructed, the tube perfectly clean, and the mercury purged of all impurities. But if the inside of the tube be anywise soiled, whether covered with humidity or stained with mercurial oxyd, the metallic fluid will adhere so obstinately to the glass as to lose its convexity, and to subside into a flat surface, or even sink into a concavity, like water and other liquids. Hence the danger of boiling the mercury too long in the tube, as it becomes partially oxydated; and the thin crust so formed not only suspends the column higher, but obstructs the freedom of its motion. The same effect is produced by greasing the inside of the tube. Some respectable authors, from not attending to these facts, have hastily inferred that the convex appearance which mercury assumes in the barometer was merely accidental, and consequently removed by a more complete boiling and purification.

Quantity of depression in different tubes.

In the case of tubes having wide bores, the depression of the mercurial column may, without any sensible error, be disregarded. According to the accurate experiments made by Lord Charles Cavendish, and published by his son the celebrated Mr Cavendish, the quantity of depression is only the 200th part of an inch in a tube of 6-10ths of an inch in diameter, the 28th part of an inch in a tube of 3-10ths diameter, and the 15th part of an inch in a tube of 2-10ths diameter. Wide tubes ought, therefore, to be preferred in the construction of barometers, both on account of the facility with which the mercury moves in them, and the smallness of its depression. The only circumstance to overbalance these advantages would be the necessity and inconvenience of having a very large cistern. A quarter of an inch may be reckoned a good width of tube, and the corresponding depression is only the twentieth part of an inch.

In the siphon barometer, if both branches have the same diameter, the action is exerted on opposite sides, and therefore the effect of depression becomes entirely lost. For accurate purposes, this original form of the instrument has been resumed, and the inconvenience arising from the large variation of the lower lever entirely obviated by an ingenious contrivance introduced above fifty years ago. This consists in the application of a leathern bag, instead of a wooden or ivory cistern, to hold the surplus mercury. Besides the barometric tube, there is placed adjacent to it another short one of the same width, communicating with the mercury contained in the bag, which being pressed by turning a screw below, is at each observation brought exactly to the same mark. The external atmosphere readily acts through the substance of the leather; but the mercury, from the powerful cohesion of its own particles, cannot be squeezed through the pores of that casing without violent compression. The addition of a bag within a cylindrical box, omitting the lower tube, likewise renders the barometer easily portable; since, for safe carriage, the mercury can be screwed up tight, to fill the whole cavity of its tube, but, on turning the screw again, the column will subside and rest on a broad base.

Application of a leathern bag.

Barometer.

The last object which required nice observation, was to estimate the effect of heat in dilating the mercury, and consequently increasing the altitude of the equiponderant column. This correction could not be made with any sort of accuracy previous to the application of the thermometer, which, though invented half a century earlier than the barometer, was yet more than another half-century in arriving at perfection. Hero, a mechanical philosopher, who flourished at Alexandria about 130 years before Christ, has described in his *Spiritalia* a sort of huge weather-glass, in which water was made to rise and fall by the vicissitudes of day and night, or rather the changes of heat and cold. This machine had for ages been overlooked, or merely considered in the light of a curious contrivance. But Sanctorio, the inventor of the famous statical balance, a very learned and ingenious Italian physician, who was long professor of medicine in the university of Padua, and had laboured to improve his art by the application of experimental science, reduced the hydraulic machine of Hero into a more compendious form, and thus constructed, about the close of the sixteenth century, the instrument since known by the name of the *air thermometer*, which he employed with obvious advantage to examine the heat of the human body in fevers. Some years afterwards a similar instrument was contrived, perhaps without any communication, by Drebbel, a very clever and scheming Dutch artist, who visited London in the reign of James I., and imported the knowledge of that instrument into England.

Effect of heat on the barometer.

Invention of the thermometer.

But this air thermometer was evidently of the same nature with what has been since called the *manometer*; it could measure only the dilatation or augmented elasticity of the air confined within its bulb, whether occasioned by heat or the diminution of external pressure. It was therefore considered merely as a weather-glass, indicating the state of the atmosphere; nor could its blended impressions, which might separately affect both the thermometer and barometer, be then distinguished. Had it been more closely studied, it must have led, by another path, to the discovery of the latter. But those irregularities to which the air thermometer was hence subject appear to have created such doubts respecting the accuracy of the instrument, as occasioned its being neglected long afterwards.

Florence glass.

The same country, however, which had given birth to the thermometer, began its improvement. After the principle of the barometer was established, the members of the Academy del Cimento, founded at Florence in 1657, and supplied with liberal funds by the grand duke of Tuscany, had, among other interesting physical researches, resumed the application of the thermometer; and, instead of air, they substituted alcohol or spirit of wine, another very expansible fluid not affected by atmospheric pressure, while they attached to the tube a scale graduated on a regular plan, though directed by no very precise measures. The instrument so constructed, but somewhat varied in its form, being copied by Italian ar-

Barometer.

tists, was dispersed over Europe under the name of the *Florence Glass*. From its careless execution, however, in the hands of itinerant venders, this thermometer, or rather thermoscope, appears never to have obtained an established reputation.

Attempts to obtain a standard.

The great object proposed was to bring thermometers to an exact correspondence. It was expedient, therefore, not only to select a proper fluid, but to adopt a uniform and consistent scale. Alcohol, linseed oil, and mercury, had been successively tried. The graduation was at first derived from the temperature of cellars and deep caves, which, indicating the natural heat of the globe, had long been considered invariable; but more enlarged experience discovered the inaccuracy of that supposition, and showed the mean temperature to be materially modified by the latitude of the place, and its elevation above the level of the sea. Congelation, or rather the inverted process, the thawing of ice, or the melting of snow, was then found to remain fixed; a most important fact, which had been first noticed by Güricke, but overlooked till a considerable time afterwards. A stationary point was hence obtained, from which to commence the thermometric scale. But different modes were pursued for determining the divisions.

Amontons.

Amontons, reverting to the air thermometer in spite of its acknowledged defects, found that the elasticity of air compressed in the bulb, and able at the temperature of melting snow to support a column of mercury fifty-four inches high, was capable of raising this to seventy-eight inches at the heat of boiling water; and he seemed contented with framing a rude standard, by merely dividing the intermediate space into inches and half-inches.

Newton.

But about the same, or nearly at the beginning of the eighteenth century, Newton himself cast a keen though rapid glance on the subject of heat, and proposed a thermometer of a much simpler and more elegant construction. Having adopted linseed oil as a fixed and uniform substance, capable of great dilatation, he discovered by experiment, that dividing the capacity of the bulb into ten thousand equal parts, the liquid expanded 256 parts from melting snow to blood-heat, and 725 parts to that of boiling water. These numbers, however, being inconveniently large, he reduced them somewhat more than twenty times, adopting 12 and 34 as the proportional divisions on his scale. But oil, being so viscid a substance, was found to trail and collect on the inside of the tube; and this thermometer, though constructed on a right principle, never came into general use.

Roemer.

Roemer, the Danish astronomer who made the fine discovery of the progressive motion of light, was the first who proposed mercury as the fittest fluid for thermometers; and Halley and Amontons remarked about the same time, that it expands uniformly with heat, and remains nearly stationary at the point of boiling water. On this

Delisle's thermometer.

principle, Delisle of St Petersburg constructed, in 1733, a mercurial thermometer with a descending scale, the distance from freezing to boiling water occupying 153, or, in round numbers, 150 divisions, of which the bulb itself contains 10,000. A more ingenious method, but perhaps too refined, for graduating thermometers, was proposed

Renaldini.

by Renaldini, a distinguished Italian mathematician, in 1694. It consisted in adopting the scale, in the successive temperatures produced by mixtures, in the different proportions of twelve parts of water at the moment of thawing and of ebullition. This suggestion led to a very important inference, since it proved that mercury expands uniformly with equal additions of heat, while alcohol swells constantly in a rising progression. But the capital

Fahrenheit's thermometer.

improvement of the thermometer was effected by the skill and perseverance of Fahrenheit, whose name has remained justly attached to the instrument. This ingenious person, originally a merchant at Dantzic, who had the misfortune to fail in business, was induced, by his taste for mechanics and chemistry, to have recourse to the manufacture of thermometers, as the means of gaining a slender livelihood. But not meeting with sufficient encouragement at home, he removed, about the year 1720, to Holland, the great emporium of the arts, and fixed his future residence at Amsterdam. He now preferred mercury to alcohol for filling his thermometers; and, adopting the division of the bulb into 10,000 parts, he reckoned sixty-four of them as the expansion between freezing and blood-heat, and thirty-two as the contraction from the same point to what he considered as extreme cold, or that produced by the mixture of one part of salt with three parts of snow. These numbers were extremely convenient, being found by a repeated bisection. With respect to the heat of boiling water, Fahrenheit discovered the important fact, that it varies with the state of atmospheric pressure. Taking the mean, however, he reckoned 180 degrees from freezing to ebullition, and therefore marked this point at 212 on his scale. The thermometer owes its improvement to Celsius, professor at Upsal, who in 1742 placed the commencement of the scale at congelation, and divided the interval thence to boiling water into an hundred degrees, extending such a portion downwards as might be wanted. This centesimal thermometer is exactly the same as what the French have since called the *centigrade*, which, from its fitness and simplicity, deserves to be universally adopted.

The Celsian or centigrade thermometer.

The thermometer having been thus carried by successive steps to perfection, it was found by delicate experiments, that, between the points of boiling and freezing, the expansion of mercury amounts to the fifty-fourth part of its bulk, or that it acquires, for each degree of heat, an increase of volume amounting to the 5412th part on the centesimal scale, or the 9742d part on the scale of Fahrenheit. A correction, therefore, on the height of the mercurial column in the barometer becomes necessary according to the changes of temperature which it undergoes In this climate, the extreme variation arising from that cause will seldom exceed two tenths of an inch. But if the barometer be suspended in a room kept at an agreeable temperature, the error occasioned by the expansion of the mercury may, in ordinary cases, be disregarded, since it will scarcely amount to the twentieth part of an inch.

Correction of the barometer as affected by heat.

Since the barometer marks the condition of the distant atmosphere, and intimates those internal alterations which are generally connected with the change of the weather, it is particularly valuable at sea, by forewarning the mariner of the approach of a storm. But an instrument of the ordinary construction would not answer this purpose, the agitation of a vessel on a tempestuous ocean being such as would not only throw the ponderous mercurial column into violent oscillation, but communicate those sudden shocks which must infallibly break the tube. Various attempts have accordingly been made to obtain a *marine barometer* exempt from risk, and yet sufficiently sensible to the variations of the atmosphere. The conical or pendant barometer being, from the narrowness of its bore, rather sluggish, was first recommended for that purpose, though never adopted into practice. About the beginning of the eighteenth century, Dr Hooke and Amontons severally proposed to employ for a barometer on board ship, the manometer or air thermometer. To obviate the derangement arising from the influence of heat, there was to be placed beside it a spirit-of-wine thermometer, with a ball so large as to give expansions equal to those of the portion of air confined within the bulb. The difference between the two adjacent columns of liquid would there-

Marine barometer.

Barometer. fore measure the variation of external pressure. But to procure such a nice adaptation would prove so extremely difficult in practice, that most probably this instrument was seldom or never actually constructed. Besides, the liquid column of the manometer, though light and narrow, would yet be much shaken by the rolling and pitching at sea. Notwithstanding these weighty objections, however, this compound manometer was tried in England, mercury being employed as the fluid both of expansion and pressure, and various adjustments applied by means of a complex machinery.

Blondeau's marine barometer. An ingenious and very substantial kind of marine barometer was, above twenty years ago, recommended by Blondeau, one of the professors of the naval academy at Brest. (See fig. 11, Plate CIV.) It consisted of an iron tube, bent below into a siphon, and filled carefully with mercury, which carried a float. For this purpose, a musket-barrel, about three feet long, was chosen, having a very smooth and even bore, and an iron breech closely welded to it, instead of being soldered with brass, which might become corroded by the action of the mercury. The lower end of the tube had a collar of leather, to which was screwed a piece of iron, perforated through its whole length, and bent into an arch, having screwed likewise, with a collar of leather at its other extremity, a vertical cylinder of iron, four inches high, and of the same bore exactly as the tube. The contracted aperture at the end of the tube, not being exactly in the middle, was not always opposite that of the arch; and, therefore, by turning it occasionally aside, the communication could be contracted at pleasure, or even obstructed entirely. The cylindrical appendix was tapered at the top to a narrow orifice, through which an iron wire, attached to a small ivory float, had been introduced. To prepare this instrument for action, the mercury was first boiled in the tube; then the arch, filled with hot mercury, was screwed to the end, the cock opened, and the surplus mercury allowed to flow over; next the vertical piece, with its float, was screwed on, and a little mercury added, to give it due play. The origin of the scale was to be determined from the comparison with another good barometer of the ordinary construction; but, owing to the equality of the bores of the opposite tubes, the divisions were only half the usual size, or the inches were exhibited by half-inches.

This species of barometer is certainly free from all sort of risk, while the facility which, by means of turning the arch, it affords in checking the ascent and descent of the mercury, prevents in a great measure the oscillations of that fluid. If the instrument were properly suspended, therefore, its indications would be tolerably steady and regular. The chief objection to it consists in the diminutive range of its scale.

In every marine barometer, the main object is to give steadiness to the mercurial column, by retarding its motion in the tube; in short, to imitate the equalizing effect of the fly in mechanics. One form of construction was, instead of the cistern below, to annex a spiral tube composed of a number of horizontal convolutions. Passemant, an ingenious Parisian artist, about the year 1758 improved on this idea. He twisted the barometer tube near the middle, at least twice round, and joined to its upper end a wide cylinder. But, more effectually to prevent all irregular oscillations, he took a tube with a very narrow or capillary bore, and contracted it below, while he annexed a wide cylindrical piece at its other extremity. The only thing wanted now to the perfection of this instrument, was to devise a mode of suspending it that should soften the jerks, and allow it generally to maintain a vertical position. Our English artists have, by repeated trials, at last succeeded in surmounting all the difficulties. The marine barometer, manufactured by Mr Cary of London (see fig. 12, Plate CIV.), is one of the most approved kind. It consists of a capillary tube, about twenty-seven inches long, with a bore scarcely exceeding the thirtieth part of an inch, but terminated by a cylinder four or five inches high, and nearly three tenths of an inch in diameter. It is suspended by a spring and jimbols, near the top, at a certain point, which in each case is discovered by actual trial. By making the suspension lower, it is found that the agitation of the barometer will cause the mercury to rise a little; while, by placing the suspension higher, the mercurial column suffers always some depression. The reason of this curious observation is not well explained. It probably results from the different centrifugal tendencies communicated to the opposite portions of the columns. The swinging of the instrument would evidently augment the pressure of the upper portion of the column, while it diminished that of the under portion. But this lower portion being longer than the other, its tendency to descend would be proportionally so much greater. About the point of suspension, however, the opposite effects of the centrifugal tendencies are balanced, since the superior force being employed to set in motion a narrower column, the reflux and efflux of the mercury in the upper cylinder must be preserved nearly equal. Barometer.

Marine barometers, thus improved, are now very generally used, and with great benefit to the public service, on board ships of war and Indiamen. To facilitate the keeping of a register of barometrical observations, the meritorious and indefatigable Mr Horsburgh, hydrographer to the East India Company, published a set of engraved ruled sheets, adapted for the convenience of navigators. In these plates the height of the mercury, from twenty-seven to thirty-one inches, is represented in inches and tenth parts by horizontal lines, while each successive day has a space apportioned to it by vertical bars. The state of the barometer at every observation is marked with a dot, and these dots being afterwards connected together, exhibit an irregular waved line, stretching across the sheet, and indicating the series of the changes of the weather. At the lowest points, from which the curve again returns, a gale generally follows. From the observations made off the Cape of Good Hope during the month of May 1815, by an ingenious and active officer, Captain Basil Hall, then of his majesty's sloop Victor, it appears that whenever the mercury fell to 29·60 inches, a storm ensued; the column always rose when the gale abated, and when it reached near thirty inches, the weather became fair. Those gales often came on suddenly, without any visible change in the aspect of the sky, but the marine barometer never failed to give warning of their approach. Horsburgh's plates.

A very convenient substitute for the marine barometer is the *sympiezometer* constructed by Mr Adie, optician in Edinburgh. It is merely an improved *manometer*, partly filled with a fixed oil, and indicating the conjoined effect of heat and atmospheric pressure on the inclosed air; but the influence of temperature is corrected by means of a sliding scale, regulated by an attached mercurial thermometer. The sympiezometer occupies little room, is easily rectified, and comparatively cheap.

Difficulty in explaining the variations of the barometer. To explain the cause of the variations of the barometer, has long perplexed philosophers. Many hypotheses have at different times been advanced on the subject; but it would be a mere waste of time to make any detailed recital of such crude and unsatisfactory attempts. The various and often imaginary effects of vapours, of heat, and of winds, have been employed in framing an explication of the changes of the atmosphere. The fact, that the mer-

Barometer. curial column generally falls before rain, seemed at complete variance with the intimation of the senses, a notion having become universally prevalent, that the air is heavier when the sky appears lowering and overcast; another proof, were it wanted, how fallacious are all current opinions in matters of science.

Leibnitz, fancying he had discovered a new principle in hydrostatics, endeavoured, by a sort of metaphysical argument, to demonstrate that, though a body adds its own weight to the pressure of a fluid in which it is suspended, yet it will cease to be ponderous during the act of falling. This alleged principle will not, in the actual state of science, be thought to require any serious refutation; nor, were it even admitted, would it be found at all adequate to the explication of the phenomenon, since the weight of moisture precipitated from the whole body of atmosphere could never, by the absence of its pressure, occasion a diminution of the tenth part of an inch in the altitude of the mercurial column.

Dr Halley and Mairan sought to account for the depression of the barometer before a storm, by the withdrawing of the vertical pressure of the atmosphere, when borne swiftly along the surface of the globe by a horizontal motion. This hypothesis at first sight appears very plausible, and might seem further confirmed by a noted experiment which most authors have admitted without due examination. Hauksbee's experiment. Hauksbee, a skilful and ingenious experimental philosopher, about the year 1704 placed two barometers, about three feet asunder, with their naked cisterns in two close square wooden boxes, connected by a horizontal brass pipe; one of these boxes had, inserted at right angles, an open pipe on the one side, and a second pipe, terminating in a screw, on the other side; to this end he adapted a strong globular receiver of about a foot in diameter, which had been charged, by injection from a syringe, with three or four atmospheres; then suddenly opening the stop-cock, and giving vent for the escape of the air through the box and over the surface of the included cistern, the mercury sunk equally more than two inches in both the barometers.

This elegant experiment might be deemed entirely conclusive, if a minute circumstance, on which the success really depends, had not unfortunately been overlooked. Its fallacy. It will be perceived from the inspection of the figure which Hauksbee has given, that the exit pipe of the box was considerably wider than the pipe which conveyed into it the stream of air. This fluid, escaping from compression, would therefore be carried by its elasticity as much beyond the state of equilibrium; while the width of the orifice, by facilitating its emission, would allow the portion occupying the box and the connected reservoir to preserve its acquired expansion. If the pipe of discharge from the box had been much narrower than the other, an opposite effect must have taken place; for the air accumulated over the cistern, not finding a ready vent, would remain in a state of condensation. This curious fact is another of the many instances which might be cited to show the great delicacy and circumspection required in performing philosophical experiments.

Similar results, however, can be exhibited by a very simple apparatus. Let a small box, or rather a glass ball, have a short narrow tube inserted in the one side, and another wide tube opposite to this, with a cross slider of brass, for contracting the orifice at pleasure; and, to the under part of the ball, join a long perpendicular tube, bent back like a syphon to more than half its height, and containing a double column of water. Now, blow through the narrow tube into the cavity of the ball, while the orifice of emission is quite opened, and the liquid will rise several inches in the long stem; but, still continuing the blast, let the orifice be gradually contracted, and the column will first descend to its ordinary level, and then sink considerably below it. Barometer.

The fall and rise of the mercury in the barometer must evidently be occasioned by some corresponding reduction or accumulation of the atmosphere at the place of observation. Whatever augments the elasticity of the air will cause part of the incumbent fluid to evade and leave for the time a diminished vertical pressure. The efflux of wind might also produce a temporary reduction of the atmospheric column. But the real difficulty consists in explaining why the variations of the barometer should be greater in the high latitudes than between the tropics, and why they so much exceed in all cases the quantities which calculation might assign. Causes of the variation of the barometer

The influence of heat will account for the semi-diurnal variations of the barometer which are observed, especially within the torrid regions. From ten o'clock in the morning till four in the afternoon, the mercury generally falls; but, after that hour, it rises again, till ten o'clock at night, when it drops till four in the morning, and then mounts till ten o'clock in the forenoon. These regular changes, which amount to about the five hundredth part of the whole atmospheric pressure, depend on the prevalence of the alternating land and sea breezes, occasioned by the diversified action of the sun's rays upon the earth and water. The accumulation of air is greatest at four o'clock in the morning and evening, and the mercury then attains its highest point; but it sinks lowest at ten o'clock in the morning and evening, when the incumbent mass has been the most reduced.

A similar reason will explain the effects of the northerly and easterly winds, in elevating the mercury of the barometer in our climate. A chill air, with enfeebled elasticity, is thus accumulated and exerts a predominant pressure.

The augmented elasticity communicated to the air by the action of heat or the presence of humidity, and the reduction of the incumbent mass by the efflux of winds, have each their distinct influence in disturbing the equilibrium of the atmospheric ocean. But the effects, particularly in the high latitudes, much surpass the regular operation of those causes. The only mode, perhaps, of removing the difficulty, is to take into consideration the comparative slowness with which any force is propagated through the vast body of atmosphere. An inequality may continue to accumulate in one spot, before the counterbalancing influence of the distant portions of the aërial fluid can arrive to modify the result. In the higher latitudes, the narrow circle of air may be considered as, in some measure, insulated from the expanded ocean of atmosphere, and hence, perhaps, the variations of the barometer are concentrated there, and swelled beyond the due proportion. See the articles CLIMATE and METEOROLOGY. (J.L.)

SUPPLEMENT.

Aneroid Barometer. A very ingenious instrument for indicating atmospheric pressure is the invention of M. Vidi of France, which is called the *Aneroid Barometer* (from ἀνέρομαι, I inquire). The appearance and construction will be best understood from the annexed diagrams.

The action of the aneroid depends on the effect produced by the pressure of the atmosphere on a circular metallic chamber exhausted of air and hermetically sealed; thus the chamber is a substitute for the Torricellian tube, and the vacuum for the column of mercury.

Supplement.

The mechanical arrangements of the instrument will be understood by reference to the woodcuts.

Fig. 1.

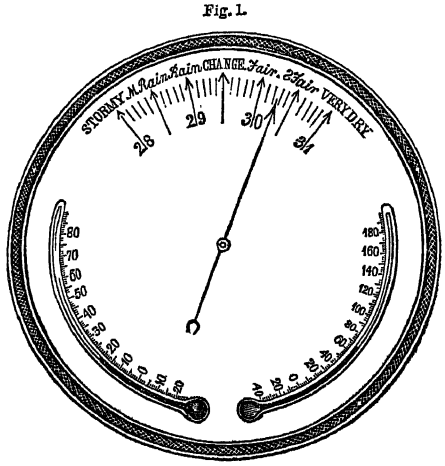


Figure 1 represents the external appearance of the instrument. It is four inches and three-quarters in diameter across the face, and one inch and three-quarters in thickness. The pressure of the atmosphere is indicated by a hand pointing to a scale which is graduated to forty divisions to the inch; one or two thermometers are fixed on the face, as shown in the drawing, but these are not essential.

Fig. 2.

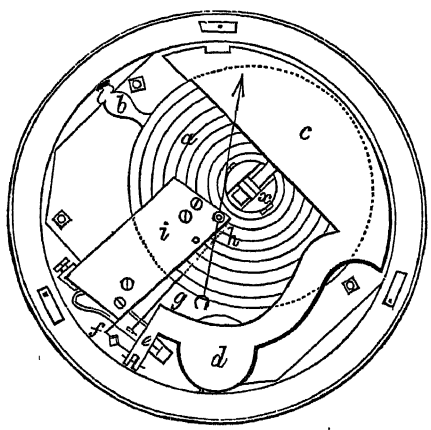


Figure 2 represents the internal construction, as seen when the face is removed, but with the hand still attached. *a* is a flat circular metallic box, about two inches and three-quarters in diameter, and a quarter of an inch in depth, having its upper and under surfaces corrugated in concentric circles. This box or chamber being exhausted of air, through the short tube *b*, which is subsequently made air-tight by soldering, constitutes a spring, which is affected by every variation of pressure in the external atmosphere, the corrugations on its surface increasing its elasticity. At the centre of the upper surface of the exhausted chamber there is a solid cylindrical projection *x*, about half an inch high, to the top of which the principal lever, *c*, *d*, *e*, is attached, as shown in the drawing. This lever rests partly on a spiral spring at *d*; it is also supported by two vertical pins, with perfect freedom of motion. The end *e* of the large or principal lever is attached to a second or small lever *f*, from which a chain *g* extends to *h*, where it works on a drum attached to the arbor or axis of the hand, connected with a hair spring at *h*, changing the motion from vertical to horizontal, and regulating the hand, the attachments of which are made to the metallic plate *i*. The motion originates in the corrugated elastic box *a*, the surface of which is depressed or elevated as the weight of the atmosphere is increased or diminished, and this motion is communicated through the levers to the axis of the hand at *h*. The spiral spring on which the lever rests at *d* is intended to compensate for the effects of alterations of temperature. The actual movement at the centre of the exhausted box, from whence the indications emanate, is very slight, but by the action of the levers this is multiplied 657 times at the point of the hand, so that a movement of the twenty-second part of the tenth of an inch in the box carries the point of the hand through three inches on the dial.

Supplement.

The effect of this combination is to multiply the smallest degrees of atmospheric pressure, so as to render them sensible on the index.

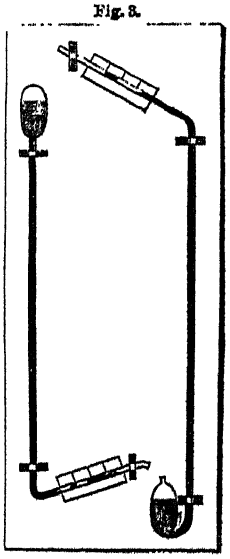
The aneroid is a very delicate instrument, and seems to answer well at moderate elevations above the sea.

Metallic Barometer. M. Bourdon constructed in 1850 a modification of the aneroid, and, like it, a very portable instrument, in which the movement is produced by the inequalities of atmospheric pressure on the convex and concave sides of a thin box in the form of a segment of a circle. The idea is ingenious. It is very similar to a contrivance of Messrs Bryson of Edinburgh in 1849, which diminished the instrument to the size of a small snuff-box. Both appear to be original, but are perhaps inferior to the instrument of Vidi.

Register Barometers. Barometers have been invented which indicate their own extremes of altitude during the absence of the meteorologist. These instruments render his task less irksome; and if generally adopted, would increase our knowledge of atmospheric phenomena.

Dr Traill exhibited to the meeting of German philosophers at Hamburg in 1830, a register-instrument which he had constructed for showing the maxima and minima of barometric pressure during the absence of the observer. It is cheap and simple in construction, and consists of two diagonal barometers, one of which is inverted, and resembles in principle the rectangular barometer. Both are attached to the same frame. Before bending and filling the upright one, and after filling the inverted barometer, a piece of smooth steel wire is introduced into each, to serve as indices to the instrument.

Fig. 3.



When the upright barometer rises, the mercurial column pushes before it the index, which remains there by its own gravity on the sinking of the mercury; so that its extremity next the mercury will indicate the extreme rise of the barometer. When the mercurial column descends in the inverted instrument, which has a small aperture to admit atmospheric pressure at its lower extremity, that index is pushed before it, and its end nearest the mercury will indicate the extreme of the barometric depression, should the increased atmospheric pressure cause that end of the column to recede.

In the first instrument of this kind which Dr Traill constructed the inverted one was the common rectangular barometer; but he conceived that it would be preferable to give the same inclination to the angles of each tube, that the gravitation of both indices might be equal, as represented in the woodcut.

To adjust the instrument for observation, the indices are

Supplement.

drawn into contact with the end of each mercurial column by a small magnet. One of the instruments was used for several years without requiring any fresh adjustment. It is not, however, very portable.

A thermometer should be attached to the frame, to indicate the temperature of the instrument, for the same reason as in other barometers. If the cisterns be of considerable size in proportion to the bore of the tubes, we may for common purposes neglect the adjustment for inequalities in the level of the mercury in the cisterns; to which, indeed, it would not be easy to adapt an accurate indicator.

The general appearance of the instrument will be seen in the woodcut; and the construction, it is hoped, will be understood from this short description. This instrument was first published in a German journal, Oken's *Isis;* and again described in the article PHYSICAL GEOGRAPHY, in the seventh edition of this work.

Keith's Siphon Barometer. The late Alexander Keith, Esq. of Ravelston, invented one of the first of such instruments, which was described in the 4th volume of the *Transactions of the Royal Society of Edinburgh.* It is a siphon barometer, in the shorter limb of which an ivory float rests on the surface of the mercury, and carries a wire bent at the top at right angles. This bended extremity is placed between two lists of oiled silk, which it moves up and down as the float rises and falls with the mercury, on a wire stretched along the scale of the instrument. The objection made to this contrivance was, that it is subject to derangement from slight accidental causes, as the collection of dust, and the wearing of the apertures in the silk indices. But Mr Keith improved his barometer farther, by adapting to it a clock, which turned a vertical cylinder, covered with paper ruled into 31 columns, for the days of the month, and a pencil attached to the *kneed* wire traced the oscillations of the column through its whole monthly course. At the commencement of each monthly period, a new paper was substituted for the old, which was preserved in the register of the weather.

This very ingenious instrument never came into much use, both on account of the expense, and because it was alleged that the continual friction of the pencil rendered slight changes of atmospheric pressure inappreciable.

Bryson's Improved Siphon Barometer. More recently a great improvement on the instrument of Mr Keith was contrived and executed by the late Mr Bryson, an eminent watchmaker of Edinburgh. Supplement.

This is also a siphon barometer, furnished with an ivory float, and *kneed* wire, ending in a small knife-edge, intended to mark the oscillations of the mercurial column. A vertical cylinder of japanned tinned iron, about three inches in diameter, moves round its axis once in every 24 hours. At one of its ends the hours from 1 to 12 A.M. are in red, and from 1 to 12 P.M. in black characters. Seven such cylinders are made, one for each day of the week. The cylinder for each day's observations has its surface thinly coated with a mixture of fine chalk and water, laid on with a camel-hair pencil. The cylinder fits accurately on a square arbor or spindle, which is steadily moved round by clockwork attached to the barometer. The knife-edge, instead of constantly pressing against the cylinder, is made to touch it only for a moment every hour, by means of a series of pins on the wheel connecting the clock with the cylinder. This slight touch is sufficient to cut through the thin film of chalk, and shew a black line on a white ground. There is therefore on the cylinder one such mark for every hour; and their position indicates the successive oscillations of the barometer.

When the day is completed, the cylinder is removed, and a fresh one substituted, and the first is fixed horizontally between two pivots, on which it is made to revolve steadily in what is termed the *reader.* On the front of the *reader* is a scale of inches from 27 to 32, divided into hundredths by means of a vernier, moved by a firm tangent screw, and ending upwards in a point. The precise value of each mark on the cylinder is thus ascertained.

This scale is first adjusted by simultaneous observations on a standard barometer. Should the scale be too high, the fixed pivot of the reader is loosened, and screwed out, until the point of the vernier corresponds to the indications of the standard barometer; after which the fixed pivot is permanently secured in its place for future observations.

The simple mechanism by which he has secured the steady movements of the cylinder in its horary revolution, and when transferred to the reader, is creditable to the skill of the inventor; and the barometer of Mr Bryson may be considered as probably the best register barometer hitherto constructed.

Specimen of Bryson's Hourly Barometric Register.

	A.M.											
1843	1	2	3	4	5	6	7	8	9	10	11	12
June 22	...	...	...	...	...	...	...	...	...	...	...	...
23	29·93	29·91	29·90	29·90	29·90	29·90	29·90	29·92	29·93	29·94	29·94	29·94
24	29·96	29·95	29·95	29·95	29·95	29·95	29·95	29·95	29·92	29·92	29·92	29·93
25	29.97	29·97	29·97	29·97	29·97	29·97	29·97	29·97	29·97	29·97	29·96	29·96
26	29·85	29·85	29·83	29·83	29·83	29·83	29·83	29·83	29·83	29·83	29·83	29·83
27	29·80	29·79	29·79	29·78	29·78	29·78	29·78	29·78	29·77	29·76	29·76	29·74
28	29·71	29·69	29·69	29·69	29·66	29·66	29·66	29·66	29·65	29·65	29·65	29·65
29	29·67	29·67	29·67	29·67	29·67	29·67	29·67	29·67	29·67	29·67	29·65	29·65
30	29·66	29·66	29·65	29·65	29·65	29·65	29·65	29·62	29·62	29·62	29·62	29·62
	P.M.											
June 22	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·97	29·98	29·94	29·93
23	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·96	29·96
24	29·95	29·95	29·95	29·95	29·95	29·95	29·96	29·97	29·97	29·97	29·97	29·97
25	29·93	29·91	29·91	29·91	29·91	29·91	29·91	29·86	29·86	29·86	29·86	29·86
26	29·84	29·84	29·84	29·84	29·80	29·82	29·82	29·82	29·82	29·82	29·82	29·82
27	29·74	29·74	29·74	29·74	29·73	29·73	29·71	29·71	29·71	29·71	29·71	29·71
28	29·63	29·63	29·63	29·65	29·65	29·65	29·67	29·67	29·67	29·67	29·67	29·67
29	29·63	29·62	29·62	29·62	29·62	29·62	29·63	29·64	29·64	29·66	29·66	29·66
30	29·61	29·61	29·61	29·61	29·60	29·63	29·63	29·67	29·67	29·67	29·67	29·68

BAROMETRICAL MEASUREMENTS.

Barometrical Measurements.

It was remarked in the preceding article, that the decisive experiment by which Pascal established the reality of atmospheric pressure, had likewise suggested to this ingenious philosopher the method of determining the elevations of distant points on the surface of the globe. But the first attempts were very rude, proceeding on the inaccurate supposition that the lower mass of air is a fluid of uniform density. Different authors estimated variously from eighty to ninety feet as the altitude, which corresponds to a variation of the tenth part of an inch in the mercurial column. The Torricellian tube or cane, as it was then called, was, on its first introduction to England, carried accordingly to the tops of mountains, or conveyed to the bottom of pits and mines, or even let down to great depths in the sea.

Sinclair.

Among those experimentalists who laboured most assiduously in the study and application of the barometer in this part of the island, we may mention George Sinclair. This ingenious person had been professor of philosophy in the university of Glasgow, but seems to have conscientiously resigned his office soon after the Restoration, rather than comply with that hated episcopacy which the minions of Charles II. had forced upon the people of Scotland. He then retired to the village of Tranent, not far from Edinburgh, and was employed as a practical engineer, in tracing the levels of coal-pits, in directing the machinery employed in the mines at Leadhills, and afterwards in the great undertaking of conducting water from the heights of the Pentlands to supply the northern metropolis. Though not a profound mathematician, he was skilled in mechanics and hydrostatics, and possessed no small share of invention. Sinclair is said to have been the first who applied to the mercurial tube the name of *baroscope*, or *indicator of weight;* the more definite appellation of *barometer*, or *measurer of weight*, not having been appropriated till many years afterwards. During his excursions in 1668 and 1670, he employed that instrument to measure the heights of Arthur's Seat, Leadhills, and Tinto, above the adjacent plains. He followed the original mode of using a tube sealed at the top, with a paper scale pasted against the side, which he carried to the top of the mountain, where he filled it with mercury; and, inverting it in a basin, he noted the altitude of the suspended column, and repeated the same experiment below; a very rude method, certainly, but no better was practised in England during the succeeding thirty years.

In a small scarce tract, printed in 1688, and bearing the quaint title of *Proteus bound with Chains*, Sinclair gives some judicious remarks on the variations of the barometer, considered as a weather-glass, and delivers very sound opinions, on the whole, respecting the causes of the chief meteorological phenomena. In a postscript to that piece, he proposes a most efficient and ingenious method of weighing up wrecks from the bottom of the sea. It consisted in employing two large arks, or square wooden boxes, fastened to the sides of the ship, and charged with air carried down to them by a succession of inverted casks, open at the lower end. An arc of a cubical shape, and twenty feet in every dimension, the smallest which he mentions, would, as he computes, have a buoyancy equivalent to 448,000 pounds Troy. It is remarkable that the celebrated Mr Watt always employed this very mode using a large gazometer, floating in a pond dug in the court of his manufactory, and charged gradually by the action of bellows, for raising the ponderous engines constructed at Soho, and lifting them over his walls into the boats, which were stationed to receive them in the adjacent canal.[1]

Barometrical Measurements.

In all the computations hitherto made from different altitudes of the barometer, the air was considered as a uniform fluid; no regard being had to the gradual diminution of density which must evidently take place in ascending the atmosphere. To estimate the effect of that gradation, it became requisite previously to determine the actual relation subsisting between the density of the fluid and its elasticity. This was first ascertained in England by Townley, who inferred, from some experiments of Boyle, that the elastic force which the air exerts is exactly proportional to its density. A similar conclusion was about the same time drawn by Mariotte, a French philosopher, from a still better series of experiments. Following out this very simple law, he thought of computing heights from barometrical observations, by the rules usually employed in constructing tables of logarithms; and had, therefore, obtained some glimpse, no doubt by a sort of conjectural process, of the remarkable result, that the density of the atmosphere decreases in a geometrical progression, corresponding to the elevations taken after an arithmetical one. But seemingly not aware of the importance of the principle at which he was pointing, Mariotte immediately deserted it; and calculating from a repeated bisection of the column of air between the two stations into successive horizontal strata, he contented himself with interpolating the densities according to a harmonic division, which he next abandoned for the simplicity of a series with equal differences. This able experimenter hence only sketched out a mode of investigating the problem of barometrical measurements, without arriving at any very definite or consistent rule of solution.

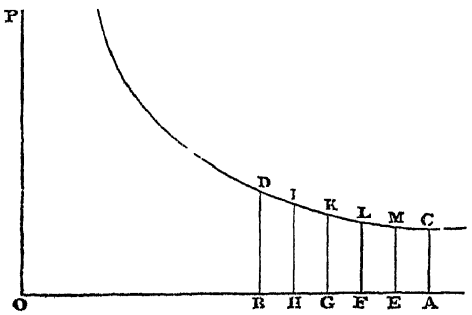
Relation of the air's density and elasticity.

[1] Sinclair was author of a well-known little book entitled *Satan's Invisible World Displayed*, which, at a former period, was sold at all the public fairs in the country, and devoured with eagerness and dismay by the Scottish peasantry. In a quarto volume, on *Hydrostatics, and the Working of Coal-mines*, printed in Holland, and published by subscription in 1672, he digressed so widely from his subject as to insert *A True Relation of the Witches of Glenluce*. But this was the folly of the age, from which several of the most learned men had not been able to escape. It is painful to observe, that James Gregory, the inventor of the reflecting telescope, who, although endowed with talents of the highest order, appears to have had a keen temper, and to have imbibed an hereditary attachment to royalism and episcopacy, should have stooped to attack an unoffending and less fortunate rival. He wrote a little tract against Sinclair's *Hydrostatics*, with the title of the *Art of Weighing Vanity*, and under the thin disguise of Patrick Mather, archbeadle to the university of St Andrew's. It is a piece full of low scurrility, and memorable only for a very short Latin paper appended to it, containing the series first given to represent the motion of a pendulum in a circular arc. In the British Museum, there is a letter of Gregory to Collins, the secretary of the Royal Society, boasting of his project, and soliciting information with which to overwhelm the poor author. But with all his eagerness to hunt down Sinclair, he never touches on the strange episode of the Witches of Glenluce. What a picture of times approaching so near to our own! Sinclair was restored to his chair at the Revolution, and lived a few years longer. He answered Gregory's attack in the same coarse style, charging him with total want of skill in the use of astronomical instruments, though by help of subscriptions he had erected a sort of observatory at St Andrew's. The manuscript of this reply is preserved in the College Library of Glasgow.

Barometrical Measurements.

Relation of atmospheric density and elevation.

In 1686 that ingenious and active philosopher Dr Halley resumed the subject, and discovered the law that connects the elevation of the atmosphere with its density; of which he gave a clear demonstration, derived from the well-known properties of the hyperbola referred to its asymptotes.[1] Since the height of the mercury indicates the pressure, and consequently the elasticity of the external air, it must be proportioned likewise to the density. Wherefore the breadth of a given mass of air, or the thickness of a stratum which corresponds to a certain portion of the mercurial column, will be inversely as this altitude. Let O be the centre of a rectangular hyperbola, of which OA and OP are the asymptotes; and conceive the distances OA and OB to represent the heights of the mercury at two stations. The perpendiculars AC and BD, which are reciprocally as OA and OB, must hence express the relative thickness of strata corresponding to equal portions of the barometric scale. Divide AB into a multitude of equal segments, and erect the perpendiculars EM, FL, GK, and HI. The intercluded spaces, from AC to BD, will denote the successive thickness of the series of strata into which the whole mass of air between the two stations is subdivided. Consequently the aggregate or mixtilineal space DBAC, which is proportional to the logarithm of the ratio of OB to OA, will express the difference of atmospheric elevation when the mercurial column mounts from B to A. Taking equal ascents, therefore, in the atmosphere, the corresponding densities must, from the property of the hyperbola, form a decreasing geometrical series.



Rule deduced.

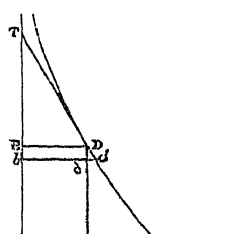
To apply this elegant theorem, Dr Halley availed himself of the best experiments which had been performed to determine the relative densities of air, water, and mercury. In different trials made near the earth's surface, it was found, when the barometer stood at 29¾ inches, that the air is 840, 852, or even 860 times lighter than water. Employing round numbers, therefore, and assuming the specific gravity of mercury to be 13½, he reckoned $800 \times 13\frac{1}{2} \times 30 = 10{,}800$ inches, or 90 feet, as the altitude of an atmospheric column which, near the level of the sea, would exert a pressure equivalent to that of an inch of mercury. For the co-efficient, which answers to the actual constitution of the atmosphere, Halley should have taken the thirtieth part of ·4342945, the modulus of the common system of logarithms, or ·0144748. But he proceeded less directly, having satisfied himself with taking the arithmetical mean between the differences of the logarithms of 29 and 30, and of those of 30 and 31; a compensation of errors which gives ·0144765, hardly deviating from the former. Hence he gave this simple analogy for computing the heights of mountains by the barometer: *As the constant number* ·0144765 *is to the difference between the logarithms of the barometric columns at the two stations, so is* 900 *feet to the elevation required.* The result of this operation is evidently the same as if the logarithmic difference had been multiplied by the number 62170; a very tolerable approximation at all seasons for a northern climate, and quite accurate, indeed, if the mass of intervening air had a medium temperature of 46° by Fahrenheit's scale. Dr Halley supposed that the observations themselves might, from the influence of heat, differ about a fifteenth part between summer and winter. But the thermometer was still so imperfect an instrument, that it could not be applied with confidence in correcting such variations.

Barometrical Measurements.

Otherwise investigated.

The principle which Halley thus investigated might be derived from a simpler process. Conceive the atmosphere to be divided into a multitude of equally thin horizontal layers, it is evident that each successive stratum would, to the pressure of the superincumbent stratum, add its own weight, which being as its density or elasticity, is therefore proportioned to the collective pressure; and, consequently, those densities must continually increase in going downwards, exactly in the same way, and after a like progression, as money accumulates at compound interest, where a constant portion of the aggregate fund is regularly joined to the capital.[2] Such, in fact, is the distinguishing character of a geometrical progression, that the increase or decrease of each succeeding term is always proportional to the term itself. The logarithmic curve is hence the best adapted for exhibiting the relations which connect the densities with the elevations in the atmosphere; the axis of the curve expressing the elevation, while each ordinate represents the corresponding density of the stratum of air. It being a fundamental property of the logarithmic curve, that every subtangent applied to it has the same length, the exact determination of this in the case of our atmosphere is the only thing wanted for the final solution of the general problem.

Let AB, the abscis of a logarithmic curve, represent a line descending perpendicular through the atmosphere; the ordinates AC and BD will indicate the elasticity of the strata at A and B, and consequently, abating the influence of temperature, their densities. Draw the tangent DT, and form the elemental triangle $Dd\delta$; then BD : BT :: δd : δD, or inversely BD : δd :: BT : δD. But the thickness δD of each accrescent stratum being assumed to be the same, and the subtangent being constant, from the nature of the curve; the ratio of BT to δD is given; therefore the ratio of BD to δd is likewise given, or the increment of the density in the successive strata is proportional to



[1] It appears, however, that he was anticipated by Huygens, who had found, as early as the year 1662, that the altitudes of successive strata of air being taken in arithmetical progression, the corresponding densities will form a geometrical series. This beautiful proposition he never published, indeed, but left it recorded upon one of the blank leaves of a Dutch almanac, containing various other speculations, and now preserved in the library of the university of Leyden.

[2] To illustrate still further this comparison; if we reckon the mean altitude of a uniform atmosphere to be 26000 feet, it will follow that, for every descent of 26 feet, the density of the air will increase one thousandth part. This rate of progression corresponds precisely with the weekly improvement of money invested at 5 per cent. per annum, supposing, for the sake of simplicity, the year to contain only 50 weeks. Since money at the statute interest doubles in 14½ years, so the air has its dilatation doubled at the height of $26 \times 50 \times 14{\cdot}2$ or 18466 feet, answering to three miles and a half.

Barometrical Measurements.

the density itself, the leading property of air. The pressure of the thin stratum at B is represented by BD*db*, which is equal to the rectangle under BT and *bd*. Hence, drawing the parallel DE, the collective area ABDC, which represents the weight of the atmosphere between the altitudes A and B, is equal to the rectangle under the subtangent and EC. But AB expresses the difference of the logarithms of the ordinates AC and BD, or the densities at A and B; and consequently this difference multiplied by the length of BT will indicate AB. In relation to our atmosphere at the point of congelation, the numerical value of the subtangent is about 26,000 feet, which is very nearly the product of 60,000 into the *modulus* of the ordinary logarithms.

Eleven years after Dr Halley had given his rule for barometrical measurements, this philosopher had an opportunity of applying it to discover the height of Snowdon in North Wales. He found that the barometer which stood at 29·9 inches on the sea-shore near Caernarvon, fell a few hours after, when planted on the summit of the mountain, to 26·1 inches, the altitude having been ascertained previously, by a trigonometrical observation, to be 1240 yards.

Newton's general solution.

The year 1687 is memorable as being the date of the first publication of the *Principia*, which was drawn up chiefly at the urgent request of Halley, from disjointed materials that had lain a considerable time in the author's closet. In that immortal work, Newton resumed the problem of the gradation of atmospheric density, and solved it in that general way which suited his penetrating genius. He demonstrated that, supposing the particles of air, like other bodies, to have their weight or gravitating tendency diminished as the squares of their distances from the centre of the earth, if those distances be taken in harmonic progression, the corresponding densities of the atmosphere will form a geometrical one. But since the diminution of attraction at the greatest height we are able to reach amounts only to the two thousandth part of the whole, this difference is too minute to be adopted in practice; and the simpler law first established by the sagacity of Halley may be deemed sufficiently accurate for every real purpose.

Newton has given a sort of geometrical solution of the problem. But a more precise, and, in this case, a clearer investigation, is obtained by help of the symbols of the integral calculus. Let x and x' express the altitudes of two strata of atmosphere, y and y' the corresponding densities, r the radius of the earth; and suppose further, that e represents the altitude of the equiponderant column which measures the elasticity of the air. Since the density of the air depends on the incumbent pressure, its decrement must evidently be proportional to the weight of each superadded minute stratum, or to the density of this stratum multiplied into its thickness and power of gravitation.

Whence $-edy = ydx\left(\frac{r}{r+x}\right)^2$, or $-\frac{edy}{y} = \frac{r^2dx}{(r+x)^2}$,

of which the complete integral is e Hyp. Log. $\frac{y'}{y} = \frac{r^2}{r+x} - \frac{r^2}{r+x} = \frac{r^2}{r+x}\cdot\frac{x'-x}{r+x'}$. If r be regarded as indefinitely great in comparison of x, the expression will pass into e Hyp. Log. $\frac{y'}{y} = x' - x$, which is only the common formula.

Application of the thermometer.

Little seemed wanting, therefore, to complete the practice of barometrical measurements, but the application of the thermometer to correct the results. This instrument, however, advanced slowly to perfection, and more than forty years yet elapsed before it came into current use. Some of the continental philosophers likewise, biassed, perhaps, by a secret jealousy of the superiority which England had acquired in science, began to throw out doubts respecting the reality or accuracy of the law of geometrical progression in the atmosphere. Daniel Bernoulli, a man of candour on the whole, as well as ingenuity, but who, with some proneness to speculative reasoning, had unfortunately imbibed many of the prejudices of the Cartesian and Leibnitzian schools, proposed in his capital work, the *Hydrodynamica*, which appeared in 1736, some vague hypotheses regarding the constitution of the atmosphere, as deduced from certain internal motions attributed to its component strata. The specious results of those calculations led him hastily to deviate from the principle of the geometrical progression of density in the upper regions. In this departure from nice theory he was followed by Cassini and Horrebow, who concluded, from some partial observations they had made, that the barometer, in its indications of atmospheric pressure, is subject to irregularity; and that, near the surface of the earth, it obeys a different law from that which obtains at great elevations. A strong light, however, was thrown upon the subject in 1753 by Bouguer, an able mathematician and very skilful and ingenious observer, who, with other academicians, had been employed for several years in measuring a degree of the meridian along the stupendous ridge of the Andes. From the comparison of more than thirty distinct observations, he deduced a simple and elegant rule for computing heights by means of the barometer. It is this, that the difference between the logarithms of the mercurial columns at the two stations being *diminished* by one thirtieth part, and the decimal point shifted four places to the right, will express the required elevation in *toises*. Since the English was to the French foot nearly as fifteen to sixteen, the rule would be accommodated to our measures, and the result expressed in feet, if the logarithmic difference were *augmented* by the thirtieth part, then multiplied by six, and the decimal point thrown back four places; or, which is the same thing, if that logarithmic difference were multiplied at once by 62,000. But Bouguer imagined, that this rule would not hold exactly in Europe, or in the lower regions of the torrid zone; and to explain the deviation, he had recourse to the forced supposition that the particles of air possess different degrees of elasticity. Lambert, a philosopher of great originality and penetration, afterwards published some excellent remarks on the comparison of barometrical measurements. But no material progress was made till 1755, when M. de Luc of Geneva resumed the subject, and carefully combined experiment with observation. For the space of fifteen years and upwards, he prosecuted his inquiries with diligence and perseverance, aided by the peculiar advantages of local situation, in a city abounding with skilful artists, and seated in the neighbourhood of lofty mountains. The discrepancies which had hitherto created so much embarrassment proceeded mostly from the inattention of observers to the disturbing influence of heat, and particularly its effect in expanding the air, and consequently augmenting the elevation due to a given difference of atmospheric pressure. De Luc's first object was to improve the thermometer of Reaumur, which, though greatly inferior to that of Fahrenheit, had been adopted in France and the adjacent parts of the Continent. Having ascertained that mercury has the valuable property of expanding equably with equal additions of heat, he substituted that metallic fluid for spirit of wine, but retained its arbitrary and inconvenient scale of eighty degrees between the points of freezing and boiling water. He next examined the dilatation of air

Bouguer.

De Luc.

Barometrical Measurements.

at different temperatures, and corrected those results by numerous observations made on the mountains of Savoy, and the mines of the Hartz, in which the barometer was combined with the thermometer. The *formula* which he thence deduced for the computation of barometrical measurements was, in 1772, published in his *Recherches sur les Modifications de l'Atmosphère*, and seemed to attract, especially in England, a very considerable degree of notice. Dr Maskelyne, the astronomer-royal, adapted it to our system of measures, and De Horsley made annotations and comments on it. But, what was of more importance, other accurate observers, incited by De Luc's example, entered the same field of inquiry, provided with instruments of greater delicacy and much better construction.

Shuckburgh,

In 1775 Sir George Shuckburgh Evelyn visited the Alps, and combined trigonometrical operations with corresponding observations by barometers and thermometers from the hands of Ramsden; and about this time likewise,

and Roy.

General Roy not only measured, with instruments made by that excellent artist, some of the principal mountains in Scotland and Wales, but instituted a series of manometrical experiments. It resulted from all these researches that, for each degree on Fahrenheit's scale, mercury expands the 9700th part, and air the 435th part of their respective bulks. It further appeared that the atmosphere has its temperature almost uniformly diminished at equal ascents; and that the logarithmic difference, reckoning as integers the first four digits, expresses in English fathoms the height of an aërial column as cold as the point of congelation. General Roy proposed likewise another correction depending on the enfeebled gravity, and consequently the augmented altitude, of the equiponderant column of atmosphere in the lower latitudes, occasioned by the influence of centrifugal force arising from the earth's rotation. Several years afterwards, Professor Playfair, in a learned paper, printed in the first volume of the *Transactions of the Royal Society of Edinburgh*, examined all the circumstances which can affect barometrical measurements, and discussed each question with the correctness and perspicuity that we might expect from his distinguished abilities. At nearly an equal interval of time the celebrated Laplace resumed the subject in his *Mécanique Céleste*, and brought all the conditions together in a very complicated formula. Such an appearance of extreme accuracy, however, is perhaps to be regarded merely as a theoretical illusion, unsuited and inapplicable to any real state of practice. Biot has since attempted to arrive at a similar conclusion, by setting out *à priori* from some careful experiments on the relative density of air and mercury, performed by him in conjunction with Arago. He thence infers that, in the latitude of Paris, and at the point of congelation, air, under a mercurial pressure of 76 metres, or 29,922 English inches, is 10,463 times lighter than mercury at the temperature of water at its lowest contraction. This would give 26,090 feet for the height of a column of homogeneous fluid, whose pressure is equivalent to the elasticity of the atmosphere. The co-efficient adapted to common logarithms, and adjusted to the force of attraction at the level of the sea, would therefore be 60,148 feet, or 18,334 metres; scarcely differing sensibly from the quantity which Ramond had deduced from a very numerous set of experiments made by him on the Pyrenees. But Biot prefers, as the co-efficient, the number 18,393, answering for an elevation of 1200 metres, or about 4000 feet above the sea, which is not far from the general level of such observations. The formula is hence, in English feet,

Formula of Laplace.

$$60{,}346\ (1 + \cdot 002837 \cos. 2\psi)\left(1 + \frac{2(T+t)}{1000}\right) \log. \frac{H}{h};$$

where ψ denotes the latitude of the place, T and t the temperatures of the air at the two stations, as indicated by the centesimal thermometer, and H and h the heights of mercurial columns corrected for the effects of heat.

Barometrical Measurements.

This active writer has likewise given tables for expediting the calculation of barometrical measurements; in which he was anticipated, however, by Oltmans of Berlin, who published, in 1809, large *Hypsometrical Tables*, as they are called, accommodated to the complex formula of Laplace. Such tables might no doubt prove useful where very frequent computations are wanted, as in the case of the reduction of the numerous observations brought home by Baron Humboldt, for which, indeed, they were first designed. But still they contain a needless profusion of figures, and hold forth a show of extreme accuracy which the nature of the observations themselves can never justify. The mere calculation of barometrical measurements is a secondary object. The great difficulty is to procure good observations, and to combine tolerable accuracy with expedition. For this purpose, a very portable barometer is still wanted;—an instrument light and commodious, exempt from injury or derangement, and yet sensible to minute changes of atmospheric pressure. These properties, indeed, are seldom conjoined, and one advantage must generally be sacrificed to obtain another. A modification of the conical barometer already suggested would seem, on the whole, to be well adapted for the geological traveller. The two unequal tubes are cemented into a small cylinder of steel, with a fine stop-cock of the same metal confining the mercury. This renders the instrument so portable that it may be inclosed in a walking-stick; on turning the steel-cock, and inverting the staff, the height of the mercurial column is readily found.

Mountain barometer. Pl. CIV.

A barometer of the most improved construction is represented in fig. 19; a portion of the tube is shown in fig. 20; and a section of its cistern in fig. 21. By help of a screw pressing against the bottom of a leathern bag, inclosed within a cylindrical ivory box, the mercury is always brought up through a tubular aperture to the same precise level; or till its convex surface appears to touch a very thin line of light, which is admitted through a slip of ivory applied against the side of the chink or separation of this tube from a wider one immediately over it. The lower end of the mercurial column being thus adjusted, the length is easily measured by drawing gradually down a hollow brass tube, divided at intervals by wide slits, covered on one side by thin bits of ivory, till by that softened light a contact is observed with the edge of a slit and the convex top of the column. The fine Vernier which the movable tube carries gives the altitude of the mercury in thousandth parts of an inch. A thermometer is likewise constantly attached to the instrument, for the purpose of indicating the temperature of the mercury, which, from the heat of the hand in carrying, or the influence of the solar beams, is commonly warmer than the external air.

This mountain barometer is suspended for observation by jimbols from a tripod, as exhibited in fig. 18; but its several parts can be folded up together into a convenient compass, tolerably well fitted for carriage, as represented in fig. 19. The whole apparatus may not exceed the weight of ten pounds; yet even this, moderate as it might seem, would be felt a serious encumbrance by a traveller who is engaged, day after day, in the labour of climbing mountains. The risk which the instrument incurs, besides, in transporting it perhaps over rough precipices, imposes a perpetual constraint, while to make correct observations with it must always require time and patient attention. A lighter and more compact, though less accurate, barometer will generally be preferred by the geo-

Barometrical Measurements.

logical traveller, whose object is rather to extend our acquaintance with the altitudes of mountains, than to aim at a superfluous and often illusory precision. The portable instrument, invented by Sir Henry Englefield, and represented in fig. 14, will, on the whole, answer those views. Its cistern is formed of box-wood, sufficiently tight to hold the mercury, without preventing the access and impression of the external air. When this barometer is inverted, the mercury, therefore, subsides very slowly in the tube, which must be firmly suspended in a vertical position. For greater security, the mercury is now put into a leathern bag introduced within the cistern.

Portable barometer of Sir H. Englefield, and of Gay-Lussac.

A very simple and convenient sort of portable barometer was lately invented in France by that celebrated chemical philosopher M. Gay-Lussac. (See fig. 15 and 16.) It consists of rather a wide siphon tube, filled with mercury, and sealed hermetically at the inverted end, having a very fine capillary hole formed about an inch under this, by nicely directing the flame of a blow-pipe against the side of the glass, and drawing a melted spot of it out to a point. The lower portion of the principal branch has its bore contracted to less than the tenth part of an inch, to prevent the mercurial column from dividing in the act of inverting it. The mercury is boiled as usual, and the tube may be concealed in a walking-stick, or lodged, like the complete mountain barometer, in a cylinder of brass, with movable sliders bearing the divisions of a Vernier at both ends. (See fig. 17.) For greater simplicity, however, the larger divisions might be engraved on the tube itself. This kind of barometer is of ready use, and very little exposed to hazard in carriage. It is commonly held in a reclined or inverted position; but, in making an observation, it must be gently turned back, and kept perpendicular till the mercury descends through the contracted bore, and slowly rises again in the opposite short branch; the scale is noticed at both ends of the incurved column, and the difference of those indications gives its correct altitude.

Modified conical barometer.

A modification of the conical barometer, which, in travelling, we have ourselves employed with great ease and advantage, should likewise be mentioned. The principal part of it consists of a small stop-cock made of steel, and represented in fig. 13. A glass tube of 31 or 32 inches long, with a bore of the tenth part of an inch hermetically sealed at the top, and filled with quicksilver, is cemented into the one end of the stop-cock; and into the other end is cemented an open and wider tube, 16 inches or more in length, and having its diameter above the eighth part of an inch. This compound tube is lodged in a walking-stick, divided into inches and tenths through its whole extent, or only at the upper part, if uniform tubes be selected. In making an observation, the cock is turned, and the instrument inverted. The upper column then descends partly into the lower tube, till it becomes shortened to the proper altitude.

We have already stated the principles on which the calculation of barometrical measurements proceeds. But there still are some points, either assumed or overlooked, which may considerably modify the results. It is presumed, that, at equal successive heights, the temperature of the atmosphere decreases uniformly. This property, however, does not hold strictly, and it may be shown, from a comparison of the best observations, that the decrements of heat follow a quicker progression in the higher regions. But we shall soon have another opportunity to examine this subject, and trace out its various consequences.

The humidity of the air also materially affects its elasticity, and the hygrometer should therefore be conjoined with the thermometer in correcting barometrical observations. But nothing satisfactory has yet been done in regard to that subject. The ordinary hygrometers, or rather hygroscopes, are mere toys, and their application to science is altogether hypothetical. A most unphilosophical course has lately been pursued, by multiplying calculations grounded on very loose data, instead of instituting a nice and elaborate train of original experiments.

Barometrical Measurements.

In the actual state of physical science, it is preposterous, therefore, to affect any high refinement in the formula for computing barometrical measurements. The whole operation may be reduced to a very short and easy process. But the simplicity of the calculation would be still greater, if the centesimal thermometer were generally adopted. It will be sufficiently accurate, till better data are obtained, to assume the expansion of mercury by heat as equal to the 5000th part of its bulk for every centesimal degree, while that of air is twenty times greater, being an expansion for each degree of the 250th part of the bulk of this fluid. 1. *Correct the length of the mercurial column at the upper station, adding to it the product of its multiplication into twice the difference between the degrees on the attached thermometers, the decimal point being shifted four places to the left. 2. Subtract the logarithm of this corrected length from that of the lower column, multiply by six, and move the decimal point four places to the right; the result is the approximate elevation expressed in English feet. 3. Correct this approximate elevation by shifting the decimal point three places back to the right, and multiplying by twice the sum of the degrees on the detached thermometers; this product being now added, will give the true elevation.*

Rule for computing barometrical measurements.

If it were judged worth while to make any allowance for the effect of centrifugal force, this will be easily done before the last multiplication takes place, by adding to twice the degrees on the detached thermometers the fifth part of the mean temperature corresponding to the latitude. The mean temperature itself is formed by multiplying the square of the cosine of the latitude by twenty-nine.

Examples.

In illustration of these rules, we shall subjoin some real examples. General Roy, in the month of August 1775, observed the barometer on Caernarvon Quay, at 30·091 inches, the attached centesimal thermometer indicating 15°·7, and the detached 15°·6; while, on the peak of Snowdon, the barometer fell to 26·409 inches, and the attached and detached thermometers marked respectively 10°·0 and 8°·8. Here twice the difference of the attached thermometers is 11°·4, and twice the sum of the detached thermometers is 48°·8, which becomes 50·8 when augmented by the fifth part of the mean temperature on that parallel. Now, omitting the lower decimals, the first correction is ·00264 × 11·4 = ·030, to be added to 26·409. Wherefore,

Log. 30·091	= 1·4784866
Log. 26·439	= 1·4223450
Difference	= ·0561416
Constant multiplier	= 60000
Approximate height	= 3368·496

And, for the true height, the correction is 3·37 × 50·8 = 171·2, which gives 3340 for the final result.

We shall take another example from the observations made by Sir George Shuckburgh Evelyn, at the same period, among the mountains of Savoy. This accurate philosopher found the barometer, placed in a cabin near the base of the Mole, and only 672 feet above the surface of the lake of Geneva, to stand at 28·152 inches, while the attached and detached thermometers indicated 16°·3 and and 17°·4; but, in another barometer carried to the summit of that lofty insulated mountain, the mercury sunk to 24·176 inches, the attached and detached thermometers marking 14°·4 and 13°·4. Wherefore, twice the difference

Barometrical Measurements.

of the degrees on the attached was 3°·8, and twice the sum of the degrees on the detached thermometers was 61°·6. Consequently the correction to be applied to the higher column was ·0024 × 3·8 = ·009, which makes it 4·185. Now,

Log. 28·152 =	1·4495092
Log. 24·185 =	1·3835461
Difference =	·0659631
Constant multiplier =	60000
Approximate elevation =	3957·786

To correct this approximate elevation, remove the decimal point three places back, and multiply it by 61°·6, increased by 2°·9, the fifth part of the mean temperature, corresponding to the latitude; but 3·96 × 64·5 = 255·4, and 3957·8 + 255·4 = 4213. Hence the summit of the Mole is 4885 feet above the lake of Geneva, or 6083 feet above the level of the Mediterranean Sea.

The last example we shall give is drawn from the observation which Baron Humboldt made among the Andes, near the summit of Chimboraço, the highest spot ever approached by man. This celebrated traveller found there, that the barometer fell to 14·850 English inches; the attached thermometer in the tent being at 10°, and the detached in open air being 1°·6 under zero. But the same barometer, carried down to the shore of the Pacific Ocean, rose exactly to thirty inches, while both the attached and detached thermometers stood at 25°·3. Consequently the correction to be applied to the upper column is = ·0015 × 30·6 = ·045. Wherefore,

Log. 30·000 =	1·4771213
Log. 14·895 =	1·1730405
Difference =	·3040808
Constant multiplier =	60000
Approximate elevation =	18244·848

Now, the difference of the detached thermometers, or 26°·9, being doubled and further increased by 5°·8, the fifth part of the mean temperature at the equator, makes 59°·6; and the final correction to be applied is therefore = 18·24 × 59°·6 = 1087, which gives 19,332 feet for the true elevation observed, or 2140 feet below the summit of Chimboraço.

Calculation without logarithms.

These calculations are performed by the help of logarithms. It is desirable, however, to approximate at least to barometrical measurements without such aid. A very simple rule for this object has been given by Professor Leslie in his *Elements of Geometry*. Since $\log.\frac{a}{b} = 2\,M\left(\frac{a-b}{a+b} + \frac{1}{3}\left(\frac{a-b}{a+b}\right)^3 + \frac{1}{5}\left(\frac{a-b}{a+b}\right)^5 \text{ \&c.}\right)$, where M denotes the modulus of the logarithmic system; when a approaches to b, the lower terms may be rejected without sensible error, or $\log.\frac{a}{b} = 2\,M\left(\frac{a-b}{a+b}\right)$, very nearly.

Wherefore, in reference to our atmosphere, the modulus is expressed by the equiponderant column of homogeneous fluid, or 60,000 × ·4342945 = 26,058 feet, or only 26,000 in round numbers; whence, *as the sum of the mercurial columns is to their difference, so is the constant number* 52,000 *feet to the approximate height.* Let General Roy's observation on Snowdon be resumed as an example: the analogy is 30·091 + 26·439 : 30·091 — 26·439, or 56·530 : 3·652 : : 52,000 : 3,359, the approximate elevation, differing very little from the logarithmic result.

This mode of calculation may be deemed sufficiently accurate for determining any altitude that exceeds not 5000 feet. But it will extend to greater elevations if the second term of the series be likewise taken, which is done by striking off three figures, and cubing the half of this number. Thus, resuming the mensuration of Chimboraço, 44·895 : 15·105 : : 52,000 : 17,496, and $(8·75)^3 = 670$, making together 18,166 for a nearer approximation.

Barometrical Measurements.

Barometric scale.

The calculation of barometrical measurements, including the corrections required, is rendered most easy and expeditious by means of a sliding rule made by Mr Cary, optician in London. This small instrument should always go along with mountain barometers; and it will be found a very agreeable companion to every geological traveller.

But portable barometers, in spite of every precaution, are yet so liable to be broken or deranged, that other auxiliary methods are desirable for ascertaining distant elevations. In this view, the variation of the boiling point of water was proposed by Fahrenheit as far back as the year 1724; the idea having occurred to him, as it had done before to Amontons, while engaged with experiments to perfect his thermometer. Little regard, however, seems to have been paid to the suggestion till De Luc and Saussure made a series of observations on the heat of ebullition at different elevations above the surface. About thirty years since, Cavallo attempted to revive the scheme of Fahrenheit, but experienced much difficulty in preventing the irregular starts of the thermometer plunged in boiling water. The best and surest way of examining the heat of ebullition, is to suspend the bulb of the thermometer in the confined steam as it rises from the water.

Temperature of boiling water applied to the mensuration of heights.

The heat at which water boils, or passes into the form of steam, depends on the weight of the superincumbent atmosphere. By diminishing this pressure, the point of ebullition is always lowered. It appears that, while the boiling heat sinks by equal differences, the corresponding atmospheric pressure decreases exactly, or at least extremely nearly, in a geometrical progression, it being found that every time such pressure is reduced to one half, the temperature of boiling water suffers a regular diminution of about eighteen centesimal degrees. This beautiful relation assimilates with the law which connects the density and elevation of the successive strata of the atmosphere. The interval noticed between the boiling points at two distinct stations must be proportional to their difference of altitude above the level of the sea. We have, therefore, only to determine the co-efficient or constant multiplier, which may be discovered either from an experiment under the rarefied receiver of an air-pump, or from an actual observation performed at the bottom and on the top of some lofty mountain. We shall prefer at present the observation made by Saussure on the summit of Mont Blanc. This diligent philosopher found, by means of a very delicate thermometer constructed on purpose, that water which boiled at 101°·62 in the plain below when the barometer stood at 30·534 English inches, boiled at 86°·24 on the top of that mountain, while the barometer had sunk to 17·136. Wherefore the distance between the points of ebullition, or 15·38 centesimal degrees, must correspond to an approximate elevation of 15,050 feet, which gives 978½ feet of ascent for each degree, supposing the mean temperature of the atmospheric column to be that of congelation. But it will be more convenient to assume 1000 for the constant multiplier, which corresponds to the temperature of 5½°.

To reduce this very simple result into practice, it would be requisite to have a thermometer with a fine capillary bore, and nicely constructed, the stem six or eight inches long, and bearing ten or a few more degrees from the boiling point; these degrees to be divided into twenty or perhaps fifty equal parts engraved on the tube, which should be rather thick, and terminating in a bulb of about half an inch diameter. This thermometer, being fitted

Barometrical Measurements || Baron.

with a brass ring two inches above the bulb, should screw into the narrow neck of a small copper flask, which holds some water, but has a hole perforated near the top for allowing the steam to escape. The water may be made to boil by the application of a lamp. The difference between the indications of the thermometers at the two stations being multiplied by a thousand feet, will give the elevation corresponding to a temperature of $5\frac{1}{2}°$. The correction for the actual mean temperature can easily be applied. If a more correct co-efficient be afterwards determined, the same thousand, retained as a multiplier, may easily be adapted to another temperature.

Mode of tracing vertical sections.

This method of measuring elevations on the surface of the globe is, therefore, capable of great improvement, and might be employed with advantage in a variety of cases where observations with the barometer are not easily obtained. Its application would be most important to physical geography, in ascertaining the capital points for tracing the outline of the profile or vertical section of any country. The common maps, which exhibit mere superficial extension, are quite insufficient to represent the great features of nature, since the climate and productions of any place depend as much on its elevation above the sea as its latitude. Scientific travellers have accordingly turned their attention of late years to the framing of vertical sections. As a specimen, we give, in fig. 22, from Humboldt's *Geography of Plants*, a section across the American continent, one of the best and most interesting that has yet appeared. It consists, in fact, of four combined sections, traversing through an extent of 425 miles. The line begins at Acapulco, on the shore of the Pacific Ocean, and runs 195 miles, about a point of the compass towards the east of north, to the city of Mexico; then 80 miles, a point to the south of east, to La Puebla de los Angeles; again it holds a north-east direction of 70 miles, to the Cruz Blanca; and finally bends 80 miles east by south, to Vera Cruz, on the coast of the Atlantic. A scale of altitudes is annexed, which shows the vast elevation of the table-land of Mexico. An attempt is likewise made in this profile to give some idea of the geological structure of the external crust. *Limestone* is represented by straight lines slightly inclined from the horizontal position; *Basalt*, by straight lines slightly reclined from the perpendicular; *Porphyry*, by waved lines somewhat reclined; *Granite*, by confused hatches; *Amygdaloid*, by confused points.

Barometrical Measurements || Baron.

The Caspian below the level of the ocean.

By this mode of distant levelling, a very interesting discovery, in another quarter of our globe, was made by Engelhardt and Parrot, two Prussian travellers. They proceeded, on the 13th July 1814, from the mouth of the Kuban, at the island of Taman, on the Black Sea; and, examining carefully every day the state of the barometer, they advanced with fifty-one observations, the distance of 990 wersts, or 711 English miles, to the mouth of the Terek, on the margin of the Caspian Sea. Similar observations were repeated and multiplied on their return. From a diligent comparison of the whole, it follows that the Caspian is 334 English feet below the level of the Black Sea.[1] That the Caspian really occupies a lower level than the Ocean, had been suspected before, from a comparison of some registers of barometers kept at St Petersburg, and on the borders of that inland sea; but the last observation places the question beyond all doubt. It further appears, that within 250 wersts, or 189 miles, of the Caspian, the country is already depressed to the level of the Ocean, leaving, therefore, an immense basin, from which the waters are supposed to have retired by a subterranean percolation.

If the same plan of barometrical measurements had been followed by the adventurous explorers of the African continent, and the altitudes of the central lakes ascertained, the question regarding the course of the Niger would have been much sooner settled, and much vague and unsatisfactory discussion avoided. Even thermometrical observations of the temperature of springs, or of the ground at moderate depths, would have furnished an approximation to those elevations sufficiently near for solving that great problem in geography on scientific principles alone.

The spirit of modern enterprise has more lately carried barometers to the remotest and loftiest stations on the surface of our globe. It has been thus ascertained that some of the mountains in the equatorial parts of America attain the stupendous altitude of 25,000 feet, while the great chain of Upper India seems to rear its vast summit about 2000 feet still higher. See CLIMATE, HYGROMETRY, and METEOROLOGY. (J. L.)

BARON. The origin and primary import of this term have been much contested. Menage derives it from the Latin *baro*, a word which we find used for *vir*, a "stout" or "valiant man;" whence it was that those placed next the king in battles were, according to him, called *barones*, as being the bravest men in the army; and as princes frequently rewarded with fees the bravery and fidelity of those about them, the word came to signify any noble person who held a fee immediately of the king. Isidore, and after him Camden, suppose the word, in its original acceptation, to have meant a "mercenary soldier;" and Messieurs de Port Royal derive it from βάρος, "weight" or "authority." But Cicero uses the word *baro* for a stupid brutal man; the old Germans make mention of "buffeting a baron," meaning a villain; and the Italians use the word *barone* to signify a "beggar." M. de Marca thinks baron derived from the German *bar*, "man," or "freeman;" others seek its origin in the old Gaulish, Celtic, and Hebrew languages; and some are of opinion that it comes from the Spanish *varo*, a "stout noble person;" whence wives used to call their husbands, and princes their tenants, "barons." In the Salic law, as well as in the laws of the Lombards, the word *baron* signifies *man* in general; and, accordingly, the old glossary of Philomenes renders baron ἀνήρ, "man." The old law expression "*baron* and *feme*" (man and wife) preserves the traces of this signification.

The term is more particularly applied among us to a lord or peer of the lowest class, or a degree of nobility next below that of viscount. In ancient records the word *baron* included all the nobility of England, because all noblemen were barons even although they occupied a higher rank in the peerage. But it sometimes happened, that, when a baron had been raised to a new degree of peerage, the two titles, in the course of a few generations, descended differently, one perhaps to the male descendants, and the other to the heirs-general, by which means the earldom or other superior title subsisted without a barony; and there are also modern instances where persons have been created earls and viscounts without annexing a barony to their other

[1] The trigonometric measurement, however, of Fuss, Sabler, and Sawitsch, make the depression of the Caspian much less, being only 81.4 English feet.

Barons. honours; so that now the rule does not hold universally that all peers are barons.

The origin and comparative antiquity of barons have been the subject of much research amongst English antiquaries. But the most probable opinion is, that they were the same with our present lords of manors; to which the appellation of *court-baron*, which is the lord's court, and incident to every manor, seems to give countenance. The original name of this dignity in England is said to have been *vavassour*, which by the Saxons was changed into *thane*, and by the Normans into *baron*. From Magna Charta it appears that originally all lords of manors, or barons, had seats in the great council or parliament; but such is the defective state of the public records, that the first precept to be found is not of older date than the 49th of Henry III.; and this, though it had been issued out in the king's name, had neither his authority nor his sanction, the king himself, his son Prince Edward, and most of the nobility who remained faithful to him, being then prisoners in the hands of the rebellious barons.

Before the date above mentioned, the ancient parliaments consisted of archbishops, bishops, abbots, earls, and barons. Of these barons there were two sorts; the greater barons, or the king's chief tenants, who held *in capite* of the crown; and the lesser barons, who held of the greater by the tenure of military service. The former had a summons to parliament by several writs; and the latter, if possessed of thirteen knights' fees and a quarter, had a general summons from the sheriff in each county. At the date above given, instead of keeping to the old form, the prevailing powers thought fit to summon only those of the greater barons who were of their party, and, in room of the lesser barons who attended with large retinues, to issue their precepts to the sheriffs of counties to cause two knights in every shire to be chosen, and one or two burgesses for each borough, to represent the people residing in those counties and boroughs; —an innovation which gave rise to the separation into two houses of parliament. Hence the title came by degrees to be confined to the greater barons, or lords of parliament; and, among the peerage, no other barons were admitted except such as had been summoned by writ, in respect of the tenure of their lands or baronies, until Richard II. converted it into a mere title of honour, by conferring it on divers persons by his letters patent.

When a baron is called up to the house of peers by writ of summons, the writ is in the sovereign's name, and he is directed to repair to the parliament appointed to be holden at a certain time and place, and there to treat and advise with his sovereign, the prelates, and nobility, about the weighty affairs of the nation. The ceremony of the admission of a baron into the house of peers is this: He is brought into the house between two barons, who conduct him up to the lord chancellor, his patent or writ of summons being carried by a king-at-arms, and presented by him kneeling to the lord chancellor, who reads it, then congratulates him on his becoming a member of the house of peers, and invests him with his parliamentary robe. Thereafter the patent is delivered to the clerk of parliament, and the oaths are administered to the new peer, who is then conducted to his seat on the barons' bench. The coronation robes of a baron are the same as those of an earl, except that he has only two rows of spots on each shoulder; and, in like manner, his parliamentary robes have but two guards of white fur, with rows of gold lace; but in other respects, they are the same as those of other peers. King Charles II. granted to the barons a coronet, having six large pearls set at equal distances on the chaplet. A baron's cap is the same as a viscount's. His style is *Right Honourable;* and he is addressed by the king or queen, *Right Trusty and Well Beloved.*

Barons by ancient tenure were those who held certain territories of the king, who still reserved the tenure in chief to himself. There were also *barons by temporal tenure*, who held their honours, castles, and manors, as heads of their barony; that is, by grand serjeantry, by which tenure they were anciently summoned to parliament. But at present a baron by tenure is not a lord of parliament till he be called thither by writ. Barons || Baronet.

Barons of the Exchequer, four judges to whom the administration of justice is committed in causes betwixt the king and his subjects relative to matters of revenue. Their office is also to look into the accounts of the king, for which reason they have auditors under them.

Barons of the Cinque-ports were (prior to 1831) members of the house of commons, elected by the cinque-ports, two for each port. These ports are now under the jurisdiction of a *warden*.

Baron and Feme, in *English Law*, a term used for husband and wife, in relation to each other, who are accounted as one person. Hence by the old law of evidence the one party was excluded from being evidence for or against the other in civil questions, and a relic of it is still preserved in the criminal law.

Baron and Feme, in *Heraldry*, is when the coats-of-arms of a man and his wife are borne per pale in the same escutcheon; the man's being always on the dexter side, and the woman's on the sinister. But in this case the woman is supposed not to be an heiress, for then her coat must be borne by the husband on an escutcheon of pretence. See Heraldry.

Baron, or Boyron, *Michel*, a celebrated French actor, born at Paris in 1653; died in 1729. He was first brought on the stage by Moliere, and during his lifetime was said to be "*du théâtre Français l'honneur et la merveille.*" He was equally successful in tragedy and comedy, and likewise composed some comedies. His self-esteem seems to have been equal to his success; "every hundred years," he said, "a Cæsar may be seen, but it needs ten thousand to produce a Baron!"

Baron, *Robert*, an English writer of the seventeenth century, author of a novel called the *Cyprian Academy* (8vo, 1647), and some dramatic pieces, and poems (8vo, 1650).

BARONET, a dignity or degree of honour next below that of baron, and above that of knight, with precedency of all knights excepting those of the Garter.

The dignity of baronet is generally conferred by patent, and forms the lowest degree of honour that is hereditary. The order was instituted by King James I. at the suggestion of Sir Robert Cotton in 1611, when 200 baronets were created at once, being the number to which it was intended they should always be restricted; but it is now enlarged at the sovereign's pleasure, without limitation. Originally the creation of this order seems to have been merely an expedient to raise money in the name of fees, which, in each case, amounted to about L.1200 sterling.

Baronets take precedence according to the dates of their patents, conformably to the terms of which, no intermediate honour between baron and baronets can be established. The title or prefix of *Sir* is granted them by a peculiar clause in their patents, though they be not dubbed knights.

Baronets of Scotland, called also *Baronets of Nova Scotia*. This order of knights-baronets was instituted by Charles I. in the year 1625, when the first person dignified with the title was Sir Robert Gordon of Gordonstone, a younger son of the Earl of Sutherland. The professed object of the institution was to encourage the plantation and settlement of Nova Scotia in North America: hence the king granted to each of them a certain portion of land in that province, which they were to hold of Sir William Alexander, afterwards Earl of Stirling, with precedency to them and their heirs-male for ever, before all knights called *equites aurati*, all lesser barons called *lairds*, and all other gentlemen, except Sir William Alexander, His Majesty's lieutenant in Nova Scotia, his heirs, their wives and chil-

Baronets || Barony.

dren. It was further provided that the title of *Sir* should be prefixed to their Christian name, and *Baronet* added to their surname; and that their own and their eldest sons' wives should enjoy the title of *Lady, Madam*, or *Dame*.

Malone has given the following curious note upon this subject, in his very learned *Life of Dryden*, prefixed to his edition of the prose works of that writer:—"When the order of baronets was first established in 1611, King James engaged that they should not exceed two hundred. However, towards the close of his reign, that number being completed, and the creation of baronets being found a useful engine of government (the courtier by whose influence the title was obtained receiving usually L.1000 for the grant), it was not lightly to be parted with. A scheme, therefore, of creating *Baronets of Scotland* was devised, which, it was conceived, would be no infraction of the original compact, to confine the grants to a limited number; and as the English baronets were created under the great seal of England, for the reduction of Ulster in Ireland, so the Scottish baronets were created under the great seal of Scotland, for the reduction of Acadia, or *Nova Scotia*. The scheme, however, was not carried into execution by King James; but early in the reign of his successor several Scottish baronets were made. From this statement it appears, that there is no more necessity for calling a baronet created under the great seal of Scotland (whether he be an Englishman or Scotchman), a *Baronet of Nova Scotia*, than there is to denominate one created under the great seal of England a *Baronet of Ulster*." (Malone's *Dryden*, vol. i. pp. 28–29.)

Baronets of Ireland. This order was likewise instituted by King James I. in the 18th year of his reign, for the same purpose and with the same privileges within the kingdom of Ireland as had been conferred on the analogous order in England; for which also the Irish baronets paid the same fees into the treasury of Ireland.

BARONI, Leonora, a celebrated singer and composer, was born at Naples, but spent the greater part of her life at Rome. She was daughter of Adriana Baroni of Mantua, baroness of Piancaretta, a lady also distinguished for her musical talents, and, on account of her beauty, surnamed the Fair. A collection of verses in her honour was published in 1623, under the title of *Teatro della gloria D'Adriana*. Leonora, like her mother, was celebrated by the wits; and in 1639 there was published a collection of poems in various languages addressed to her, under the title of *Applausi Poetici alle Glorie della Signora Leonora Baroni*. Among the Latin poems of Milton are no fewer than three, entitled *Ad Leonoram Romæ Canentem*, of which this lady is the subject. Mazuchelli, *Scritt. d'Ital.*; Mangers, *Discours sur la Musique d'Italie*, Paris, 1672.

BARONIUS, Cæsar, a pious and learned cardinal, was born at Sora in 1538. He studied at Rome, and put himself under the discipline of Filippo di Neri, the founder of the congregation of the Oratory; on whose resignation in 1593 Baronius succeeded him as superior. Pope Clement VIII. made him his confessor, and raised him to the rank of cardinal in 1596. He was afterwards made librarian to the Vatican, and died from excessive study in 1607, at the age of sixty-nine. His principal work is his *Annales Ecclesiastici*, from A.D. 1 to 1198, in 12 vols. folio, Rome, 1588–93, which is characterized by very great learning and ability, and has always been in high esteem in the Church of Rome; though, having been composed with the express object of vindicating that church against the supposed misrepresentations of the *Magdeburg Centuriators*, it is necessarily partial and imperfect. The best edition, including the continuation of Raynaldi, is that published at Lucca in 38 vols. folio, 1738–1787. A further continuation in 8 vols. folio, is at present in preparation by Father Theiner, a priest of the Oratory at Rome.

BARONY, Baronia, or *Baronagium*, the lordship or fee of a baron, either temporal or spiritual. Baronies, in their first creation, proceeded from the king himself, the chief lord of the whole realm, and could be holden immediately of no other lord. Thus the king enfeoffed a man of a great seigniory in land, to be held by the person enfeoffed and his heirs, of the king and his heirs, by baronial service; that is, by the service of so many knights as the royal act appointed. In the ages immediately succeeding the Conquest, such seigniory was called a *barony*, but more commonly an *honour*; as the honour of Gloucestershire, of Wallingford, &c. In England these were sometimes called by Norman or other foreign designations, when the same person was lord of an honour in Normandy, or some other foreign country, and also of an honour in England. Thus, William de Forz, de Force, or de Fortibus, was lord of the honour of Albemarle in Normandy, and also of the honours of Holderness and of Skipton in England, and these latter were sometimes called by the Norman name, as the honour of Albemarle, or the honour of the Earl of Albemarle.

Barquicimeto || Barracks.

BARQUICIMETO, a province in Venezuela, with a capital of the same name. This city, which had a population of 15,000, was nearly destroyed by the great earthquake of 1812, which desolated Caraccas; but it has since been rebuilt, and already has above 12,000 inhabitants. Lat. 9. 50. N. Long. 69. 20. W.

BARRA, or Barray, island of. See Barray.

Barra, or Vara, in *Commerce*, a long measure used in Portugal and some parts of Spain, to measure woollen and linen cloths and serges. In Valencia, 13 barras = 12¾ yards English measure; in Castile, 7 barras = 6¾ yards; and in Aragon, 3 barras = 2¾ yards.

BARRACAN, in *Commerce*, a sort of stuff, something like camlet. It is used to make various outer garments. The cities where barracans are chiefly made in France are Valenciennes, Lisle, Abbeville, Amiens, and Rouen.

BARRACKPORE, a town and military cantonment of Hindustan, in the province of Bengal, about 16 miles above Calcutta. The cantonment consists of a large village in the occupation of soldiers, with separate lodges for the European officers. In its vicinity is the country residence of the governor-general of India, situate on the banks of the Hooghly, within a park containing 200 or 300 acres. Lat. 22. 46. Long. 88. 26.

BARRACKS, called by the French *Casernes*, places for soldiers to lodge in, especially in garrisons. Till the middle of the year 1792, when there was a prospect of war with revolutionary France, and the British ministry became apprehensive of disturbances in this country, barracks were not numerous, nor were they under the control and management of a separate and peculiar board. Previous to this they were built under the authority and directions of the Board of Ordnance, which also supplied them with bedding and the necessary utensils; and any extra articles that were requisite were furnished by the secretary at war. In 1792 orders were issued by the ministry for building cavalry barracks with the utmost despatch, and the deputy-adjutant-general was directed to superintend the building and fitting them up. In January 1793 the same officer was appointed superintendent-general of barracks; and on the 1st of May the king's warrant was issued for their regulation. Greater powers were given to the superintendent-general in the year 1794; but as these seemed to interfere with the duties and powers of the Board of Ordnance, a new warrant was issued in the year 1795, defining and limiting the respective duties and powers of the Board of Ordnance, and the superintendent-general, or barrackmaster-general, as he was now called.

In 1806 the barrack establishment was placed under the direction of four commissioners, one of whom was generally a military man. Since 1834 the superintendence of barracks has reverted to the master-general of ordnance

Barracks throughout the country are more immediately

Barramahal || Barratry.

under the management and care of the resident barrack-masters, especially since the reduction of the barrack-office establishment, and the further reduction of the assistant-barrackmasters-general attached to districts.

The barrack districts in Great Britain are—Dover, Eastern, London, Manchester, Medway, Midland and South Wales, Northern, North Britain, South West and Sussex, Woolwich, Exeter, Western, Yorkshire, Guernsey and Alderney, Jersey, Dublin, Athlone, Belfast, Cork, and Limerick.

In the cavalry barracks, field-officers have two rooms each; captains one; subalterns, staff, and quartermasters, one; serjeants of each troop of dragoons, and corporals of each troop of horse, one; eight rank and file one among them; and two rooms are allowed for the officers' mess. In infantry barracks, field-officers are allowed two each; captains one; one is allotted to two subalterns; the staff has one; twelve non-commissioned officers and private men one among them; the serjeant-major and quartermaster-serjeant one; and two are allotted for the officers' mess. The barracks are supplied by the barrack-office with beds, bedding, sheets, blankets, towels, house and stable utensils, coals, and candles; beer was formerly supplied, but now an allowance is made instead of it. Forage is supplied by the commissariat.

The expense of erecting barracks must of course greatly depend on the price of materials at the time, and, in some measure, on the part of the kingdom where they are erected. The total expense incurred by the nation for barracks and the barrack-office, in Great Britain, between the 25th of December 1792 and the 10th of November 1804, was L.9,024,005, 8s. 9d.

During the last war the annual expense of the barrack establishment in Great Britain varied from L.350,000 to L.500,000. But in Ireland, where barracks are more numerous, the expense generally equalled, and often exceeded, that of Great Britain in this particular. Thus, in 1814 the sum required for Great Britain was L.309,826, whilst that necessary for Ireland was L.360,515; and a similar excess appears in the peace estimate for 1816, which was for Great Britain L.173,500, and for Ireland L.213,000. Since this period the annual expense has of course been greatly reduced.

BARRAMAHAL, a territorial subdivision in the south of Hindustan, situated between the 12th and 13th degrees of N. Lat. This district was annexed by Hyder to the dominions of Mysore about the middle of the last century; in 1792 it was ceded to the British government by the treaty of Seringapatam, and now constitutes the northern portion of the British district of Salem.

BARRAS, Paul Jean François Nicolas, Comte de, the representative of an ancient family in Provence, a leader in the first French Revolution, and member of the executive directory, was born in Provence in 1755, and died near Paris in 1829. See France.

BARRATOR, or Barretor, in the law of England, a person guilty of barretry. See Barretry.

Lambert conceives the word *barretor* to have been formed from the Latin *balatro*, a vile knave; but the proper derivation is from the French *barrateur*, a deceiver; and this agrees with the description of a common barretor given by Lord Coke, namely, that he is a common mover and maintainer of suits in disturbance of the peace, particularly by taking and detaining the possession of houses and lands or goods by false inventions or pretences. Hence it is said that a common barretor is the most dangerous oppressor in the law, for he oppresses the innocent under colour of law, which was made to protect them from oppression.

BARRATRY, in a shipmaster, consists in defrauding the owners. If goods delivered on shipboard are embezzled, all the mariners are bound by the maritime law to contribute to the satisfaction of the party that has lost his goods; and the cause is to be tried in the admiralty. In a case where a ship had been insured against the barratry of the master, and the jury found that the ship was lost by the fraud and negligence of the master, the court ruled that the fraud was barratry, though not named in the covenant, but that negligence did not amount to that offence. A shipmaster who is at the same time a part owner, cannot commit barratry. See Marshall on *Insurance*, I. c. 12; Park on *Insurance*, c. 5.

Barraux || Barrère.

BARRAUX, a fortress of Dauphiné, now in the department of Isère. It stands on the river Isère, in the valley of Grésivaudan, and was built in 1597.

BARRAY, or Barra, (from the Scandinavian, *Baraey*, isle of the ocean,) one of the Hebrides or Western Isles of Scotland, forming part of Inverness-shire. It lies about 5 miles S.W. of South Uist, and is 8 miles in length by from 2 to 4 miles in breadth. The parish of the same name comprehends, besides Barra, a number of smaller islands and islets, and is estimated to contain 4000 acres of arable, and 18,000 of meadow and hill pasture. The cod, ling, and herring fisheries are considerable; and its coasts abound with shell-fish, especially cockles. On Barra Head, the highest part of Bernera, one of the Barra Islands, is a lighthouse with an intermitting light 680 feet above high-water, in Lat. 56. 48. N., Long. 7. 38. W. Population of island (chiefly Roman Catholics), in 1841, 1977; in 1851, 1624.

BARRE, Louis François Joseph de la, a learned French historian and antiquary, born at Tournay in 1688. Besides various learned papers contributed to the *Memoirs of the Academy of Inscriptions and Belles-Lettres*, of which he was a member, he published, in 1729, *Mémoires pour servir à l'Histoire de France et de Bourgogne*. He also contributed many articles to the edition of Moreri's Dictionary published in 1724, and was concerned in various other works. He died in 1738, whilst preparing a dictionary of Greek and Roman antiquities.

BARREL, in *Commerce*, a round vessel bulging in the middle, composed of staves, and bound with hoops. It is chiefly used for holding liquids, particularly ale and beer. The barrel of beer in London formerly contained only 32 ale gallons, $= 32\frac{1}{2}$ imperial gallons; but by 43d Geo. III. cap. 69, it was enacted that the barrel of beer should contain 36 gallons, and by 6th Geo. IV. cap. 58, the standard *imperial* gallon is always to be understood in any excise law where the gallon is mentioned. The barrel therefore contains 36 imperial gallons. (M'Culloch's *Dict. of Commerce.*)

Barrel also denotes a certain weight of several kinds of merchandise, and differs according to the nature of the commodities. Thus a barrel of Essex butter weighs 106 pounds, and of Suffolk butter 256 pounds; a barrel of herrings ought to contain 32 gallons wine-measure, and about 1000 herrings; a barrel of salmon should contain 42 gallons, and a barrel of eels the same; a barrel of soap should weigh 256 lb. The measure of capacity called barrel-bulk = 5 cubic feet.

Barrel, in *Mechanics*, a term given by watch-makers to the cylinder about which the spring is coiled; and by gunsmiths to the cylindrical tube of a gun, pistol, or blunderbuss, which contains the charge.

Barrel, in *Anatomy*, the cavity of the *tympanum*.

BARREN CAPE, an island in Bass's Straits, in the South Pacific Ocean, between Great Island on the N. and Clarke's Island on the S. It is about twenty miles in length by ten in breadth, and chiefly covered with low vegetation. Long. 148. 10. E. Lat. 40. 23. S.

BARREN ISLAND, an island in the Bay of Bengal, about 18 miles in circumference. It contains a volcano 1800 feet above the level of the sea, which is sometimes in a state of activity, and discharges immense columns of smoke and showers of red-hot stones. Long. 94. 1. E. Lat. 12. 15. N.

BARRÈRE (or BARÈRE) DE VIEUZAC, Bertrand, originally an *avocat*, was one of the most noted and

Barretry || Barrington.

cruel members of the convention in the first French Revolution. He was born at Tarbes in 1755, and died at Paris in 1841. His was the horrible apophthegm, "*Il n'y a que les morts qui ne reviennent pas.*" The list of his works, historical, political, poetical, and miscellaneous, is numerous. The graceful style in which he couched even his sanguinary proscriptions procured him the singular title of *the Anacreon of the Guillotine.* See FRANCE.

BARRETRY, or BARRATRY, in the *Law of England*, is, according to Blackstone, "the offence of frequently exciting and stirring up suits and quarrels between the lieges, either at law or otherwise. The punishment for this offence, in a common person, is by fine and imprisonment; but if the offender, as is too frequently the case, belongs to the profession of the law, a barretor who is thus able as well as willing to do mischief ought also to be disabled from practising for the future." And hence it is enacted by statute 12th Geo. I. cap. 29, which is made perpetual by the 21st Geo. II. cap 3, "that if any person who has been convicted of common barretry, shall act or practise as an attorney, solicitor, or agent, in any suit or action, the court, upon complaint, shall examine the matter in a summary way, in open court, and, if proved, shall direct the offender to be transported for seven years." "To this head," continues the learned commentator, "also may be referred an offence of equal malignity and audaciousness, that of suing another in the name of a fictitious plaintiff, either one not in being at all, or one who is ignorant of the suit. This offence, if committed in any of the king's superior courts, is left, as a high contempt, to be punished at their discretion; but in courts of a lower degree, where the crime is equally pernicious, but the authority of the judges is not equally extensive, it is directed by statute 8th Elizabeth, cap. 2, to be punished by six months' imprisonment, and treble damages to the party injured."

In Scotland the crime of a judge who receives a bribe is called barratry.

BARRHEAD, a large village of Scotland, county of Renfrew, three miles S. of Paisley, and 8 miles S.W. of Glasgow. Its population, which in 1841 was 3492, had increased in 1851 to 6069. The principal employment is spinning, weaving, and bleaching. It is connected with Glasgow by the Glasgow Barrhead and Neilston Railway.

BARRICADE, or BARRICADO, a military term for a fence formed in haste with trees, baskets of earth, palisades, waggons, or any bulky material, to serve as a defence against the shot or assault of the enemy.

BARRICADE, in *Naval Architecture*, a strong wooden rail, supported by stanchions, extending across the foremost part of the quarterdeck in ships of war. The vacant spaces between the stanchions are commonly filled with rope-mats, cork, or pieces of old cable; and the upper part, which contains a double rope-netting above the rail, is stuffed with hammocks, to prevent the execution of small-shot in time of action.

BARRIER, in *Fortification*, a kind of fence erected at a passage, retrenchment, or breach, composed of great stakes, about four or five feet in height, placed at the distance of eight or ten feet spart, with transoms or overthwart rafters, to stop the enemy.

It is also applied to a wall of defence, fortress, or fortified town, on the frontier of a country.

BARRINGTON, The HON. DAINES, fourth son of Lord Viscount Barrington, a distinguished antiquary and naturalist, born about the year 1730. He was educated for the profession of the law, and, after filling various posts, was appointed a Welsh judge in 1757, and afterwards second justice of Chester. He never rose to much eminence at the bar, but he showed his knowledge of the law as a subject of liberal study by a valuable publication entitled *Observations on the Statutes, chiefly the more ancient, from Magna Charta to 21st James I. cap. 27, with an Appendix, being a proposal for new-modelling the Statutes*, 1766, 4to; a work which has been quoted with merited commendation by many of our historians and constitutional antiquaries. In 1773 he published an edition of Orosius, with Alfred's Saxon version, and an English translation with notes of his own, which was severely animadverted on by the critics. His *Tracts on the Probability of reaching the North Pole*, 1775, 4to, were written in consequence of the northern voyage of discovery undertaken by Captain Phipps, afterwards Lord Mulgrave. In these he has accumulated a variety of evidence favourable to his own opinion of the practicability of attaining the object in which that voyage had failed; and it is not improbable that his views and arguments had some effect in determining the government at a later period to renew the attempt. Mr Barrington's other writings are chiefly to be found in the publications of the Royal and Antiquarian Societies, of both of which he was long an assiduous member, and of the latter vice-president. Many of these were collected by him in a quarto volume entitled *Miscellanies on various Subjects*, 1781. Among the most curious and ingenious of his papers, are his *Experiments and Observations on the Singing of Birds*, and his *Essay on the Language of Birds.* He died on the 14th March 1800, and was buried in the Temple church.

Barrington.

BARRINGTON, *John Shute*, Lord Viscount Barrington, a nobleman distinguished for theological learning, was the youngest son of Benjamin Shute, merchant, and was born at Theobald, in Hertfordshire, in 1678. He received part of his education at the university of Utrecht; and, after returning to England, studied law in the Inner Temple. In 1701 he published several pamphlets in favour of the civil rights of Protestant dissenters, to which body he belonged. On the recommendation of Lord Somers, he was employed to engage the Presbyterians in Scotland to favour the union of the two kingdoms; and, in 1708, he was rewarded for this service by being appointed to the office of commissioner of the customs. From this, however, he was removed on the change of administration in 1711; but his fortune had, in the meantime, been improved by the bequest of two considerable estates; one of them left him by Francis Barrington of Tofts, Esq., whose name he assumed by act of parliament; the other by John Wildman of Becket, Esq. Mr Barrington now stood at the head of the dissenters. On the accession of George I. he was returned member of parliament for Berwick-upon-Tweed; and in 1720 the king raised him to the Irish peerage, by the style and title of Viscount Barrington of Ardglass. But having unfortunately engaged in one of the bubbles of the time, the Harburg lottery, he incurred the disgrace of expulsion from the House of Commons in 1723; a punishment which was thought greatly too severe, indeed altogether unmerited on his part. In 1725 he published his principal work, entitled *Miscellanea Sacra, or a New Method of considering so much of the History of the Apostles as is contained in Scripture, in an Abstract of their History, an Abstract of that Abstract, and four Critical Essays*, 2 vols. 8vo; afterwards reprinted with additions and corrections, in 3 vols. 8vo, 1770, by his son, the Bishop of Durham. In the same year he published *An Essay on the several Dispensations of God to Mankind.* He was the author of various other tracts, chiefly on subjects relating to religious toleration. He died in 1734, leaving a number of children, five of whom rose to high stations in the church, the law, the army, and the navy Lord Barrington was a friend and disciple of Locke, whose sentiments he adopted as to the right and advantage of free inquiry, and the value of civil and religious liberty; and he contributed greatly to the rising spirit of liberal scriptural criticism amongst those who wished to render religion a subject of rational belief. He was a man of great moderation, and, though chiefly connected with the dissenters, he occasionally communicated with the Established church.

Barrister || Barrow.

BARRISTER is a counsellor learned in the law, admitted to plead at the bar, and there to take upon him the protection and defence of clients. "Barristers," observes Mr Justice Blackstone, "are in our old books styled apprentices (*apprenticii ad legem*), being looked upon as merely learners, and not qualified to execute the full office of an advocate till they were sixteen years' standing; at which time, according to Fortescue, they might be called to the state and degree of serjeants, or *servientes ad legem*." According to Dugdale, they seem to have been first appointed by an ordinance in parliament of 20th Edward I.

The rank or degree of barrister-at-law is conferred exclusively by the inns of court, and its possession constitutes an indispensable qualification for practising as an advocate in the superior courts at Westminster.

In order to be entitled to be called to the bar, it is necessary for the student to have kept commons for three years, that is, twelve terms, by dining in the hall of the society of which he is entered, three times at least in each term. The usual course is to attend as a student in the chambers of a practising barrister, conveyancer, or special pleader, in order to attain a knowledge of the practice and of the principles of the law. Under the new regulations of Hilary term 1853, no student is eligible to be called to the bar who shall not have satisfactorily passed a public examination, *or* have attended during one whole year the lectures of two of the readers appointed on—1. Constitutional Law and Legal History; 2. Equity; 3. Jurisprudence and the Civil Law; 4. The Law of Real Property; and 5. The Common Law of England. The Council of Legal Education have also instituted a public examination of candidates for honours or certificates, entitling students to be called to the bar two terms before the regular period; and such students rank in seniority over all other students called on the same day.

In accordance with the notion derived from the ancient Roman orators or patrons, who practised *gratis* for honour or to gain influence, the fees of counsel are given, not as *locatio vel conductio*, but as *quiddam honorarium*, and hence no action can be maintained for their amount.

Counsel is not answerable for any matter spoken by him relating to the cause in hand and suggested in his instructions, even though it prove untrue and reflect on another's reputation; but it is otherwise if the matter be not pertinent; and under the statute of Westm. 1 (3d Edward I. cap. 28) they are punishable with imprisonment for a year and a day, and perpetual silence in the courts, if guilty of deceit or collusion; or they may for gross misconduct be disbarred by the benchers of their inn of court. See ADVOCATE. (R. M—M.)

BARRITUS, or more properly *Barītus* (from the old German *bar*, *baren*, to raise the voice), was the war-cry of the Germans, and adopted by the Romans to signify the general shout raised by their armies on their first encounter, after the *classicum* or alarm.

BARROS, JOAO DE, a celebrated Portuguese historian, born about 1496; died in 1570. In 1522, he was made governor of St George del Mina, on the coast of Guinea. Three years after, the king recalled him to court, and made him treasurer of the Indies. This appointment inspired him with the thought of writing the well-known and valuable history entitled *Azia Portuguesa;* the first decade of which he published in 1552, the second in 1553, and the third in 1563; the fourth was not published till 1615. Several authors have continued the work, so that it extends to twelve decades. A handsome edition of the original work, and its continuations, was published at Lisbon in 1774, in 11 vols. 8vo.

BARROW, an artificial hillock or mound, used in ancient times as a repository for the dead. They were formed either of stones heaped up, or of earth. The former, more generally known by the name of *cairns*, are almost exclusively confined to Scotland. Of the latter, Dr Plott takes notice of two sorts in Oxfordshire; one placed on the military ways, the other in the fields or woods; the first sort being probably of Roman origin, the other erected by the Britons or Danes. Monuments of this kind are also very frequent in Scotland. On digging into barrows, urns made of calcined earth, and containing burnt bones and ashes, have sometimes been found; in others are found stone chests, containing bones entire; in others, again, bones neither lodged in chests nor deposited in urns. These tumuli are round, not greatly elevated, and generally at their bases surrounded by a fosse. They are of different sizes, being in proportion, it is supposed, to the rank and power of the deceased person. Of those found in the Orkneys, some are formed of earth alone, whilst others consist of stone covered with earth. In one of the former was discovered a coffin made of six flat stones, but too short to receive a body at full length. The latter feature is a general characteristic of all these sarcophagi: the skeletons found in them lie with the knees pressed to the breast, and the legs doubled along the thighs. In one of them were found multitudes of small beetles; and as similar insects have been discovered in the bag which inclosed the sacred ibis among the Egyptians, we may suppose that the nation to whom these tumuli belonged had the same superstition respecting them as the subjects of the Pharaohs. Ancient Greece and Latium concurred with the natives of this island in the erection of sepulchral tumuli. Patroclus among the Greeks, and Hector among the Trojans, received the same funeral honours with our Caledonian heroes; and the ashes of Dercennus the Laurentine monarch could boast of no prouder receptacle. The urn and pall of the Trojan warrior might perhaps be more superb than those of a British leader; but the monument of each was composed of the same rude materials, dug from the bosom of the earth. The Grecian barrows, however, do not seem to have been all equally simple. The barrow of Alyattes, father of Crœsus king of Lydia, is described by Herodotus (i. 93.) as a most superb monument, inferior only to the works of the Egyptians and Babylonians. It was a vast mound of earth nearly a mile in circumference, heaped on a basement of large stones, by three classes of the people, one of which was composed of girls devoted to prostitution. Alyattes died in the year B.C. 560; but Herodotus informs us, that, in his time, above a century afterwards, five stones, or *stelæ*, on which letters were engraved, remained on the top, recording what each class had performed; and from the measurement it appeared that the greater portion of the work had been done by females. It was customary among the Greeks to place on barrows the image of some animal, or round pillars (*stelæ*), with inscriptions. The famous barrow of the Athenians in the plain of Marathon, described by Pausanias, is an instance of the latter usage. An ancient monument in Italy near the Appian Way, vulgarly called the sepulchre of the Curiatii, has the same number of *termini* as the barrow of Alyattes; the basement, which is square, supporting five round pyramids.

Barrow.

Barrows, and similar tumuli, are also found in great numbers in America. These are of different sizes; some of them being constructed of earth, and others of loose stones. That they were repositories of the dead has been generally believed; but on what particular occasions they were constructed is matter of conjecture. Some have thought that they covered the bones of those who had fallen in battle on the spot; others ascribe them to the custom said to prevail among the Indians, of collecting at certain periods the bones of all their dead, wheresoever deposited at the time of death; whilst others, again, suppose them to have been the general sepulchre for towns that existed on or near the spots where they are met with. For a minute and interesting account of one of these remarkable tumuli, the reader may consult Mr Jefferson's *Notes on the State of Virginia*, p. 156. See also Wörsae's *Scandinavian Antiquities*; and Hamilton's *Researches in Asia Minor*, vol. i.

Barrow. BARROW, a large river of Ireland, which rises in Queen's county, and being joined by the Nore and the Suir, falls into the sea at Waterford Bay. In spring-tides, vessels of 300 tons can ascend to New Ross, and it is navigable for barges to Athy, where it is joined by a branch of the Grand Canal.

BARROW, *Isaac*, an eminent mathematician and divine, was the son of Mr Thomas Barrow, a linen-draper in London, where he was born in 1630. He was at first placed for two or three years at the Charter-house School. There, however, his conduct gave but little hopes of his ever succeeding as a scholar; for he was extremely fond of fighting, and of promoting pugnacity among his school-fellows. But being removed from this establishment, his disposition took a happier turn; and having soon made considerable progress in learning, he was admitted a pensioner of St Peter's College, and afterwards of Trinity College, Cambridge, where he applied himself with great diligence to the study of literature and science, especially of natural philosophy. He afterwards turned his thoughts to the profession of physic, and made some progress in anatomy, botany, and chemistry; after which he studied chronology, geometry, and astronomy. He then travelled into France and Italy, and in a voyage from Leghorn to Smyrna gave proofs of great personal bravery; for the ship having been attacked by an Algerine pirate, Barrow remained upon deck, and fought with the utmost intrepidity, until the pirate, unprepared for the stout resistance made by the ship, sheered off and left her to pursue her voyage.

At Smyrna he met with a most kind reception from Mr Bretton, the English consul, upon whose death he afterwards wrote a Latin elegy. From this place he proceeded to Constantinople, where he received similar civilities from Sir Thomas Bendish, the English ambassador, and Sir Jonathan Dawes, with whom he afterwards contracted an intimate friendship. While at Constantinople he read and studied the works of Chrysostom, once bishop of that see, whom he preferred to all the other fathers. He resided in Turkey somewhat more than a year, after which he proceeded to Venice, and thence returned home through Germany and Holland in 1659. Immediately on his return he received episcopal ordination from Bishop Brownrig; and in 1660 he was appointed to the Greek professorship at Cambridge. When he entered upon this office, he intended to have prelected upon the tragedies of Sophocles; but he altered his intention, and made choice of Aristotle's Rhetoric. His lectures on this subject, however, having been lent to a friend who never returned them, are irrecoverably lost. In July 1662 he was elected professor of geometry in Gresham College, on the recommendation of Dr Wilkins, master of Trinity College, and afterwards bishop of Chester; and in May 1663 he was chosen a fellow of the Royal Society, at the first election made by the council after obtaining their charter. The same year the executors of Mr Lucas, who, according to the will of that individual, had founded a mathematical chair at Cambridge, fixed upon Barrow as the first professor; and although his two professorships were not inconsistent with each other, he chose to resign that of Gresham College, which he did on the 20th May 1664. In 1669 he resigned his mathematical chair to his illustrious friend Isaac Newton, having now determined to renounce the study of mathematics for that of divinity. Upon quitting his professorship, Barrow was only a fellow of Trinity College; but his uncle gave him a small sinecure in Wales, and Dr Seth Ward, bishop of Salisbury, constituted him a prebend in that church. In the year 1670 he was created doctor in divinity by mandate; and, upon the promotion of Dr Pearson, master of Trinity College, to the see of Chester, he was appointed to succeed him by the king's patent, bearing date the 13th February 1672. When the king advanced Barrow to this dignity, he was pleased to say, "he had given it to the best scholar in England." His Majesty did not speak from report, but from his own knowledge; for the doctor being then his chaplain, His Majesty frequently conversed with him, and in his humorous way used to call him an "unfair preacher," as he exhausted every subject he discussed, and left no room for others to come after him. In 1675 Dr Barrow was chosen vice-chancellor of the university. His scientific works are very numerous, and such as do honour to the science and literature of his country. They are, 1. Euclid's Elements; 2. Euclid's Data; 3. Optical Lectures, read in the public school of Cambridge; 4. Thirteen Geometrical Lectures; 5. The Works of Archimedes, the four Books of Apollonius's Conic Sections, and Theodosius's Spherics explained in a New Method; 6. A Lecture, in which Archimedes's Theorems of the Sphere and Cylinder are investigated and briefly demonstrated; 7. Mathematical Lectures, read in the public schools of the university of Cambridge. The above were all written in Latin. His English works have been collected and printed together in four volumes folio. "The name of Dr Barrow," says Grainger, "will ever be illustrious for a strength of mind and a compass of knowledge that did honour to his country. He was unrivalled in mathematical learning, and especially in the sublime geometry; in which he has been excelled only by one man, and that man was his pupil, the great Sir Isaac Newton. The same genius that seemed to be born only to bring hidden truths to light, to rise to the heights or descend to the depths of science, would sometimes amuse itself in the flowery paths of poetry; and he composed verses both in Greek and Latin. He at length gave himself up entirely to divinity; and particularly to the most useful part of it, that which has a tendency to make men wiser and better. He has, in his excellent sermons on the Creed, solved every difficulty and removed every obstacle that opposed itself to our faith, and made divine revelation as clear as the demonstrations in his own Euclid. In his sermons he knew not how to leave off writing till he had exhausted his subject; and his admirable discourse on the duty and reward of bounty to the poor took him up three hours and a half in preaching." This great man, who was a bright example of Christian virtue, as well as a prodigy of learning, died on the 4th of May 1677, in the forty-seventh year of his age; and was interred in Westminster Abbey, where a monument, surmounted with his bust, was soon after erected, by the contributions of his friends.

Barrow. BARROW, *Sir John, Bart., F.R.S., LL.D.*, was born near Ulverston, in Lancashire, June 19. 1764. His early opportunities of instruction were limited; but by self-education he matured those powers which eventually were turned to so good an account. He displayed, at an early age, a decided inclination for mathematical pursuits. Some of his earlier years were passed as superintending clerk of an iron foundry at Liverpool; and he afterwards taught mathematics at an academy in Greenwich. While in this latter situation he was fortunate in obtaining, through the interest of Sir George Staunton, a place in the first British embassy to China. He was thus enabled to put his foot on the first step of the ladder of ambition; but each step in his subsequent career may be fairly said to have been achieved by himself. The account of the embassy, published by Sir George Staunton, records many of Mr Barrow's valuable contributions to literature and science connected with China. This work, together with his own subsequently published volume of travels, is ample evidence how well his time had been employed. Few persons could within the space of a few months overcome all the practical difficulties of such a language as the Chinese; but Mr Barrow soon began to converse in it, and acquired a complete knowledge of its theory. His papers on this subject in the *Quarterly Review* (to which periodical he was for many years a very frequent contributor) contain the best and most popular account of that singular language ever presented to the British public.

Barrow's Straits.

Although Mr Barrow ceased to be personally connected with our affairs in China after the return of the embassy in 1794, he always continued to take a lively interest in the varying circumstances of our relations with that empire. On the occasion of the second embassy under Lord Amherst in 1816, he was of course consulted by the ruling powers; but unfortunately his advice was not taken; and in consequence of the injudicious rejection of the proposal which he had suggested for getting rid of the vexatious question of the Chinese ceremony, Lord Amherst and his colleagues were compelled to abandon the personal reception of the mission for the sake of preserving the honour and interests of the English in China, which would have been essentially damaged by the acceptance of the terms upon which it was offered. Mr Barrow was likewise consulted on the occasion of our recent conflict with China, which, it is to be hoped, has secured our future peace with that country.

Lord Macartney was naturally anxious to secure the aid of such a man as Mr Barrow in his next public service, his important and delicate mission to settle the government of our newly-acquired colony of the Cape of Good Hope. Mr Barrow was intrusted with our first communication with the Caffre tribes; and it would have been well if the spirit, judgment, and humanity, which he then displayed had more uniformly governed our subsequent transactions with that remarkable race. The two volumes of his history of the colony made the public at once fully acquainted with the extent, capacities, and resources of that important, but till then little understood, acquisition of the British crown.

There is little doubt that it was the perusal of this valuable work which mainly decided Lord Melville to accept Lord Macartney's recommendation of a perfect stranger to him, as Mr Barrow then was, as his second secretary of the admiralty. Mr Barrow's subsequent career for forty years at the admiralty, embracing the whole period of the last war, will be for ever historically associated with the civil administration of our navy for the same period. He enjoyed the uniform esteem and confidence of the eleven chief lords who successively presided at the admiralty board during that period, and more especially of King William IV., while lord high admiral, who honoured him with tokens of his personal regard. Mr Barrow received the honour of the baronetcy during the short administration of Sir Robert Peel in 1835; and the information was communicated to him by Sir Robert in a letter acknowledging, in highly gratifying terms, his literary and scientific eminence, and his "long, most able, and most faithful public service."

Sir John Barrow, besides the works already mentioned, published the lives of Lord Macartney, Lord Anson, Lord Howe, and Peter the Great; and he was also the author of several valuable contributions to the seventh edition of the Encyclopædia Britannica.

Sir John retired from public life in 1845, in consideration of his advanced years, although still in vigorous possession of all the mental and bodily powers required for the due discharge of the functions of his office. In the course of the succeeding three years his vital energies gradually declined, but he nevertheless continued so fully in the enjoyment of his faculties, writing a history of the modern arctic voyages of discovery, of which he was a great promoter, as well as his autobiography, that his friends and relatives entertained no apprehension that his end was so near. He expired suddenly on the 23d November 1848, in the 85th year of his age, much honoured and respected by his friends and the public at large.

BARROW'S STRAITS, a channel leading from the N.W. part of Baffin's Bay into the Polar Sea, and lying between Lat. 73. 45. and 74. 40. N. It is about 200 miles in length, and has an average breadth of 60 or 70 miles. The coasts on both sides are generally steep and rugged, with numerous bays and inlets. In many places it is upwards of 200 fathoms in depth, and not unfrequently no bottom can be found. It abounds in whales and other inhabitants of the northern seas.

Barry.

BARRY, or BARRI, GIRALD DE, commonly called *Giraldus Cambrensis*, an historian and ecclesiastic of the twelfth and thirteenth century, was born at the castle of Mainarpir, near Pembroke, in 1146. By his mother he was descended from the princes of South Wales; and his father, William de Barri, was one of the chief men of that principality. Being a younger brother, and intended for the church, he was sent to St David's, and educated in the family of his uncle, the bishop of that see. When about twenty years of age he was sent to the university of Paris, where he continued for three years, and, according to his own account, became an excellent rhetorician. On his return he entered into holy orders, and obtained several benefices both in England and Wales. But observing with much concern that his countrymen the Welsh were very backward in paying tithes of wool and cheese, he applied to Richard, archbishop of Canterbury, and was appointed his legate in Wales for rectifying this and other disorders. Barri excommunicated all, without distinction, who refused to compound matters with the church, and, in particular, delivered over bodily to the Evil One those who withheld the tithes. Not satisfied with enriching, he also attempted to reform, the clergy. He delated the archdeacon of Brecon to the archbishop, for the unpardonable crime of matrimony; and on his refusing to put away his wife, he was deprived of his archdeaconry, which was bestowed upon the zealous legate. On the death of his uncle, the bishop of St David's, in 1176, he was elected his successor by the chapter; but this choice having been made without the permission of Henry II., Girald prudently declined to insist upon it, and went again to Paris to prosecute his studies. He speaks with exultation of the prodigious fame which he acquired by his eloquent declamations in the schools, and of the crowded audiences who attended them. Having spent about four years at Paris, he returned to St David's, where he found everything in confusion; and on the expulsion of the bishop by the people, which took place soon after, he was appointed administrator by the archbishop of Canterbury, and governed the diocese in that capacity till 1184, when the bishop was restored. About the same time he was called to court by Henry II., appointed one of his chaplains, and sent into Ireland with Prince John, by whom he was offered the united bishoprics of Fernes and Leighlin, but declined them, and employed his time in collecting materials for his Topography of Ireland, and his history of the conquest of that island, which was completed in three books in 1187. In 1188 he attended Baldwin, archbishop of Canterbury, in his progress through Wales, preaching a crusade for the recovery of the Holy Land; an employment in which he tells us, with his usual modesty, that he was far more successful than the primate,—adding significantly, that the people were most affected with the Latin sermons (which they did not understand), melting into tears, and coming in crowds to take the cross. On the accession of Richard I. in 1189, he was sent by that prince into Wales to preserve the peace of the country, and was even joined in commission with William Longchamp, bishop of Ely, as one of the regents of the kingdom. He failed, however, to improve this favourable opportunity; and having fixed his heart on the see of St David's, the bishop of which was very old and infirm, he refused the bishopric of Bangor in 1190, and that of Landaff the year following. But in 1192 the state of public affairs became so unfavourable to Barri's interest at court that he determined to retire. He proceeded to Lincoln, where William de Monte read lectures in theology with great applause; and here he spent about six years in the study of divinity, and in composing several works. At

Barry. last the see of St David's, which had long been the object of his ambition, became vacant, and he was unanimously elected by the chapter, but met with so powerful an adversary in Hubert, archbishop of Canterbury, that it involved him in a litigation which lasted five years, cost him three journeys to Rome, and ended in his defeat in the year 1203. Retiring from the world, he spent the last seventeen years of his life in a studious privacy, composing many books, of which a catalogue is given in the *Biographia Britannica*. His MSS. are preserved in the British Museum, the library at Lambeth, and the Bodleian Library. Of his published works, the best known is his *Itinerarium Cambriæ*, of which a translation, illustrated with annotations, and accompanied with a life of the author, was published by Sir Richard Colt Hoare, in two splendid quarto volumes, in 1806.

BARRY, *James*, an eminent painter, was born at Cork, on the 11th October 1741. His father had been a builder, and at one time of his life a coasting trader between the two countries of England and Ireland. To this business of trader was James destined, and he actually made, when a boy, several voyages; but these voyages being forced upon him, he on one occasion ran away from the ship, and on others discovered such an aversion to the life and habits of a sailor, as to induce his father to relinquish all hopes of him in this line, and to suffer him to pursue his inclinations, which led him to drawing and study. When on board his father's vessel, instead of handling sails and ropes, and climbing the mast, he was generally occupied with a piece of black chalk, sketching the coast or drawing figures, as his fancy directed him. When his father found that the idea of making a sailor of him must be given up, he permitted him to acquire as much instruction as the schools of Cork afforded, but long retained his aversion to the chalk drawings with which the floors and walls of the house were covered; the boy being always engaged in some attempt at large figures, and early catching at the means of representing action, attitude, and passion. It was at a very early period of his life that young Barry offered to furnish the drawings, and, as it is believed, helped to etch the engravings, such as they were, for a set of fables or emblems which a bookseller in Ireland had undertaken to reprint. At the schools in Cork to which he was sent, he was distinguished by his parts and industry above his school-fellows; his habits differed from those of ordinary boys, as he seldom mixed in their games or amusements, but at those times stole off to his own room, where he worked at his pencil, or was studying some book that he had borrowed or bought. He would spend whole nights in this manner at his studies, to the alarm of his mother, who dreaded his injuring his health or setting fire to the house, and who often kept up his sister or the servant to watch him. His allowance of money he spent in buying books or candles to read by; he sometimes locked himself up in his room for days, and seldom slept upon his bed, or else made it so hard as to take away the temptation or luxury of lying long in it. It is not to be understood that at this period he used to lead the life of an absolute recluse, for he could and did occasionally join in any feats going on in the neighbourhood, and was not behind other boys in such pastimes and mischief as boys are usually fond of. An adventure which happened to him about this time, and which left a strong impression on his mind, is worth mentioning here. In one of his rambles in the neighbourhood, he entered, one winter's evening, an old, and, as he thought, an uninhabited house, situate in a narrow by-lane in the city of Cork. The house was without doors or windows; but curiosity impelled him to enter, and, after mounting a rotten staircase which conducted to empty rooms on different floors, he arrived at the garret, where he could just discern, by the glimmering light of a few embers, two old and emaciated figures, broken by age, disease, and want, sitting opposite each other, in the act, as far as their palsied efforts would permit, of tearing each other's faces; not a word being uttered by either, but with the most horrible grimaces that malice could invent. They took no notice of his entrance, but went on with their deeds of mutual hate; which made such an impression on the boy that he ran down stairs, making his own reflections, which he afterwards found verified through life, that man and all animals are malicious and cruel in proportion as they are impotent; and that age and poverty, two of the worst evils in human life, almost always add to the calamities inherent in them by arts of their own creating. As his industry was excessive, his advances in the acquisition of knowledge were rapid, and he was regarded as a prodigy by his school-fellows. His mother being a zealous Catholic, the son could not avoid mixing at times in the company of priests resident at Cork, who pointed out to him books of polemical divinity, of which he became a great reader, and for which he retained a strong bias during his lifetime. He was said at one time to have been destined for the priesthood, but for this report there is no authority. He, however, always continued a Catholic, and in the decline of life manifested rather a bigoted attachment to the religion of his youth. Barry.

About the age of seventeen he first attempted oil painting, and between that and the age of twenty-two, when he first went to Dublin, he produced several large pictures, which decorated his father's house, and represented subjects not often handled by young men, such as Æneas escaping with his family from the flames of Troy, Susanna and the Elders, Daniel in the Lion's Den, &c. At this period he also produced the picture which first drew him into public notice, and gained him the acquaintance and patronage of the celebrated Edmund Burke. This picture was founded on an old tradition of the landing of St Patrick on the sea-coast of Cashel, and of the conversion and baptism of the king of that district by the patron saint of Ireland. Barry's manner of treating it was such as to insure him the applause and admiration of the connoisseurs of the metropolis of the sister kingdom, where it was exhibited in 1762 or 1763. He took this picture with him to Dublin; and when he went to the exhibition room, being delighted with the encomiums it received from the spectators, he could not refrain from making himself known as the painter. His pretensions were treated with incredulous contempt by the company, and Barry burst into tears of anger and vexation. During his early acquaintance with Burke, having fallen into a dispute on the subject of taste, he quoted a passage in support of his opinion from the *Essay on the Sublime and Beautiful*, which had been just then published anonymously, and which Barry, in his youthful admiration of it, had, it seems, transcribed entire. Burke affected to treat this work as a theoretical romance of no authority whatever; which threw Barry into such a rage in its defence, that Mr Burke thought it necessary to appease him by owning himself to be the author. The scene ended in Barry's running to embrace him, and showing him the copy of the work which he had been at the pains to transcribe. After a residence of seven or eight months in Dublin, an opportunity offered of accompanying some part of Mr Burke's family to London, which he eagerly embraced. This took place some time in the year 1764, when he was twenty-three years of age, and with one of those advantages which but rarely fall to the lot of young artists on their arrival in the British capital, that of being recommended to the acquaintance of the most eminent men in the profession by the persuasive eloquence of a man who, to genius in himself, added the rare and noble quality of encouraging it in others.

By the liberality of Mr Burke and his other friends, Mr Barry, in the latter part of 1765, was enabled to proceed to the Continent, where he remained till the beginning of 1771, studying his art with an enthusiasm which seemed to augur the highest success, and making observations on the different *chefs d'œuvre* of Italy with equal independence of

Barry. judgment and nicety of discrimination. He proceeded first to Paris, then to Rome, where he remained upwards of three years, from thence to Florence and Bologna, and home through Venice. His letters to the Burkes, giving an account of Michael Angelo, Raphael, Titian, and Lionardo da Vinci, show a complete insight into the characteristic merits of their works, and would make us wonder (if the case were at all singular) how he could enter with such force, delicacy, and feeling, into excellencies of which he never transplanted an atom into his own works. He saw, felt, and *wrote;* his impressions were profound and refined; but the expression of them must be instantaneous, such as gave the results of them with a stroke of the pen, as they were received by a glance of the eye, and he could not wait for the slow process of the pencil for embodying his conceptions in the necessary details of his own art.

We suspect Mr Barry did not succeed very well in copying the pictures he so well describes; because he appears to have copied but few—only one of Raphael, as far as we can find, and three from Titian, whom he justly considered as the model of colouring, and as more perfect in that department of the art than either Raphael or Michael Angelo were in theirs, expression and form, the highest excellence in which he conceives to have been possessed only by the ancients. In copying from the antique, however, he manifested the same aversion to labour, or to that kind of labour which, by showing us our defects, compels us to make exertions to remedy them. He made all his drawings from the antique by means of a *delineator*, that is, a mechanical instrument, to save the trouble of acquiring a knowledge both of form and proportion.

The consequences are before us in his pictures; namely, that all those of his figures which he took from these memorandums are deficient in everything but form, and that all the others are equally deficient in form and everything else. Mr Barry painted two pictures while abroad, his Adam and Eve, and his Philoctetes. The first of these he sent home as a specimen of his progress in the art. It does not appear to have given much satisfaction. His Philoctetes he brought home with him. It is a most wretched, coarse, unclassical performance, the direct opposite of all that he thought it to be. During his stay at Rome, he made an excursion to Naples, and was highly delighted with the collections of art there. All the time he was abroad, Mr Burke and his brothers not only were punctual in their remittances to him, but kept up a most friendly and cordial correspondence. For some time previous to his return to England, Mr Hamilton (afterwards Sir William) appears to have been almost the only person with whom he kept up any intimacy. It was on his return home through Milan that he witnessed, and has recorded with due reprobation, the destruction of Lionardo's Last Supper, which two bungling artists were employed to paint over by order of one Count de Firmian, the secretary of state.

In the spring of 1771 Mr Barry arrived in England, after an absence of five years. He soon after produced his picture of Venus, which, absurdly enough, has been compared to the Galatea of Raphael, the Venus of Titian, and the Venus de' Medici. Mr Barry flattered himself that he had surpassed the famous statue of that name, by avoiding the appearance of *maternity* in it. There is an engraving of it by Mr Valentine Green. In 1773 he exhibited his Jupiter and Juno on Mount Ida, which was much praised by some critics of that day. His Death of General Wolfe was considered as a falling off from his great style of art, which consisted in painting Greek subjects, and accordingly it is said to "have obtained no praise." His fondness for Greek costume was assigned by his admirers as the cause of his reluctance to paint portraits; as if the coat were of more importance than the face. His fastidiousness in this respect, and his frequent excuses or blunt refusals to go on with a portrait of Mr Burke which he had begun, caused a misunderstanding with that gentleman, which does not appear to have been ever entirely made up. The difference between them is said to have been widened by Burke's growing intimacy with Sir Joshua, and by Barry's feeling some little jealousy of the fame and fortune of his rival *in an humbler walk of the art.* About the same time he painted a pair of classical subjects, Mercury inventing the Lyre, and Narcissus looking at himself in the water, the last suggested to him by Mr Burke. He also painted an historical picture of Chiron and Achilles, and another of the story of Stratonice, for which last the Duke of Richmond gave him a hundred guineas. In 1773 there was a plan in contemplation for our artists to decorate the inside of St Paul's with historical and sacred subjects; but this plan fell to the ground, from its not meeting with the concurrence of the bishop of London and the archbishop of Canterbury, to the no small mortification of Barry, who had fixed upon the subject he was to paint,—the rejection of Christ by the Jews when Pilate proposes his release. In 1773 he published *An Inquiry into the real and imaginary Obstructions to the Acquisition of the Arts in England*, vindicating the capacity of the English for the fine arts, and tracing their slow progress hitherto to the Reformation, to political and civil dissensions, and, lastly, to the general turn of the public mind to mechanics, manufactures, and commerce. In the year 1774, shortly after the failure of the scheme of decorating St Paul's, a proposal was made, through Mr Valentine Green, to the same artists, Reynolds, West, Cipriani, Barry, &c., for ornamenting the great room of the Society for the Encouragement of Arts, Manufactures, and Commerce, in the Adelphi, with historical and allegorical paintings. This proposal was at the time rejected by the artists themselves; but, in 1777, Mr Barry made an offer to paint the whole himself, on condition of being allowed the choice of his subjects, and being paid by the society the expense of canvass, paints, and models. This offer was accepted, and he finished the series of pictures at the end of seven years, instead of two, which he had proposed to himself, but with entire satisfaction to the members of the society for whom it was intended, and who conducted themselves to him with liberality throughout. They granted him two exhibitions, and at different periods voted him 50 guineas, their gold medal, and again 200 guineas, and a seat among them. Dr Johnson remarked, when he saw the pictures, that, "whatever the hand had done, the head had done its part." There was published an excellent anonymous criticism on them, supposed to be by Burke, in answer to some remarks put forth by Barry in his descriptive catalogue on the *ideal* style of art, and the necessity of size to grandeur. His notions on both these subjects are very ably controverted, and, indeed, they are the rock on which Barry's genius split. It would be curious if Burke were the author of these strictures; for it is not improbable that Barry was led into the last error, here deprecated, by that author's *Essay on the Sublime and Beautiful.* The series consists of six pictures, showing the progress of human culture. The first represents Orpheus taming the savages by his lyre. The figure of Orpheus himself is more like that of a drunken bacchanal than an inspired poet or lawgiver. The only part of this picture which is valuable is the background, in one part of which a lion is seen ready to dart upon a family group milking near a cave, and, in another, a tiger is pursuing a horse. There is certainly a scope of thought and picturesque invention in thus showing indirectly the protection which civilization extends, as it were, over both man and animals. The second picture is a Grecian harvest, which has nothing Grecian in it. But we cannot apply this censure to the third picture of the Olympic Games, some of the figures in which, and the principal group, are exceedingly graceful, classical, and finely

Barry. conceived. This picture is the only proof Barry has left upon canvass that he was not utterly insensible to the beauties of the art. The figure of the young man on horseback really reminds the spectator of some of the Elgin marbles; and the outlines of the two youthful victors at the games, supporting their father on their shoulders, are excellent. The colouring is, however, as bald and wretched in this picture as in the rest, and there is a great want of expression. The fourth picture is the Triumph of Commerce, with Dr Burney swimming in the Thames, with his hair powdered, among naked sea-nymphs: the fifth, the Society of Arts distributing their annual prizes: and the sixth represents Elysium. This last picture is a collection of caricatured portraits of celebrated individuals of all ages and nations, strangely jumbled together, with a huge allegorical figure of Retribution driving Heresy, Vice, and Atheism into the infernal regions. The moral design of all these pictures is much better explained in the catalogue than on the canvass; and the artist has added none of the graces of the pencil to it in any of them, with the exception above made. Barry appears, however, to have rested his pretensions to fame as an artist on this work, for he did little afterwards but paltry engravings from his own paintings, and the enormous and totally worthless picture of Pandora in the assembly of the gods. His self-denial, frugality, and fortitude, in the prosecution of his work at the Adelphi, cannot be too much applauded. He has been heard to say, that at the time of his undertaking it, he had only 16s. in his pocket; and that he had often been obliged, after painting all day, to sit up at night to sketch or engrave some design for the printsellers, which was to supply him with his next day's subsistence. In this manner he did his prints of Job, dedicated to Mr Burke, of the Birth of Venus, Polemon, Head of Chatham, King Lear from the picture painted for the Shakspeare gallery, &c. His prints are caricatures even of his pictures; they seem engraved on rotten wood.

Soon after his return from the Continent, Barry was chosen a member of the Royal Academy; and in 1782 he was appointed professor of painting, in the room of Mr Penny, with a salary of L.30 a-year. The lectures which he delivered from the chair were full of strong sense and wholesome advice, both to the students and academicians. Among other things, he insisted much on the necessity of purchasing a collection of pictures by the best masters as models for the students, and proposed several of those in the Orleans collection. This recommendation was not relished by the academicians, who perhaps thought their own pictures the best models for their several pupils. Bickerings, jealousies, and quarrels arose, and at length reached such a height, that, in 1799, Barry was expelled from the Academy, soon after the appearance of his *Letter to the Dilettanti Society*; a very amusing but eccentric publication, full of the highest enthusiasm for his art, and the lowest contempt for the living professors of it. In 1800 he undertook a design or drawing to celebrate the union of the two kingdoms of Great Britain and Ireland. The profits of the two exhibitions of the Adelphi pictures are said to have amounted to above L.500. Lord Romney presented him with 100 guineas for his portrait, which had been copied into one of the pictures, and he had 20 guineas for a head of Mr Hooper. He probably received other sums for portraits introduced into the work. By extreme frugality, he contrived not only to live, but to save money. His house was twice robbed of sums which he kept by him; one of the times (in 1794) of upwards of L.100, a loss which was made up by the munificence of Lord Radnor, and by that of his friends the Hollises. After the loss of his salary, a subscription was set on foot by the Earl of Buchan to relieve him from his difficulties, and to settle him in a larger house to finish his picture of Pandora. The subscription amounted to L.1000, with which an annuity was bought, but of this he was prevented from enjoying the benefit, for on the 6th of February 1806 he was seized with a pleuritic fever, and died on the 22d of the same month. On the 14th of March the body was attended by a numerous and respectable train of his friends to the cathedral of St Paul's, where it was deposited. Barry || Barthélemy.

Mr Barry, as an artist, a writer, and a man, was distinguished by great inequality of powers and extreme contradictions in character. He was gross and refined at the same time; violent and urbane; sociable and sullen; inflammable and inert; ardent and phlegmatic; relapsing from enthusiasm into indolence; irritable, headstrong, impatient of restraint; captious in his intercourse with his friends; wavering and desultory in his profession. In his personal habits he was careless of appearances or decency; penurious, slovenly, and squalid. He regarded nothing but his immediate impulses, confirmed into incorrigible habits. His pencil was under no control. His eye and his hand seemed to receive a first rude impulse, to which it gave itself up, and paid no regard to anything else. The strength of the original impetus only drove him farther from his object. His genius constantly flew off in tangents, and came in contact with nature only at salient points. His writings are a greater acquisition to the art than his paintings. The powers of conversation were what he most excelled in; and the influence which he exercised in this way over all companies where he came, in spite of the coarseness of his dress, and the frequent rudeness of his manner, was great. Take him for all in all, he was a man of whose memory it is impossible to think without admiration as well as regret. (W. H–Z–T.)

BARRY, in *Heraldry*, is when an escutcheon is divided bar-ways, that is, across from side to side, into an even number of partitions, consisting of two or more tinctures, interchangeably disposed. In the blazon the word *barry* must be expressed, and the number of pieces specified; but if the divisions be odd, the field must be first named, and the number of bars expressed.

Barry-Bendy is when an escutcheon is divided evenly, bar and bend-ways, by transverse and diagonal lines, interchangeably varying the tinctures of which it consists.

BARS, a county of Hungary, in the circle of the Hither Danube, with a population of 138,000, and an area computed at 1044 square miles. See HUNGARY.

BARSAC, a town of France, on the Garonne, in the department of the Gironde, famous for its white wines, which are of the same class as those of Sauternes, but stronger. Pop. 2896.

BARTAS, GUILLAUME DE SALLUSTE DU, a French poet, born in 1544. He was employed by Henry IV. of France, in England, Denmark, and Scotland; and he commanded a troop of horse in Gascony, under the Marshal de Martingan. His principal work, *The Week, or the Creation of the World*, which has long since fallen into oblivion, once enjoyed a high reputation, thirty editions of it having been printed within six years after its appearance. It was translated into English by Joshua Sylvester. Du Bartas died in 1590, of wounds received in the battle of Ivry.

BARTER, or TRUCK, is the exchanging of one commodity for another. The word comes from the Spanish *baratar*, to deceive or circumvent in bargaining. See TRUCK.

BARTFELD, a town of Hungary, county of Saros, on the river Tepla. It has some trade in wine, corn, linen and woollen goods, paper, &c., and is noted for the mineral springs and baths in the vicinity. Pop. 6000.

BARTH, or BART, JEAN, a fisherman of Dunkirk, who rose to the rank of admiral, and is celebrated in the annals of France for his valour and naval exploits. He died in 1702, aged fifty-one. (*Histoire de Jean Bart*, by Vanderest; Paris, 1841, 8vo.)

BARTHÉLEMY, JEAN-JACQUES, a celebrated French writer, born at Cassis, a little seaport on the shores of the Mediterranean, on the 20th January 1716. At twelve

Barthélemy.

years of age he entered the college of the Oratory at Marseilles, under the care of Father Rénaud, a person of taste and ability, who soon discovered similar qualities in his pupil, and became uncommonly attentive to his progress. M. de Visclède, a man of letters, and friend to the former, also concurred with him in his endeavours; and young Barthélemy's career soon became equally rapid and brilliant.

He had resolved to dedicate himself to the church; but, in order to qualify himself, it became necessary to change his place of residence, as M. de Belzunce, bishop of Marseilles, refused to admit to holy orders the students of the Oratory. Barthélemy, therefore, quitting his old masters with regret, found himself under the necessity of studying philosophy and theology under the Jesuits.

Following a plan of education independently of the professors, he was indefatigable in his study of the Greek, Hebrew, Chaldee, and Syriac languages. His passion for learning, however, nearly cost him his life; for he fell dangerously ill, and did not recover his strength until he had entered the seminary where he received the tonsure.

In this retreat he dedicated his leisure hours to the study of Arabic; and, with the assistance of a young Maronite who had been educated at Rome, he soon acquired a perfect knowledge of that language. By way of return, his new friend proposed to him to render all the services in his power to the Maronites, Armenians, and other Catholic Arabians, who were but slightly acquainted with the language of the country in which they resided; in other words, he expressed a wish that Barthélemy would announce the word of God to them in their native tongue, and with that view presented him with some Arabic sermons composed by a Jesuit who had belonged to the Propaganda. Accordingly Barthélemy got one or two of them by heart, and pronounced them in a spacious hall belonging to the seminary, to the entire satisfaction of his oriental auditors.

When Barthélemy had finished his education at the seminary, he retired to Aubagne, and spent some time in the bosom of his family. He made frequent visits, however, to Marseilles; and among the learned of that city to whom he attached himself in a particular manner was M. de Cary, the possessor of a fine cabinet of medals and a valuable library. They spent whole days together in conversing on literary subjects; after which Barthélemy, as if insatiable in his thirst for knowledge, would retire to the Minims, where Father Sigaloux, a correspondent of the Academy of Sciences, was employed in making astronomical observations; and in these labours the young abbé became his associate.

In 1744 he repaired to Paris, with the view of devoting himself entirely to literature, and carried with him a letter to M. de Boze, keeper of the medals, and perpetual secretary of the Academy of Inscriptions and Belles-Lettres.

The increasing age and declining health of De Boze rendered it necessary that he should have assistance; and Barthélemy was selected as his colleague. From that moment the abbé dedicated both his days and nights to the study of those medals which De Boze had been prevented by his infirmities from arranging.

On the death of M. de Boze in 1753, Barthélemy, who had been his colleague during eight years, was nominated his successor.

M. de Stainville, afterwards better known during his administration by the title of Duke de Choiseul, being appointed ambassador to Rome in 1754, Madame de Stainville, a lady of great personal beauty, and an enthusiastic admirer of learning and literary men, conceived a particular regard for the abbé; and it was proposed that he should occupy a place in their carriage on this occasion, and make the tour of Italy along with them. Such a proposition could not fail to be highly flattering; and having been accepted, he set out soon after, and in November arrived at Rome. Pope Benedict XIV., who then wore the tiara, and was a learned man himself, distinguished Barthélemy by the most courteous reception. But his stay at Rome was not of long duration; for he was desirous of visiting Naples, rendered at that period particularly interesting to an antiquary, by the recent discoveries made in its neighbourhood. During a whole month he and his fellow-travellers were occupied in admiring the curiosities of that capital, and in studying ancient literature; after which they took a journey of thirty leagues to examine the monuments of Grecian architecture still extant amidst the splendid ruins of the ancient city of Pæstum.

Barthélemy.

As he was exceedingly desirous of presenting the learned men of France with a specimen of the ancient writing employed in the Greek manuscripts, he addressed himself on this subject to his friend Mazocchi, and also to M. Paderno, who superintended the collection of antiquities from Herculaneum and Pompeii in the palace of Portici; but both replied that they were expressly enjoined not to make any communication on the subject. On this he solicited permission to look, for a few minutes only, on a page of a manuscript which had been cut from top to bottom since its discovery. It contained twenty-eight lines, and Barthélemy read it over six different times with extreme attention, after which he transcribed the precious fragment on a piece of paper, from memory. On making a mental collation between the copy and the original, he corrected two or three trifling errors that had escaped his attention. Having thus rendered himself master of a fac-simile of the manuscript, which related to the persecution of the Greek philosophers during the time of Pericles, he transmitted the literary plunder in the course of that very day to the Academy of Belles-Lettres; strictly enjoining secrecy, however, that Mazocchi and Paderno might escape all manner of blame.

M. de Stainville having been appointed ambassador to the court of Vienna in 1757, the abbé accompanied his lady thither. On his arrival he found that his friend and protector had made certain engagements with the French ministry with the view of gratifying his passion for antiquities; and, in consequence, he received permission to visit, at the king's expense, Greece and the seaports of the Mediterranean, where he was to collect new treasures, and return with them to his native country by Marseilles. But notwithstanding all the attractions which this project presented, his scrupulous attachment to his duty prevailed over his passion for knowledge; and as he deemed it highly improper that the cabinet of medals should remain so long shut, he abandoned the scheme of visiting the Levant.

Towards the end of 1758, M. de Stainville, now become Duke de Choiseul, was nominated minister for foreign affairs, which enabled him to provide for his friend; and having requested him to state the sum which would make him easy for life, Barthélemy instantly mentioned 6000 livres a year, blushing at the same time at the largeness of the demand.

In 1759 the duke presented him with a pension on the archbishopric of Alby; in 1765 he conferred on him the treasurership of St Martin de Tours; and, in 1768, he made him secretary-general to the Swiss guards. In addition to these the abbé also enjoyed a pension of 5000 livres on the *Mercure de France*. By these means his income was now large; but he employed it nobly; for he distributed the surplus, which was considerable, among indigent men of letters.

In 1771 M. de Choiseul was superseded by the Duke d'Aiguillon, and exiled to his estate at Chanteloupe. On this occasion he was as usual forsaken by the courtiers who had basked in the sunshine of his favour. But he was not deserted by the grateful antiquary, who instantly repaired to Chanteloupe to pay his respects to the fallen minister.

Barthélemy was now in possession of more than L.1200 sterling per annum, of which he distributed between L.300 and L.400 in assisting men of letters. He also educated and established in life three nephews, one of whom was successively an ambassador and a director; at the same time

Barthélemy.

supporting the rest of his family in Provence, and collecting a noble library, which he disposed of some years before his death. But after having thus possessed an ample income during more than twenty years, Barthélemy at last, in consequence of the suppression of places and appointments occasioned by the Revolution, found himself reduced to live on a pittance barely adequate to furnish the necessaries of life. He was never heard to complain, however, nor, indeed, did he seem to perceive the change; and while age and infirmities permitted him to walk from one end of Paris to the other, in order to visit his kind friend Madame de Choiseul, his happiness suffered no apparent diminution.

In 1788 appeared his celebrated work, entitled *Voyage du ieune Anacharsis en Grèce, dans le milieu du quatrième siècle avant l'ère Chrétienne.* He had begun it in 1757, and, during an uninterrupted succession of thirty years, occupied his leisure hours in bringing it to maturity. His hero, a young Scythian, descended from the famous philosopher Anacharsis, whose name he bears, is supposed to repair to Greece for instruction in his early youth, and after making the tour of her republics, colonies, and islands, to return to his native country and write this book in his old age, after the Macedonian hero had overturned the Persian empire. In the manner of modern travellers, he gives an account of the customs, government, and antiquities of the country he is supposed to have visited; a copious introduction supplies whatever may be wanting in respect to historical details; whilst various dissertations on the music of the Greeks, on the literature of the Athenians, and on the economy, pursuits, ruling passions, manners, and customs, of the surrounding states, supply ample information on the subjects of which they treat. The author, indeed, is not profound; and the young Scythian seldom penetrates much below the surface. But his remarks are commonly judicious, and to respectable erudition he unites singular skill in the distribution of his materials, and a happy talent for presenting his subject in the most agreeable and attractive form. The assumed character is so admirably sustained throughout, that we can scarcely persuade ourselves we are not perusing a book of real travels, and communing with an actual personage who has recorded his observations and experience for the instruction and improvement of his countrymen.

In 1789 Barthélemy became a candidate for a chair in the French Academy; and was enrolled among its members by acclamation. The speech delivered by the abbé on his inauguration is equally remarkable for its simplicity and modesty.

In 1790 M. de St Priest, minister of the department of Paris, made him an offer of the situation of librarian to the king, then vacant by the resignation of M. le Noir; but this very flattering proposal was not accepted.

But while Barthélemy was thus refusing one of the most honourable offices which a man of letters could at that time aspire to, he did not neglect the department which had so long been confided to his charge. His ardour respecting everything that concerned the cabinet of medals remained unabated through life; and he now found means to have his nephew, Barthélemy Courcy, associated with him in his labours. This grand collection had received a considerable increase, and had been embellished with a number of fine specimens since it was first confided to his care. To enrich it still more, he carried on an extensive correspondence not only with the various provinces of France, but also with every part of Europe.

In the mean time the health of the learned medalist declined daily, and in 1792 his strength had so much failed him that, towards the close of the year, he became subject to fainting fits which deprived him of the exercise of his faculties for several hours together. Being naturally calm and courageous, he did not appear to be the least affected by these accidents; his friends, however, considered them as sypmtoms of approaching dissolution. He was now seventy-eight years of age, sixty of which had been spent in literary toils; and it might therefore have been expected that, even at that agitated period, the venerable veteran would have been suffered to die in peace. But it was not so. On the 30th of August 1793 this feeble old man was denounced as an aristocrat, and his nephew and several other young men employed about the library were included in the charge. The accusation proceeded from a person of the name of Duby, a clerk in the library, and it was conveyed in a letter written by him to a person of the name of Chrétien, a pastry-cook (who happened to be a member of the section before which it was first read), and then transmitted to the municipality. It was of no consequence that Duby did not know Chrétien, nor Chrétien Duby, and that Barthélemy was not acquainted with either. A warrant was immediately issued against the supposed culprits, and the fact was signified by the officers of justice, to the abbé, while at Madame de Choiseul's on the morning of the 2d of September. On receiving the intimation he instantly rose, without discovering any symptoms of perturbation, and taking his leave of that lady, was conducted to the Magdelonettes, where he found his nephew Courcy. Such, however, was the respect paid to his virtue and his talents, even within the walls of a prison, that he was received with every expression of regard by the inhabitants of that dreary mansion: even the jailer paid him the most respectful attention. He was lodged in a little apartment along with his relation; and in the course of that evening he received a visit from Madame de Choiseul, who had taken care to notify the event to the government. No sooner was the Committee of Public Safety informed that the Abbé Barthélemy had been included in the order, which was meant to extend only to some of the subalterns in the library, than orders were instantly issued for his release; and such zeal did the clerks in the public offices display in forwarding the necessary papers for his liberation, that he was awakened from his sleep at eleven o'clock at night, and conducted to the house of his fair friend. In a few weeks afterwards, the office of national librarian having become vacant by the death of Carra and the resignation of Chamfort, who had held it jointly, it was offered to the abbé, with the most flattering marks of respect. But his advanced age and increasing infirmities did not admit of his accepting the offer.

Barthélemy || Barthez.

He expired without a struggle on the 30th April 1795, retaining to the last moment full possession of his faculties. In his person Barthélemy was above the middle size; and, if we are to credit his admirers, his countenance displayed an air of antiquity wonderfully corresponding with his studies. His bust, sculptured by Houdon, is allowed to be a masterpiece of art; and that able artist has contrived to infuse into the physiognomy a mixture of the mildness, simplicity, goodnature, and elevation of soul, so visible in the original.

BARTHELEMY DE GROAIN, *St*, a village of France, in the department of Isere, and arrondissement of Grenoble. In the vicinity is a burning fountain, *i.e.*, inflamed carburetted hydrogen.

BARTHEZ, or BARTHÈS, PAUL JOSEPH, one of the most celebrated physicians of the university of Montpellier, equally remarkable for the variety and extent of his erudition, and for the vigour of mind displayed in his abstruse speculations. He was born on the 11th of December 1734, at Montpellier, and received his early education at Narbonne, where his family resided, and afterwards at Toulouse. He soon gave decisive indications of those talents with which nature had endowed him, and which destined him to occupy a distinguished station among the learned men of the age. He commenced the study of medicine at Montpellier in 1750, and in 1753, when he had only attained his nineteenth year, he received his doctor's degree. He afterwards occasionally visited Paris, where he attracted the notice, and acquired the friendship, of the most distinguished literati of

Barthez. that period. In 1756 he obtained the appointment of physician to the military hospital in Normandy, attached to the army of observation commanded by Marshal d'Estrées. The zeal and assiduity with which he discharged the duties of his new office were most exemplary. He spent his whole time at the hospital, and often passed the night at the bedside of his patients. Though naturally of a good constitution, his strength was not commensurate with the ardour of his mind. His health suffered much from the intensity of his application, and he was often very near falling a sacrifice to fevers and other disorders which he caught from the patients in the hospital; and he thence became liable ever after to attacks of dysentery and bilious fever.

Many of the observations and inquiries which he made during this period were published in the *Memoirs of the Academy of Sciences;* and two of his first productions were crowned by the Academy of Inscriptions. In 1757 his services were required in the medical staff of the army of Westphalia, where he had the rank of consulting physician. On his return to Paris he contributed several articles to the *Journal des Savans* and to the *Encyclopédie;* and was, indeed, for a time considered one of the editors of the former of those works. In 1761 he obtained a medical professorship at Montpellier, in which his abilities as a teacher soon shone forth with unrivalled lustre. His success was the more honourable inasmuch as his colleagues, Lamure, Leroy, and Venel, were men of distinguished reputation, and had raised the school to a high pitch of celebrity.

In 1774 he was created joint chancellor of the university, with the certainty of succeeding singly to the office on the death of his colleague, which happened in 1786. He afterwards took the degree of doctor in civil law, and was appointed counsellor to the supreme court of Aids at Montpellier. In 1780, he was induced to fix his residence in Paris, having been nominated consulting physician to the king, with a brevet of counsellor of state, and a pension of a hundred louis. Honours now crowded upon him; he was admitted free associate to the Academies of Sciences and of Inscriptions, and appointed first physician to the Duke of Orleans, in the room of Tronchin. His reputation increased in proportion as his merits were displayed on a wider theatre. He practised as a physician at Paris for nearly ten years, and received the most flattering testimonials of public approbation.

This brilliant career was suddenly interrupted by the great political revolution which broke out at this period, and by which the interests of every individual in France, however tranquil his pursuits or obscure his station, were more or less immediately affected.

Barthez was now obliged to quit Paris, and seek in his native province that tranquillity and repose which the stormy aspect of the times forbade him to hope for in a more conspicuous station, holding, as he did, opinions so much at variance with the new order of things. Though he had lost the greater part of his fortune, acquired by so much labour, and was deprived of the honours to which he possessed so just a claim, he determined, upon his retiring to Carcassone, to practise his profession gratuitously, and devote all his leisure hours to the speculative studies connected with it, which had been the ruling passion of his life. It was in this retreat that he gave to the world his *Nouvelle Mécanique des Mouvemens de l'Homme et des Animaux*, which appeared in 1798.

On the re-establishment of the College of Medicine at Montpellier, Barthez was naturally looked up to as the person best calculated to revive its former fame. But age and infirmity operated to dissuade him from resuming the laborious office of teacher; and he was accordingly nominated honorary professor. In 1802 he received several marks of favour from the new government under Buonaparte; he was nominated titular physician to the government, and afterwards consulting physician to the emperor, and member of the Legion of Honour. Barthius.

His *Traité des Maladies Goutteuses*, in two volumes octavo, appeared in 1802; and he afterwards occupied himself in preparing for the press a new edition of his *Elémens de la Science de l'Homme*, of which he just lived to see the publication. His health had been declining for some years before his death, which took place soon after his removal to Paris, on the 15th of October 1806, in the seventy-second year of his age. He bequeathed his books and manuscripts to M. Lordat, who, in consequence, published two volumes of *Consultations de Médecine*, Paris, 1810, 8vo, to which he prefixed a preface of his own. Another posthumous work of Barthez, the *Traité du Beau*, preceded by some account of his life, was edited in 1807 by his brother, M. Barthez de Marmorières, who is known as the author of agricultural essays, and projects for improving the maritime coast of Languedoc, together with some translations from the oriental languages; and who has sometimes been mistaken for the subject of the present article.

Barthez has enjoyed a much higher reputation on the Continent than in this country, where, indeed, his writings are comparatively little known. The work which has chiefly contributed to establish his fame, and which contains the development of his peculiar opinions on physiology, is the *Nouveaux Elémens de la Science de l'Homme*. It is not written, however, with the simplicity and clearness which might have been expected from one who had been in the constant habit of instructing others, and whose lectures were generally admired as possessing those qualities in an eminent degree.

Amidst many vague and unprofitable speculations, his work contains a great store of facts, which are often instructive, though sometimes they expose the credulity of the author.

In the preface to his *Nova Doctrina de Functionibus Naturæ Humanæ*, he has given an excellent arrangement of the general principles of the objects to be kept in view in the medical treatment of diseases. He treats of this subject more at large in his treatise *De Methodo Medendi*, published at Montpellier in 1777, and also in the preface to his *Traité des Maladies Goutteuses*.

The writings of Barthez appear to have had considerable influence in overthrowing many of the crude and preposterous theories which had prevailed in the schools of medicine; and, however he may have been seduced from the path of genuine philosophy by an excessive disposition to generalize, and an overweening fondness for abstruse speculation, he still deserves the praise of being an original thinker, and of standing pre-eminent among his contemporaries for the courage with which he shook off the trammels of authority, in a university where it had ruled with despotic sway, and where the dogmas of antiquity were held in peculiar reverence. (P. M. R.)

BARTHIUS, Gaspard, a learned German philologist, born at Custrin, in Brandenburg, on the 22d June 1587. M. Baillet has inserted his name among his *Enfans Célèbres*, upon the ground that at twelve years of age he had translated the Psalms of David into Latin verse of every measure. Upon the death of his father, who was professor of the civil law at Frankfort, counsellor to the elector of Brandenburg, and chancellor at Custrin, he was sent to Gotha, then to Eisenach, and afterwards, according to custom, went through all the different universities in Germany. He afterwards travelled into Italy, France, Spain, and England. He resided latterly at Leipzig, where he died in 1658. He wrote a great number of books, the principal of which are, 1. His Adversaria, a large volume in folio, the second and third volumes being left by him in manuscript; 2. A Translation of Æneas Gazæus; 3. A large volume of Notes upon Claudian, in 4to; 4. Three large volumes upon Statius.

Bartholinus. || Bartholomew.

BARTHOLINUS, GASPARD, a learned writer, born in 1585, at Malmoë in Scandinavia. At three years of age he had such a quick capacity, that in fourteen days he learned to read; and in his thirteenth year he composed Greek and Latin orations, and delivered them in public. When he was about eighteen he went to the university of Copenhagen, and afterwards studied at Rostock and Wittemberg. He then travelled through Germany, the Low Countries, England, France, and Italy, and was received with marked respect at the different universities he visited. In 1613 he was chosen professor of physic in the university of Copenhagen, and filled that office for eleven years, when, falling into a dangerous illness, he made a vow, that if it should please God to restore him, he would apply himself solely to the study of divinity. He recovered, observed his vow, and soon after obtained the professorship of divinity, with the canonry of Rotschild. He died on the 13th of July 1630, after having written nearly fifty works on different subjects.

BARTHOLINUS, *Thomas*, a very celebrated physician, son of the former, was born at Copenhagen in 1619. After studying some time in his native country, he went in 1637 to Leyden, where he studied medicine for three years. He then travelled into France, and resided two years at Paris and Montpellier, in order to improve himself under the distinguished physicians of those universities; after which he visited Italy, remained three years at Padua, and then went to Basle, where he obtained the degree of doctor in philosophy. Returning to Copenhagen, he was appointed professor of mathematics in 1647, and next year was nominated to the chair of anatomy, which was better suited to his genius and inclination. This he held for thirteen years, distinguishing himself by several observations respecting the lacteal and lymphatic vessels, shortly after their discovery by Olaus Rudbeck. His close application, however, having rendered his constitution very infirm, he resigned his chair in 1661; but the king of Denmark allowed him the title of "honorary professor." He now retired to a little estate he had at Hagestaed, near Copenhagen, where he hoped to spend the remainder of his days in peace and tranquillity; but his house having been burnt in 1670, his library, with all his books and manuscripts, was consumed. In consideration of this loss, the king appointed Bartholinus his physician, with a handsome salary, and exempted his land from all taxes; the university of Copenhagen also chose him for their librarian; and, in 1675, he was honoured with a seat in the grand council of Denmark. He died on the 4th of December 1680. He wrote, Anatomia Gaspardi Bartholini Parentis, novis Observationibus primum locupletata, 8vo; De Monstris in Natura et Medicina, 4to; De Armillis Veterum, præsertim Danorum, Schedion, 8vo; and several other works.

BARTHOLOMEW, ST, one of the twelve apostles, generally supposed to have been the same individual who in St John's Gospel is called Nathanael. This appears to have been his real name, while Bartholomew merely expresses his filial relation. He was a native of Cana in Galilee (John xxi. 2). He was introduced by Philip to Jesus, who, on seeing him approach, at once pronounced that eulogy on his character which has made his name almost synonymous with sincerity: he was a witness of the resurrection and the ascension, and returned with the other apostles to Jerusalem. Of his subsequent history we have little more than vague traditions. According to Eusebius (*Hist. Eccles.* v. 10), when Pantænus went on a mission to the Indians (towards the close of the second century), he found among them the Gospel of Matthew, written in Hebrew, which had been left there by the apostle Bartholomew. Jerome (*De Vir. Illustr.* c. 36) gives a similar account. But the name Indians is applied by ancient writers to so many different nations, that it is difficult to determine the scene of Bartholomew's labours. Mosheim (with whom Neander agrees) is of opinion that it was a part of Arabia Felix, inhabited by Jews, to whom alone a Hebrew gospel could be of any service. According to the received tradition, this apostle was flayed alive and crucified with his head downwards, at Albanopolis in Armenia, or, according to Nicephorus, at Urbanopolis in Cilicia. A spurious gospel which bears his name is in the catalogue of apocryphal books condemned by Pope Gelasius. Bartholomew || Barton.

The festival of St Bartholomew is celebrated on the 24th of August. On the night of this festival, in the year 1572, took place that foul and treacherous massacre of the Huguenots in France, which has stamped with infamy the memory of the detestable Catherine de' Medici and her son Charles IX. This massacre lasted three days. See FRANCE.

BARTHOLOMEW, *St*, one of the West India Islands, 30 miles north of St Christopher's. Lat. 17. 55. 35. N. Long. 62. 50. W. Though destitute of fresh water except what is supplied by rain, it is very fertile, producing sugar, cotton, and tobacco. It is of an irregular oblong shape, and has an area of 35 square miles, with a population of 18,000. Being surrounded by rocks and shoals, it is difficult of access, but its harbour, Le Carenage, on the western side, is safe and commodious. This island was ceded by France to Sweden in 1784.

BARTIZAN, in *Architecture*, a small turret projecting from the angle of a square tower, or from the parapet.

BARTOLOCCI, JULIUS, a learned monk, and professor of Hebrew at Rome, was born at Celano in 1613. He distinguished himself by writing a Hebrew and Latin catalogue of the Hebrew writers and writings, entitled *Bibliotheca Magna Rabbinica*, &c., in four volumes folio. This important work was continued by his disciple Imbonati. Bartolocci died in 1687.

BARTOLOMEO, FRANCESCO, a celebrated painter, born at Savignano near Florence, in the year 1469, was the disciple of Cosimo Rosselli, but was much more indebted to the works of Lionardo da Vinci for his extraordinary skill in painting. He was so well versed in the principles of design, that Raphael, after quitting the school of Perugino, applied to this master, and studied under him the rules of perspective, with the art of managing and uniting his colours. He painted both portraits and historical pieces; but from conscientious scruples, he seldom drew naked figures. He died in 1517, aged forty-eight.

BARTOLOZZI, FRANCESCO, a very celebrated designer and engraver, was the son of a silversmith at Florence, in which city he was born about the year 1730. After studying at Venice and at Rome, in 1764 he came to England at the invitation of Mr Dalton, the king's librarian, and soon afterwards was elected a member of the Royal Academy. He was induced by an offer of the Prince Regent of Portugal to remove to Lisbon, where it is supposed he died about the year 1815; though some place that event at London in 1819. The productions of his graver are very numerous, and are greatly esteemed by collectors.

BARTON, BENJAMIN SMITH, M.D., an eminent American naturalist, who was the first professor of botany and natural history in a college in the United States. He was born in Pennsylvania in 1766. He studied for two years at Edinburgh, and afterwards graduated at Göttingen. He began to practise his profession at Philadelphia, and soon obtained a respectable share of employment. In 1790 he was appointed to the professorship above mentioned in Philadelphia College; in 1802 was chosen president of the American Philosophical Society; was made professor of materia medica; and on the death of Dr Rush he obtained the chair of practical medicine. By his lectures and his writings he may be considered as the founder of the American school of natural history, which has risen to such a high rank in that branch of science. He died in 1815.

Barton-on-Humber || Basedow.

BARTON-ON-HUMBER, a market-town in the hundred of Yarborough and county of Lincoln. It stands on the Humber, six miles S.W. of Hull, with which town it has steam communication. Its principal trade is in corn and flour, and it has manufactures of ropes, sacking, bricks, and tiles. It has two parish churches. Market-day, Monday. Pop. in 1851, 3866.

BARTSCH, ADAM VON, the author of the most valuable dictionary of engravers, entitled *Le Peintre Graveur*, in 21 vols. 8vo, 1803–21. He was born at Vienna in 1757, and died there in 1821. From 1781 he was keeper of the imperial cabinet of prints.

BARUCH, THE PROPHECY OF, one of the apocryphal books subjoined to the canon of the Old Testament. Baruch the son of Neriah was the disciple and amanuensis of the prophet Jeremiah; and his prophecy has by some been reckoned part of that of Jeremiah. It is difficult to determine in what language this prophecy was originally written. Three copies of it are still extant, one in Greek, and the other two in Syriac; but which of these, or whether any one of them, is the original, remains uncertain.

BARYTES, or BARYTA, heavy earth. See MINERALOGY and CHEMISTRY.

BARYTONE (βαρυς and τονος), in *Music*, denotes a male voice intermediate between a bass and a tenor.

BARYTONIUM, in *Greek Grammar*, denotes a verb which has no accent marked on the last syllable, the grave accent being understood.

BAS, JACQUES PHILLIPE LE, a celebrated French engraver. He particularly excelled in landscapes and small figures. He was born at Paris in 1707, and died there in 1783.

BAS-RELIEF. See *BASSO-RILIEVO*.

BASALT. See MINERALOGY.

BASAN, or BASHAN, in *Ancient Geography*, a territory beyond Jordan, mentioned in Scripture, and called by Josephus, Eusebius, and Jerome, *Batanæa*. The sacred writers include in Bashan that part of the country eastward of the Jordan which was given to the half tribe of Manasseh, situated to the north of Gilead. After the Babylonish captivity it was subdivided into Batanæa or Basan, Trachonitis, Auranitis, and Gaulonitis. To settle the limits of these, however, is now impossible. Bashan was famous for its pastures and large breed of cattle.

BASCINET, BASINET, or BASNET, a light helmet generally without a vizor, and so called from its resemblance to a basin. (See Grose on *Ancient Armour*.)

BASEDOW, JOHANN BERNHARD, a celebrated German writer, born at Hamburg, the 11th September 1723, was the son of a hairdresser. Ill treatment made him abandon his father's house. A physician in a neighbouring village took him into his service, and shortly after persuaded him to return home to his father. Being placed in one of the lower classes of the college of St John, the severity of his masters rendered him harsh and violent himself. Forced to submit to a slow and rigorous method of study, he contracted a dislike to patience and regularity, which exercised a marked influence over the whole course of his life. Poor but intelligent, he often performed their tasks for schoolfellows who could afford to pay for it; and they, in return, invited him to their parties of pleasure, which contributed to those habits of irregularity by which his health and reputation often suffered. In 1744 Basedow went to Leipzig to study theology. He gave himself up entirely to the instructions of Crusius the professor, and to the study of philosophy. This at first made him sceptical in theology; a more profound examination of the sacred writings, and of all that relates to them, brought him back to the Christian faith; but, in his retirement, he formed his belief after his own ideas, and it was far from orthodox. Having returned to Hamburg, he lived there without any employment till 1749, when M. de Quaalen, privy-councillor of Holstein, appointed him preceptor to his son. Basedow now began to apply himself to the subject of education. At first he would not teach his pupil Latin otherwise than by talking with him in Latin; and he wrote a dissertation on this subject, published at Kiel in 1751, *Inusitata et optima honestioris Juventutis erudiendæ Methodus*. In 1753 he was chosen professor of moral philosophy and belles-lettres in the academy of Soroë in Denmark. Here, between the years 1758 and 1764, he published several works of a heterodox character, which exposed him to the opposition of the magistrates and the odium of the people. Constantly persecuted in his theological career, he would have fallen the victim of his incautious zeal, if the Count de Bernstoff, minister of state, and J. A. Cramer, another officer of the court of Copenhagen, had not taken him under their protection. He left off giving lessons without losing his salary; and, towards the end of 1767, he abandoned theology to devote himself with the same ardour to education, of which he conceived the project of a general reform in Germany. He began by publishing *An Address to the Friends of Humanity, and to Persons in Power, on Schools, on Education, and its Influence on Public Happiness, with the Plan of an Elementary Treatise on Human Knowledge*; Hamburg, 1768. He proposed the reform of schools and of the common methods of instruction, and the establishment of an institute for qualifying teachers; soliciting subscriptions for the printing of his elementary work, where his principles were to be explained at length, and accompanied with plates. For this object he required 5050 crowns. The subscriptions presently amounted to 15,000 crowns: the Empress of Russia, Catherine II., sent a thousand crowns, the King of Denmark nine hundred. In 1770 appeared at Altona the first volume of his *Method for Fathers and Mothers of Families, and for the Chiefs of the People*, which was followed by other treatises on education. In his travels he had been well received by the Prince of Anhalt-Dessau, who promised him his protection. From that time he had resolved to establish an institute for education at Dessau, and to apply his principles himself in forming disciples, who might spread them over all Germany. Little calculated by nature or habit to succeed in an employment which requires the greatest regularity, patience, and attention, he, however, engaged in this new project with all his accustomed ardour. The name of *Philanthropinon* appeared to him the most expressive of his views; and he published at Leipzig in 1774 a pamphlet entitled *The Philanthropinon founded at Dessau*, containing the details of his plan. He immediately set about carrying it into execution; but he had few scholars, and the success by no means answered his hopes. The institution, badly managed, became a theatre of quarrels between Basedow and the masters who taught in it under his direction. The assistance of the celebrated Campe, a journal which they both composed together, under the title of *School Dialogues*, from 1777 to 1779, and a public examination which went off with eclat, gave a transient splendour to the *Philanthropinon*; but in a short time Basedow quarrelled with Campe, made complaints against his prince, quitted, and again returned to the care of the institution, exemplifying in all his conduct the effects of coarse manners and bad temper. He was at length drawn into the most scandalous disputes with Professor Wolke, his former coadjutor. The institution was finally shut up in 1793. Basedow died at Magdeburg on the 25th July 1790. His work *On the Education of Princes destined to the Throne* has been translated into French by Bourjoing. A list of his writings may be seen in Meusel's *Lexicon of German Writers from* 1750 *to* 1800, and an account of his life in Schlichtegroll's *Necrology for* 1790. (W. H–Z–T.)

Basel.

BASEL, BASLE, or BALE, a canton in the N.W. of Switzerland, with an area of 139 geographical square miles. It is bounded on the N.W. by France, on the N. by the grand

Basel ‖ Bashaw.

duchy of Baden, E. by the canton of Aargau, and S. and S.W. by those of Solothurn and Berne. The country is generally mountainous, being traversed by the Jura chain; but it abounds in excellent pasturage, and numerous herds of cattle are reared there. The northern part of the canton is best suited for agriculture, being watered by the Rhine and numerous small mountain streams, besides the more considerable rivers of the Birse and the Ergolz, in whose valleys the vine and other fruits are cultivated. The mountains attain an elevation of from 3000 to 4000 feet; and the climate is mild and salubrious. The principal manufactures are ribbons, woollen, linen, and cotton goods, leather, paper, iron and steel wares. Basel was admitted into the Swiss confederation in 1501, and furnishes a contingent of 918 men. In consequence of a revolt of the country population against the aristocratic government of the city, this canton was divided in 1832 into two sub-cantons; viz., Basel-stadt, or Bale-ville, comprising the city and several of the neighbouring communes; and Basel-landschaft, or Bale-campagne, with the remaining communes of the canton. Pop. of Bale-ville in 1850, 29,555; of whom 24,083 were Protestants, and 5508 Roman Catholics; pop. of Bale-campagne, 47,830, of whom 38,818 were Protestants, and 9052 Roman Catholics; the former sending one, and the latter two members, to the national council. See SWITZERLAND.

BASEL, or BALE, the capital of the above province, is situated on both sides of the Rhine, 43 miles north of Berne, in Lat. 47. 33. 36. N. Long. 7. 35. 35. E. Great Basel, or that portion of the city which lies on the south side of the river, is connected with Little Basel on the opposite side by a handsome stone bridge 600 feet long. Its ancient fortifications are still in a good state of preservation, and the town is generally well built; but the streets are narrow, and it has few public edifices worthy of notice. The cathedral is a fine old Gothic edifice, founded about the beginning of the eleventh century, and contains the tombs of Erasmus, Œcolampadius, and other eminent persons.

Besides the university, which was founded by Pope Pius II. in 1459, Basel possesses an extensive public library, containing a valuable collection of MSS., a picture gallery, a museum, gymnasium, botanical garden, an orphan asylum and institution for deaf mutes, a theological institute, &c. It is the seat of an active transit trade between France, Germany, and Switzerland; and it has important manufactures of silk, linen, cotton, leather, paper, &c. Basel was the seat of a great council from 1431 to 1448; and here, in 1795, France concluded a treaty with Prussia and with Spain. It is connected by railway with Strasburg, from which it is 60 miles distant. Pop. 24,000. Basel was the birthplace of Euler, Holbein, and Bernouilli.

BASHAN. See BASAN.

BASHARIANS, a sect of Mahometans, being a branch or subdivision of the Motazalites. They maintain the tenets of Bashar Ibn Motamer, a leading teacher among the Motazalites, but who varied in some points from the general tenets of the sect, carrying man's free agency even to the extent of making him independent.

BASHAW, more commonly written Pashá or Pachá, a Turkish governor of a province or district. Nothing more s necessary to raise an Osmanli to the dignity of pasha than the firman of the grand seignior; but some ceremonies are usually observed at his investiture or installation. The badge of a pasha's authority, as well as the emblem of his rank, is the horse-tail, and he takes precedence according to the number of these in his banner. The highest rank usually conferred, however, is that of pasha of three tails. The pashas are the grand seignior's lieutenants, and exercise the supreme military and civil power in their respective provinces. But many of them own little more than a nominal subjection to the Porte, although they submit to pay it an annual tribute; and some are almost always in a state of open rebellion against its authority. Religion, in fact, is the only connecting principle which keeps the different parts of the Ottoman empire together; but, fanatical as the Moslemin almost universally are, the case of Egypt shows how frail a tie this may become, and how easily the bundle of rods may be dissolved. In fiscal matters, the pasha ordinarily acts as a horse-leech to his more immediate subjects, and serves as a sponge to the sultan, who frequently contrives to squeeze out a portion of the blood with which he is gorged, and, after a time, kindly presents him with a bowstring, and thus becomes ultimate heir to his private accumulations.

Bashee Isles ‖ Basil.

BASHEE ISLES, a cluster of small islands in the Chinese Sea, due north of Luzon, the largest of the Philippines. They are five in number, with four rocky islets. They were visited by Dampier the English navigator in 1687, and named by him Orange, Monmouth, Grafton, Goat, and Bashee Islands. These islands possess a fertile soil, and produce abundance of potatoes and yams, as also sugar-canes, pine-apples, bananas, and plantains. Orange Island is twenty-two miles long by six broad. Grafton Island is about thirteen miles in circumference, and has good anchorage on the western side, with abundance of very fine water close to the beach. The inhabitants are described by Dampier as short and squat in stature, and of a dark copper colour. Iron was formerly a favourite article of exchange with them, but the use of money is now also understood. The Spaniards took possession of these islands in 1783, being tempted by the gold which is washed down by the mountain torrents, and manufactured by the inhabitants into a thick wire, which they wear as an ornament. The Spanish governor resides at Grafton Island, with about 100 soldiers. These islands are situated between the 20th and 21st degrees of N. Lat.

BASHKIRS, a race, supposed to be descended from the Nogay Tartars, who inhabit the Russian provinces of Ufa and Iekaterinenburg, in the governments of Orenburg and Perm respectively. Little is known of their history previous to their submission to the Russian dominion in the reign of Ivan II. They have frequently attempted to revolt, but have for a long time been faithful in their allegiance to the Russian power, to which, as skilful horsemen and archers, they contribute a useful body of auxiliaries. They are but partially civilized; and, though professing Mahometanism, retain traces of their old superstitions. They have little taste for agriculture, and subsist by hunting and the breeding of cattle and bees. A favourite dish with them is a hash of horse-flesh, which they call *bichbarmark*, or *five-finger-dish*; and they are greatly addicted to an intoxicating beverage called *koumiss*, prepared from fermented mare's and camel's milk. They set so little value on the rich gold mines in their territory, that they are left entirely to the industry of Russian miners, who pay a small rent to the proprietors.

BASIGNANA, a city of Piedmont, province of Alessandria, near the junction of the Po with the Tanaro. It contains 4000 inhabitants. A celebrated treaty of peace was concluded there in 1361, between Duke Otto of Brunswick and Count Galeazzo.

BASIL THE GREAT, one of the most learned and eloquent doctors of the church, was born at Cæsarea in Cappadocia, of a noble Christian family, about the year 328 He went to finish his studies at Athens, where he contracted an intimate friendship with Gregory Nazianzen. He returned in 355 to his native country, and there taught rhetoric for some time. He then travelled into Syria, Palestine, and Egypt, for the purpose of visiting the monasteries of these countries; and finding the monastic life suited to his disposition, he resolved, upon his return, to follow it, and in fact became the first monk and the original founder of monasteries in Pontus and Cappadocia. Upon the death of Eusebius, bishop of Cæsarea, in 370, Basil was chosen his

Basil || Basilic.

successor; but it was with difficulty that he accepted of this dignity; and no sooner had he been raised to it than the Emperor Valens began to persecute him because he refused to embrace the doctrine of the Arians. As soon as this storm had blown over, the new bishop used his utmost endeavours to bring about a re-union between the Eastern and Western Churches, which were then much divided about some points of faith, and also in regard to Meletius and Paulinus, two bishops of Antioch; but all his efforts were ineffectual, and the dispute was not terminated until nine months after his death. Basil had a share in all the controversies of his time regarding the doctrine of the church. He died on the 1st of January 379. The best edition of his works is that of Garnier and Maran, Greek and Latin, 3 vols. fol., Paris, 1721. There is a good recent edition in 4 vols. 8vo, Paris, 1839. Basil's style is pure and elegant, his expressions often reach the sublime, and his thoughts are noble and full of majesty. Erasmus ranks him among the greatest orators of antiquity.

BASIL, *Ocymum basilicum*, a fragrant, aromatic, herbaceous plant, a native of warm climates, and much used to flavour food.

BASIL, in *Joinery*, the sloping edge of a chisel, or of the iron of a plane. The basil is usually made twelve degrees for soft wood, and for hard wood eighteen.

BASILAN, one of the Philippine Isles, S.W. of Mindanao; from which it is separated by the Basilan Strait. It is a fertile island, but is infested by pirates. The village is in Lat. 6. 30. N. Long. 122. 24. E.

BASILEUS, (*βασιλεύς*, *king* or *lord*), a title assumed by the emperors of Constantinople, exclusive of all other princes, to whom they gave the title of *rex*. The title *basileus* was subsequently assumed by other kings, particularly the kings of England; as *Ego Edgar totius Angliæ basileus confirmavi*. Hence also the queen of England was anciently styled *Basilea* or *Basilissa*. See ARCHON, and KING.

BASILIAN MONKS, a religious community of the order of St Basil. That saint, having retired into a desert in the province of Pontus, founded a monastery for the convenience of himself and his numerous followers; and, for the better regulation of this society, he drew up in writing the orders and rules which they were to observe. This new order quickly spread all over the East, and soon passed into the West; and it is even said that before his death Basil saw himself the spiritual father of more than ninety thousand monks in the East alone. The historians of the order state that it produced fourteen popes, many cardinals, and a great number of patriarchs and archbishops, 1805 bishops, 3010 abbots, 11,805 martyrs, with an infinite number of confessors, virgins, &c. It was introduced into the West in 1057, and reformed in 1569 by Pope Gregory XIII., who united the religious of this order in Italy, Spain, and Sicily, into one congregation.

BASILIC, or BASILICA, in the ancient architecture, a kind of public hall or court of judicature, where the princes or magistrates sat to administer justice. This word is taken from the Greek *βασιλική*, a *royal house*, or *palace*.

The basilicæ consisted of a great hall, with aisles, porticoes, tribunes, and tribunals. The bankers, too, had one part of the basilica allotted for their residence; and scholars likewise went thither to pronounce their declamations. In after times the denomination of basilica was also given to other buildings of public use, as town-houses, exchanges, and the like. The Roman basilicæ were covered, by which they were distinguished from the fora, which were public places in the open air. The first basilica at Rome was built by Cato the elder, whence it was called *Porcia;* the second was called *Opimia;* the third was that of Paulus, built at great expense, and with much magnificence, whence it was called by some *regia Pauli;* and Julius Cæsar erected a fourth called *basilica Julia*, of which Vitruvius tells us he had the direction. Besides these there were others, to the number of eighteen or twenty. The basilica Julia not only served for the hearing of causes, but likewise for the reception and audience of foreign ambassadors. It was supported by a hundred marble pillars in four rows, and enriched with decorations of gold and precious stones; and in it were thirteen tribunals or judgment-seats, where the prætors sat for the despatch of judicial business. Basilica.

Basilica is also used by ecclesiastical writers for a church; in which sense the name frequently occurs in St Ambrose, St Austin, St Jerome, Sidonius Apollinaris, and other writers of the fourth and fifth centuries. The name was probably thus applied from many of the ancient churches having been formed out of the Roman halls or basilicæ above described. The name is chiefly applied, in modern times, to churches of royal foundation, as those of St John de Lateran and St Peter of the Vatican at Rome, founded by the Emperor Constantine.

BASILICA, *τὰ Βασιλικά*, in the history of jurisprudence, a name given to a digest of laws commenced by the Emperor Basilius, and completed by his son Leo the philosopher. This collection, according to some, received the title of Basilica in honour of the Emperor Basilius; while others think that it was so denominated from the circumstance of its containing *βασιλικὰς διατάξεις* or imperial constitutions. It was begun by Basilius in the year 867, and completed by Leo in the year 880; the former having carried the work as far as forty books, and the latter having added twenty more, in which state it was published. In 911, Leo was succeeded by his son Constantinus Porphyrogenitus, from whom the Basilica received their final revision, *τὴν τελευτάιαν ἀνακάθαρσιν*; and the amended edition is supposed by Heimbach to have appeared about the year 945. Opinions, however, are divided as to whether the work has descended to us in the state in which it was first published by Leo, or according to the revised and improved edition of Constantine. Brunquell thinks that we possess the Basilica in the amended form; but Hoffmann considers this opinion doubtful, and his suspicions have been confirmed by the subsequent investigations of Heimbach. In the West, the Basilica never obtained the force of law; and the chief value of the collection therefore consists in the illustration it furnishes of the Justinianean body of law from which it was mostly compiled; but in this respect its utility has long been understood and acknowledged. Four complete books of the Basilica, namely, the forty-fifth, forty-sixth, forty-seventh, and forty-eighth, and fragments of two others, the twenty-eighth and twenty-ninth, were published at Paris in 1557, accompanied with a Latin version, by Gentianus Hervetus. In 1566, Cujacius published at Lyons a Latin version of the sixtieth book, which is of great length. All the different portions which had thus been edited were collected by Dionysius Gothofredus, and printed at Hanau in 1598 and 1606. But the more extensive and complete edition of Fabrot, which appeared at Paris in 1647, superseded these imperfect publications, and proved of great service to the study of ancient jurisprudence. It is contained in seven volumes folio, and accompanied with a Latin version of the text as well as of the Greek scholia subjoined. Of the sixty books which composed this great work Fabrot supposes that he has exhibited forty-one in an entire form; but Meerman, Reitz, and others, think that this estimate admits of some abatement. About a century after the date of Fabrot's edition, Reitz published four entire books of the Basilica, namely, the forty-ninth, fiftieth, fifty-first, and fifty-second, which were inserted in the fifth volume of Meerman's *Thesaurus Juris Civilis et Canonici*, and, thirteen years afterwards, given to the world in a separate form, accompanied with the commentaries (as edited by Ruhnken) of Thalelæus, Theodorus, Stephanus, Cyrillus, Gobidas, and other Greek lawyers, on the titles of the Pandects and Code *De Postulando sive de Advocatis, nec non de Procurator-*

Basilicata ‖ Basilisk.

bus et Defensoribus. The ancient *Glossæ*, which are not without their value, were first published by Labbé, and afterwards illustrated by Schulting and Röver.[1]

BASILICATA, a province of the kingdom of Naples, bounded on the N. by Capitanata, N.E. by Terra di Bari, E. by Otranto and the Gulf of Taranto, S. by Calabria Citra, S.W. by the Mediterranean, W. by Principato Citra, and N.W. by Principato Ultra. It has an area of 3130 geographical square miles, and is divided into four districts and 121 communes. Pop. 481,288. In the N.W. part of this territory the Apennines divide into two branches, the one running eastward to Terra di Bari, and the other southward to Calabria. The principal rivers are the Bradano, Basento, Salandrella, Agri, and Sinno, all flowing into the Gulf of Taranto. The principal productions are maize, wine, lint, hemp, and tobacco; swine, goats, and sheep, are numerous; and the produce of the silkworm forms a considerable branch of industry. The chief towns are Potenza, Francavilla, and Tursi.

BASILICI, a denomination given in the Greek empire to those who carried the emperor's orders and commands.

BASILIDIANS, the followers of Basilides of Alexandria, one of the most eminent leaders of the Gnostics, who lived near the beginning of the second century. It has commonly been said that he held the body of Christ to be a mere phantom, and that he gave his form to Simon the Cyrenian, who was crucified in his stead. We learn from Eusebius that Basilides wrote twenty-four books upon the Gospel, of which some fragments are extant, and that he forged several prophets, to two of which he gave the names of *Barcaba* and *Barcoph.* A *Gospel* of Basilides is mentioned by Origen, Ambrose, and Jerome. The Basilidians held much the same opinions with the Valentinians, another branch of the Gnostic family. They asserted that all the actions of men are necessary; that faith is a natural gift, to which men are forcibly determined; and that however irregular or vicious may be their lives, they are nevertheless sure to be saved. Irenæus and others assure us that they acted in perfect consistency with their principles, committing all manner of villanies and impurities, in confidence of their natural election. It however appears that, whatever opinions his followers may have held, Basilides himself recommended purity of life and the practice of piety; and that he supposed the man Jesus and Christ united to constitute the Saviour. (Mosheim, *de Reb. Christ., &c.* pp. 342–361.) The Basilidians believed in a hierarchy of divine persons, or Æons. Under the cabalistical name *Abraxas*, they are believed to have worshipped the supreme God, from whom, as a principle, all other things proceeded. There are still extant gems inscribed with the word *Abraxas*, and which were probably used as amulets against diseases and evil spirits. See ABRAXAS.

BASILISK (βασιλίσκος, from βασιλεύς), a fabulous crested serpent, called a cockatrice, because supposed to be produced from a cock's egg. (See Lucan, ix. 726). It is also the name given by naturalists to a genus of saurian reptiles belonging to the Iguanoid family. See REPTILIA, *Index.*

BASILISK, an ancient species of ordnance, so called from its supposed resemblance to the fabulous serpent of that name. The basilisk threw an iron ball of 200 pounds weight. It was much used in the time of Sultan Solyman, particularly during the wars of Hungary, but is now entirely out of use; unless, indeed, the name may still be applied to those enormous pieces of ordnance which the Turks have built into the ramparts of the castles on the Dardanelles, and which carry stone balls of from 200 to 300 pound weight.

Basilius ‖ Basket.

BASILIUS I., surnamed the *Macedonian*, was sprung of an obscure family in Macedonia, and rose, after many adventures and vicissitudes, from the rank of a common soldier to be emperor of the Greeks. He was made chamberlain to the Emperor Michael III., and having co-operated with that weak and vicious prince in the murder of the Cæsar Bardas, he was made his colleague in the empire. In A.D. 867, he assassinated Michael when overpowered by wine, and thus obtained undivided sovereignty. He ruled with great ability, and left the kingdom in a very flourishing condition. He was dreaded by the Saracens, whom he frequently vanquished; and he was loved by his subjects on account of his justice and clemency. He died in A.D. 886, of wounds received from a stag while hunting. He is the author of a small work on the duties of a prince, which he dedicated to his son. (Gibbon, xlvii. liv.)

BASINGSTOKE, a market and borough town in the county of Hants, 45 miles from London. It occupies a pleasant situation, and has a good trade in corn and malt, which has been greatly facilitated by the canal which joins the rivers Wey and Thames. The church is a spacious and handsome structure. The town is governed by a mayor, four aldermen, and twelve councillors. Pop. in 1851, 4263.

BASKERVILLE, JOHN, an eminent letter-founder and printer, was born in 1706, at Wolverley, in Worcestershire. He was heir to an estate of about L.60 a year, the whole of which income he allowed to his parents during their lives. In his early years he conceived a love for calligraphy and cutting in stone; and being brought up to no particular profession, he became a writing-master at Birmingham when about twenty years of age. Here the improvements made in different manufactures soon drew his attention, and he applied to the business of japanning, which he carried on for a long time with distinguished excellence and success. In 1750 he turned his attention to letter-founding, which, with much labour and expense, he brought to great perfection, and in a few years proceeded to printing. His first work was an edition of Virgil in royal quarto. Soon after this the university of Cambridge granted him permission to print a Bible in royal folio, and editions of the Common Prayer in three sizes; a privilege for which he paid a considerable sum to the university. He afterwards printed Horace, Terence, Catullus, Lucretius, Juvenal, Sallust, and Florus, in royal quarto; Virgil in octavo; and several books in duodecimo. He likewise published some of the English classics. These books are admirable specimens of typography; and indeed Baskerville is deservedly ranked among those who, in modern times, have brought the art of printing to its greatest perfection. It has been observed, however, that his books are far more elegantly than correctly printed. Not having met with that encouragement which he expected from the booksellers, Baskerville set up his letter foundery for sale a little before his death, which took place in July 1775.

BASKET, a utensil made of twigs, rushes, or chips, as well as of a variety of other materials, interwoven together, and used for holding or carrying any commodity. The ancient Britons were noted for their ingenuity in making baskets, which they exported in large quantities. These baskets were of very elegant workmanship, and bore a high price. They are mentioned by Juvenal among the extravagantly expensive furniture of the Roman tables in his time.[2]

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[1] See a very learned and satisfactory article on the Greek Texts of the Roman Law, in the *Foreign Quarterly Review*, No. xiv. April 1831.

[2] The words of Juvenal are, *Adde et bascaudas et mille escaria*, "Add *baskets*, and a thousand other dishes." That these "baskets" were of British manufacture is evident from the lines of Martial:

"Barba a de *pictis* veni bascauda *Britannis*,
Sed me jam mavult dicere Roma suam."

Basket-making.

BASKET-MAKING. Modern ingenuity has applied many substances before unthought of to the construction of baskets, such as iron and even glass. But wicker-work being the oldest as well as the most universal invention, it alone will be treated of in the present article. The process of interweaving twigs, reeds, or leaves, is seen among the rudest nations of the world; and there is known even an inferior specimen of art among the natives of Van Diemen's Land, consisting of a bunch of rushes tied together at either end, which, spread out in the middle, forms a basket. But the sudden alteration of shape obviously renders this construction less convenient; whence the same and other tribes make a basket of leaves interwoven, and that so skilfully executed, that it retains either milk or water. A bundle of rushes spread out may be compared to the warp of a web, and the application of others across it to the woof, also an early discovery; for basket-making is literally a web of the coarsest materials. By experience these materials are refined and ornamented; and, in the most improved stages of manufacture, neat and useful implements and utensils are produced. Scarcely any nation has been entirely ignorant of the art; and our ancestors in this island made baskets which, as we have already stated, were carried to Rome either for use or ornament.

Basket-making, however, has by no means been confined to the fabrication of those simple and useful utensils from which its name is derived. Of old, the shields of soldiers were fashioned of wicker-work, either plain or covered with hides; and the like has been witnessed among modern savages. In Britain, the wicker boats of the natives, covered with the skins of animals, attracted the notice of the Romans; and Herodotus mentions boats of this kind on the Tigris and Euphrates. But there was this difference, that the former seem to have been of the ordinary figure of a boat, whereas the latter were round and covered with bitumen. Boats of this shape, about seven feet in diameter, are used at the present day on these rivers; and boats of analogous construction are employed in crossing the rivers of India which have not a rapid current. Nothing can be more expeditious or more simple than the fabrication and materials of these vessels, if they merit that name. One may be made by six men in as many hours. Only two substances, almost always accessible, are used,—hides and bamboo. They are navigated either by paddles where the water is deep, or are pushed over a shallow bottom with long poles; and the passengers within are safely transported, being kept dry by planks and pieces of wood at the bottom. The basket-boats on the river Krishna, in the same country, are about twelve feet in diameter and four feet deep. Whole armies are thus enabled to continue their march, and even heavy artillery has been conveyed in this manner across rivers. Sometimes the boats are towed by bullocks fastened to them, and goaded on in the proper direction. In different parts of the world, whole houses, cottages, fences, and gates, are formed of basket or wicker work. On the Continent, a two-horse carriage, called a Holstein waggon, of very considerable size, and fit to carry several persons, is composed solely of basket-work. The same is done in Britain with regard to the bodies of gigs; and an appendage of the stage-coaches is literally designed *the basket;* besides a vast variety of works on a smaller scale.

In respect to the materials employed, besides those specified as belonging to the ruder nations, there are many which are equally the product of nature and art. Twigs, branches, straw, and whalebone, are all of the number. The natives of some parts of South America make baskets simply of rushes, so closely interwoven as to hold water; and thousands of them are annually sold in the Spanish provinces. The Kaffirs and Hottentots are alike skilful with the roots of plants. But of all materials, osiers or willows are in most general use.

Osiers employed for basket-making are either taken entire, cut from the root, split asunder, or stripped of their bark, according to the work to be produced; but in the latter case they are previously soaked in water. The stripping is performed by drawing the willows through an iron-edged implement called brakes, which removes the bark, and the willows are then cleaned, as far as necessary, by manual operation with a sharp knife. Next they are exposed to the sun and air, and afterwards placed in a dry situation. But it is not the less necessary to preserve willows with their bark in the same manner; for nothing can be more injurious than the humidity inherent in the plant; and previous to use they must be soaked some days in water also. The barked or white osier is then divided into bundles or faggots according to size; the larger being reserved to form the strong work in the skeleton of the basket, and the smaller for weaving the bottom and sides. Should the latter be applied to ordinary work, they are taken whole; but for implements of slight and finer texture, each osier is divided into splits and skains; which names denote the different degrees of size to which they are reduced. Splits are osiers cleft into four parts, by means of a particular implement employed for that purpose, consisting of two edge tools placed at right angles, whereby the rod is longitudinally divided down the pith. These are next drawn through an implement resembling the common spoke-shave, keeping the grain of the split next the wood or stock of the shave, while the pith is presented to the edge of the iron, which is set in an oblique direction to the wood: and in order to bring the split into a shape still more regular, it is passed through another implement called an upright, consisting of a flat piece of steel, each end of which is fashioned into a cutting edge, like that of an ordinary chisel. The flat is bent round, so that the two edges approach each other at a greater or less interval by means of regulating screws, and the whole is fixed into a handle. By passing the splits between the two edges they are reduced to skains, the thickness of which is determined by the interval between the edges of the tool. All the implements required by a basket-maker are few and simple: they consist, besides the preceding, of knives, bodkins and drills for boring, leads for keeping the work steady while in process, and, where it is of small dimensions, a heavy piece of iron called a beater, which is employed to beat the basket close as it is augmented. Thus a basket-maker has this great advantage over many other artificers, that he can establish himself in his profession at the most inconsiderable expense either for tools or materials.

An ordinary basket is made by preparing the requisite number of osiers, and preserving their length considerably greater than that of the finished work. They are ranged in pairs on the floor parallel to each other, at small intervals, in the direction of the longer diameter of the basket; and this may be called the woof; for, as we have said, basket-work is literally a web. These parallel rods are then crossed at right angles by two of the largest osiers, with the thick ends towards the workman, who places his foot upon them; and weaving each alternately over and under the parallel pieces first laid down, they are by that means confined in their places. The whole now forms what is technically called the slat or slate, which is the foundation of the basket. Next, the long end of one of the two rods is taken and woven under and over the pairs of short ends all round the bottom, until the whole be woven in. The same is done with the other rod, and then additional long osiers are also woven in, until the bottom be of sufficient size, and the woof be occupied by them. Thus the bottom or foundation on which the superstructure is to be raised is finished; and this latter part is accomplished by sharpening the large ends of as many long and stout osiers as may be necessary to form the ribs or skeleton. These are forced or plaited between the rods of the bottom from the edge towards the centre, and are turned up in the direction of the sides; then other rods are woven in and out between each of them, until the

Basket-making.

basket is raised to the intended height, or, more correctly speaking, the depth it is to receive. The edge or brim is finished by turning down the perpendicular ends of the ribs, now protruding and standing up over each other, whereby the whole is firmly and compactly united. A handle is adapted to the work by forcing two or three osiers, sharpened at the end, and cut to the requisite length, down the weaving of the sides, close together; and they are pinned fast, about two inches from the brim, in order that the handle, when completed, may be retained in its proper position. The osiers are then either bound or plaited in such fashion as pleases the taste of the artist.

This is the most simple kind of basket, from which others differ only in finer materials and nicer execution; but in these there is considerable scope for taste and fancy, and implements are produced of extreme neatness and ingenuity in construction. Some are formed of twigs or straw entire; others of sections, split of various thickness, coloured, plaited, or plain; and baskets of endless variety in size, figure, and texture, are fabricated according to the artist's inclination. The skains are frequently smoked and dyed either of dull or brilliant colours, and by intermixing them judiciously a very good effect is produced.

From the simplicity of this manufacture, a great many individuals, independent of professed basket-makers, are occupied in it; and, fortunately, it affords employment to the blind in the several asylums established for their reception. Not that persons suffering privation of sight are incapable of more ingenious and delicate mechanical exercises, but the facility of teaching and acquiring the principles of basket-making being alike obvious, is one of the strongest recommendations in its favour. At Liverpool, where there is an asylum of this description, the art is practised with success; and in the city of Edinburgh a number of the blind find employment of the same kind in the asylum established there.

The best materials for basket-making have been principally imported into Great Britain from France and Holland; but the duration of the late war induced the inhabitants of this country to endeavour to obtain a supply at home. Cultivation of the osier was imperfectly understood in England, and in Scotland it scarcely received any attention whatever; whence, as a suitable encouragement, that patriotic society whose notice is specially directed to the improvement of arts and manufactures, offered premiums to those cultivators who should raise the greatest quantity, not being less than 6000 plants on an acre.

It became an object with such cultivators to ascertain, not only the quantity that could be obtained, but the quality of the produce; which was of the greater consequence, as many plants, passing under the general name of osiers, and even possessing their external characters, are ill adapted for the work intended. But considerable light has been thrown on the subject by Mr Philipps of Ely, who was early rewarded by a premium on account of the utility of his observations. He remarks that the osier is a species of salix, of which there are many varieties; and that these may be comprehended under two classes, the first containing nine or ten species. None, however, excepting one, the gray or brindled osier, is of use. This, in common with the others, has a light-coloured leaf, but is distinguished by the bark being streaked with red or blood colour; and it is of late introduction into Britain, having been first planted in the isle of Ely, where the observer's experiments seem to have been chiefly made. It grows vigorously, is very hardy and tough, and bleaches well. All the others of the same class prefer a wet soil, where they grow quickly and large, flourishing even in the most barren kind of peat; but they are coarse and spongy, have a thick pith, and are extremely perishable. Nevertheless they are sometimes used for coarser workmanship, and are profitable to those who live in the vicinity of places where there is a great demand for osiers, and cheap conveyance. During the interruption of Continental intercourse they were much resorted to by basket-makers: but their inferiority has brought the English baskets into disrepute in foreign markets. The second class, according to Mr Philipps, contains four or five different species. One of these, the Welsh willow, is very tough and durable, but not of a favourable colour. There are two varieties, red and white, the former of which is preferred, and forms part of every plantation, from its particular utility in tying up the bundles of willows after they have been barked or whitened. The bitterness of this plant is such as to be a protection from the depredations of cattle. Besides these there are the west country Spaniard, the new willow, the French, and the red Kent willow. The first has been superseded by others of superior quality; but experience proves that an acre will carry 2000 plants more of them than of some which are in higher repute. But the most esteemed of all is the French willow, especially as being most adapted for smaller and finer work in baskets, fans, hats, and other light articles. It is rather of slow growth, but extremely taper, pliant, close-grained, tough, and durable. Great quantities of it are always imported from the Continent, its culture being more neglected here than that of the others; however, it must be distinguished from a species resembling it, which is characterized by the brittleness of the leaves, which snap like glass when drawn through the fingers. Plantations of the French willow have been strongly recommended as forming a useful commodity, and being always in demand. Having attained the requisite maturity, all willows are cut down and made up into bunches in iron hoops 36 or 40 inches in diameter, for the manufacturers, and are sold either in this way or in loads, the price being subject to fluctuation according to the scarcity or abundance of the commodity.

Basket-making.

In regard to the cultivation of osiers very different opinions prevail; originating, it is probable, from too limited experiments, combined with the diversity of soil and climate. Mr Philipps, whose opinions are entitled to attention, conceives that autumn, and not spring, is the most proper season for planting willows: the stagnation of the juices he considers the true criterion whereby to regulate the period, but not on account of the set so much as on account of the trunk; for if the shoot be severed when the sap is in circulation, the parent plant bleeds to death. The osiers which he planted in the first week of October he found to have struck roots about Christmas, though there was no external sign of vegetation. In prosecuting this subject Mr Philipps observes, that he made a plantation in autumn, and filled up part of the ground which was vacant, in the following month of March, with additional sets. The latter were the further advanced in May, but in June the autumn plants had the advantage, and continued growing well, while many of the others died. In summer, he remarks, "when the fibres have been formed before the winter, or when a tendency to form them has been observed by the swelling of the bark, and particularly at the eye, the plant is enabled to charge itself with a sufficient portion of the juices to answer the demand of spring." Therefore he concludes that the proper rule is to plant as early in autumn as the shoots may be cut, without injuring the parent stock. The cultivator lays out the ground in beds or burrows eighteen feet broad, digging ditches nine feet wide on each side. The upper surface of the ditches, to the depth of fourteen inches, is thrown on the beds, and the remainder of what is excavated from them is used for turf or fuel. The beds, now consisting of about two feet and a half thick of solid earth above the surface of the substratum of peat, are planted in the following autumn, and produce good crops.

Experiments have been made by various cultivators respecting the suitableness of different soils, after having borne different kinds of grain. Mr Sheriff has related a profitable mode of culture practised by him in Scotland, and also made

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some judicious observations on the subject in general. He remarks that the finest and most valuable twigs can be procured only from land cured of chilling weeping springs; and if the soil is not of considerable thickness, it must be rendered so by manure. Moderate moisture is favourable to the production of fine twigs, but water constantly stagnant is ruinous. He proposes to make the cuts or shoots from fifteen to seventeen inches in length, and to allow four or five inches to remain above ground, to be cut down by the surface of the soil, when the heads of the stocks shall, in a series of years, have become too bushy. By this operation the vigour of the plant is renewed in the most decided manner. Mr Sheriff forgets, however, that, in the time he mentions, a much greater protrusion from the earth will have taken place by the simple vegetation of the plant than is necessary to leave room for cutting off the head. It is necessary, in his opinion, to trim and dress the stocks from decayed wood, and to retain only as many buds on each as the plant may be expected to bring to perfection in length and strength of shoot. Thus the superabundant stumps of old wood are cut down, and the weakest shoots extirpated, in November and December, or March and April; and seldom more than two buds should be left on those selected to stand and produce the next summer's growth. He considers the leading errors of those who have attempted the cultivation of osiers to consist in employing improper soil, peat-earth perhaps, or poor bogs; and also in defective preparation of the soil, though suitable in other respects. Failure may, besides, arise from planting bad or useless species of osiers; putting too few cuts in the ground; neglecting their subsequent culture, particularly during the first spring and summer after plantation; and allowing the shoots to be cut down after Christmas and before the middle of March, which renders the stocks liable to be much weakened by hard frosts succeeding heavy rains, immediately after the twigs have been cut, and before the wounds from the knife have healed. By pursuing a system analogous to what is here exposed, he calculates the profits of an acre of osiers at about L.18, 10s.; and he mentions that he contracted to receive a sum between L.220 and L.250 for the produce of twelve statute acres and a half. It does not appear, however, that this was an annual crop, and it is rather to be inferred that willows of several years' growth formed part of it. Mr Sheriff's experiments and observations were rewarded with the gold medal of the Society for the Encouragement of Arts and Manufactures. Another cultivator, Mr Wade, calculated his profits on fourteen acres, which were planted with 12,000 sets each, at intervals of twenty-six inches by ten, as amounting to L.10 per acre.

Among the experiments on the quality of soil may be instanced a plantation made in spring, of large cuttings, eighteen inches long, thrust so far into the earth as to leave four or five inches protruding. Part of the ground had been in wheat after summer fallow, and part, which was also planted, had been sown with grass seeds. The plants made a more vigorous shoot in spring than at any subsequent period, and of the whole but few failed. Those which succeeded the wheat produced the best osiers, and those which were planted among the grass seeds the worst. Both stood on a strong clay soil; and from the difference seen here, it has been concluded, that, as the cleanest ground produced the best crop, summer fallowing would be advantageous. Another example is given, where, of 350 sets planted in garden ground, the soil of which was clay, 341 succeeded; producing, in the first year apparently, a bundle thirty-eight inches in circumference, and some of the osiers above ten feet long. They were planted in the latter end of March, and arranged in rows, between which was sown a crop of beans. Both the interval separating the plants and their age are arbitrary, as is also the extent of the plantation, and we may likewise add the quality of the soil; for experiments have not been made on a sufficient scale to determine the fact. The most superficial observer cannot fail to have remarked the comparative slenderness of all plants crowded together, and the superior strength of those apart from each other. The sets of osiers, for several reasons, should be inserted in regular rows. Their age does not appear important, and nowhere is a more vigorous crop produced than from the root of the oldest tree deprived of its trunk. In general, previous preparation of the ground is profitable; and plantations may thence be formed, which are to be annually cut down for baskets and such light utensils; but the shoot is allowed to grow two, or even four years, if strong rods are required for larger and coarser workmanship. The rapidity and certainty with which this plant vegetates preserves it in a manner under absolute control, and peculiarly adapts it for a variety of mechanical purposes. Many cultivators recommend deep insertion of the shoot into the ground; but here there is a limitation; for if it be too deeply inserted, the vegetation will be less vigorous. At the same time, the powerful tendency to vegetation in a willow is rather an exception to ordinary rules; and although the lower part be injured, roots may spring nearer the surface. But it is not to be overlooked, that if a tree be transplanted into too deep a pit, the root, instead of striking out new fibres, remains inactive, and the tree withers and decays; or if seeds be deposited too deeply in the earth, no vegetation will ensue; whereas, even those on the surface will put forth a radicle, and establish themselves there. In the former case, they either lose the germinative faculty, or are destroyed; but if a tree be transplanted into a shallow pit the root will spread, and the whole will exhibit a luxuriant vegetation. These are facts which demand greater attention than they usually receive; and the depth at which the shoots of osiers are inserted should be carefully observed. Nevertheless we must repeat, that it does appear that deep insertion is not as noxious to them as to other plants.

It was long supposed that willows flourish nowhere but with abundance of water. Undoubtedly, adequate humidity is very essential; but this general position was quite erroneous, as experiment and observation daily testify. Willows growing in water have almost invariably a sickly aspect; few strong or healthy scions spring from them; and their vegetation is never so vigorous as when they are at some distance from it. Every plant has a predilection for a particular place, where the conditions of its aliment and vegetation concur. The willow requires a considerable degree of humidity, though it may also be seen vigorous on drier soils; but the vicinity of water is an essential quality in selecting a suitable spot for a plantation. The purposes to which the plants are to be applied must be considered, and the circumstances of their growth so regulated that they may become suitable for the object in view. There is little doubt that, with due notice and consideration, this plant may receive great amelioration by culture.

All plantations must be well fenced against cattle, as the willow, both shoot and leaf, is with them a favourite kind of food; and as at certain seasons of the year some particular caterpillars infest the plant, stripping it totally bare and injuring its vegetation, care should also be taken to remove them as effectually as possible. (J. G. D.)

Baskets of Earth || Basnage.

Baskets of Earth, called in French *corbeilles*, are sometimes placed on the parapet of a trench, to form a sort of epaulement or breastwork, between which the soldiers fire upon the enemy.

BASKING SHARK, a very large and powerful but harmless species of shark. See Ichthyology, *Selache*.

BASNAGE, Jacques, a learned author, and pastor of the Walloon church at the Hague, was born at Rouen in Normandy on the 8th of August 1653. He was the son of Henri Basnage, one of the ablest advocates in the parliament of Normandy. At the age of seventeen, having made

himself master of the Greek and Latin authors, as well as of the English, Spanish, and Italian languages, he went to Geneva, where he began his theological studies under Mestrezat, Turretin, and Tronchin; and completed them at Sedan, under the professors Jurieu and Le Blanc de Beaulieu. He then returned to Rouen, where he was received as minister in September 1676; and in this capacity he remained till the year 1685, when the exercise of the Protestant religion being suppressed at Rouen, he obtained leave of the king to retire to Holland. He settled at Rotterdam, and continued a minister pensionary there till 1691, when he was chosen pastor of the Walloon church of that city. In 1709, the pensionary Heinsius got him elected one of the pastors of the Walloon church at the Hague, intending to employ him not only in religious but also in civil affairs. Accordingly he was engaged in a secret negotiation with Marshal d'Uxelles, plenipotentiary of France at the congress of Utrecht; a service which he executed with so much success, that he was afterwards intrusted with several important commissions, all of which he discharged in such a manner as to establish a high character for ability and address. Indeed, a celebrated modern writer has said of him, that he was fitter to be a minister of state than the minister of a parish. The Abbé Dubois, who was sent to the Hague in 1716, as ambassador plenipotentiary from His Most Christian Majesty, in order to negotiate a defensive alliance between France, England, and the States General, received instructions from the Duke of Orleans, then regent of France, to address himself to M. Basnage, and to follow his advice: they accordingly acted in concert, and the alliance was concluded in January 1717. His published works, which are mostly in French, spread his reputation over the greater part of Europe. Among these are, *The History of the Religion of the Reformed Churches; Jewish Antiquities; The History of the Old and New Testament; Dissertation on Duels, &c.* He died on the 22d September 1723.

Basnage, *Henri, Sieur de Beauval*, was the second son of Henri Basnage, and brother of the preceding. He studied the law, and was admitted an advocate in the parliament of Rouen in 1679. He practised with great reputation, till the revocation of the edict of Nantes obliged him to fly to Holland, where he composed the greater part of his works. He died in 1710, aged fifty-four. His chief work is his *Histoire des Ouvrages des Sçavans*, Rotterdam, 24 vols. 12mo.

BASON, or Basin, in *Hydraulics*, a reservoir of water, used for various purposes.

BASQUE Language. The language spoken by the Spaniards in what are called the Basque provinces, as also in Navarre. The people call it *Escuara*. For a long time it was supposed to be a dialect of the Celtic; but later researches show that there is good ground for considering it as a distinct ancient language, and as having been once spoken over all the Peninsula. This is proved by the ancient names of mountains, towns, and rivers being decidedly derived from Basque radicals; as is shown in the curious *Inquiries* of William Von Humboldt, published at Berlin in 1821; and by the dictionary and grammar of this tongue recently published. The structure of the verb is complex—it is considered as having 11 moods and 46 tenses; so as to exhibit all the relations of the agent to the action, and to the object it affects. The substantive has no distinction of gender; the articles are two, *a* for the singular, and *ac* for the plural; the cases are marked by affixes or prepositions. In the structure of the sentences the noun occupies the first place; it is followed by the article, then the adjective, next the adverb, the verb, the thing acted upon, and lastly the affix.

Basque *Provinces* (*Provincias Vascongadas*). The three Spanish provinces known by this name, which are distinguished from all the other divisions of Spain by the character, language, and manners of the inhabitants, and by the enjoyment of political privileges which make the form of their government nearly republican, are Biscay (Vizcaya), Guipúzcoa, and Alava. The territory occupied by them is in the form of a triangle, bounded on the N. by the Bay of Biscay, S. by Soria, E. by Navarra and part of France, and W. by Santander and Burgos. It comprises an area of 2958 square miles; pop. in 1849, 373,149. These three provinces are more particularly described under their respective heads. The ancient French Basque provinces now form the arrondissements of Bayonne and Mauleon.

BASS, or Base, in *Music*, means, in a general sense, the lowest part in a composition for two or more voices or instruments, or for an organ or pianoforte, &c. A fundamental bass is that in which each note bears a direct harmony only, *i. e.*, a common chord or a chord of the seventh. A thorough bass (*Basso continuo* in Italian), or continuous bass, is that which, on the organ or pianoforte, accompanies a musical composition throughout, and of which the harmony played by the right hand consists of a judicious selection of chords drawn from the upper parts of the composition. (See Music, §§ *Harmony, Organ, Pianoforte;* and *Accompaniment*, in appendix to Music.) (G. F. G.)

Bass Rock, an islet about a mile in circumference, situated on the coast of East Lothian, near the entrance of the Firth of Forth, and at a short distance from the town of North Berwick. It is steep and inaccessible on all sides, except to the south; and even there it is with some difficulty that a single person can ascend. In ancient times it belonged to the Lauders; and although long solicited by royalty, it was not acquired till 1671, when Charles II. purchased it. Its insulated situation and inaccessible nature soon suggested the idea of a state prison, which was accordingly erected in the reign of Charles, or in that of his brother James, together with some trifling fortifications. It was here that some of the Covenanters were confined, who had been found in arms against the king. At the revolution a party of King James's adherents got possession of the Bass. There being a fountain sufficient to supply water on its summit, with pasturage for the maintenance of a few sheep, and a small rabbit-warren, they were enabled to hold possession, carrying on their piratical operations by means of a boat, which they hoisted upon the rock, out of the reach of attack, and let down at pleasure. This party captured a great many vessels, and held out for King James long after the whole of Great Britain had submitted. Their boat, however, was at last seized or lost, upon which they were obliged to surrender for want of provisions. After this the island was dismantled of its fortifications. It is now the property of Sir Hew Dalrymple Hamilton of North Berwick. There is a cavern which runs quite through the rock, and is accessible at low water, affording refuge for a multitude of wild pigeons. The sea-fowl, which resort to this spot during the breeding season, nearly cover its sides and a large portion of its surface. Of these the gannet or solan goose is the principal; with puffins, cormorants, and kittywakes. The island is farmed at a considerable rent for the sake of the birds and eggs, which are brought to market. The rock consists of greenstone and trap tuffa. Long. 2. 37. W. Lat. 56. 4. N. (See *The Bass Rock, its Civic and Ecclesiastical History*, Edin. 1848.)

Bass's Straits, the channel which separates New Holland from Van Diemen's Land. It is nearly fifty leagues in length from E. to W., and about the same breadth from N. to S. The navigation of this strait is rendered dangerous in some parts by groups of barren and unproductive islands, scattered through it. Van Diemen's Land was supposed by all the earlier navigators to form a part of New Holland; until Mr Bass, the surgeon of a man-of-war, conceived that there were indications of a channel. This conjecture was found to be correct; and the channel has since borne his name.

Bass-Viol, a large old instrument of the violin family,

Bassani & Bassein.

with six strings and a fretted finger-board; long since superseded by the violoncello.

BASSANI, Giovanni Battista, maestro di cappella of the cathedral church of Bologna, was born at Padua about the year 1657. His works, which are very voluminous, consist of psalms, masses, motets with instrumental parts, and sonatas for the violin; on which last-mentioned instrument he was an admirable performer. It is said that he was the instructor of Corelli. His fifth opera, in particular, containing twelve sonatas for two violins and a bass, is written in a style wonderfully grave and pathetic, and abounding with evidences of great learning and fine invention. The first and third operas of Corelli are apparently modelled after this work. Bassani was one of the first who composed motets for a single voice, with accompaniments of violins; a practice which is liable to objection, as it assimilates church-music too nearly to that of the chamber.

BASSANO, Giacomo da Ponte, a celebrated Venetian painter, born in 1510. His subjects were generally peasants and villagers, cattle, landscapes, with some portraits and historical designs. His figures are well designed, and his animals and landscapes have an agreeable air of simple nature. His compositions, though devoid of much elegance or grandeur, have abundance of force and truth: the local colours are well observed, the carnations are fresh and brilliant, and his chiaroscuro and perspective are unexceptionable. He finished a great number of pictures; but notwithstanding his application, his genuine works are rare; many of those which are called originals being either copies by the sons of Bassano, or others. His true pictures, when undamaged, always bear a considerable price. He died in 1592, aged eighty-two. Francesco and Leandro, his sons, made some progress in the same art; but inheriting a species of lunacy from their mother, both came to an untimely end.

Bassano, a city in the Austrian kingdom of Venetian Lombardy, in the delegation of Vicenza. It stands on the river Brenta, over which there is a bridge 180 feet in length. It is surrounded with walls, and has six gates, one of which, built by Palladio, is very much admired. It contains 30 churches with some fine paintings, several religious houses, and other public edifices. Pop. about 12,000. It has extensive silk mills, besides manufactures of cloth, paper, straw hats, copper ware, &c.; and the printing establishment of S. Remondini employs about 1000 persons.

BASSANTIN, James, a Scotch astronomer, son of the Laird of Bassantin, in Teviotdale, was born in the reign of James IV. Educated at the university of Glasgow, he travelled through Germany and Italy, and then fixed his abode in the university of Paris, where he taught mathematics with great applause. Having acquired some fortune in this occupation, he returned in 1562 to Scotland, where he died in the year 1568. From his writings he appears to have been no contemptible astronomer, considering the times; but, like most of the mathematicians of that age, he was not a little addicted to judicial astrology. His works are, 1. *Astronomia Jacobi Bassantini Scoti, opus absolutissimum, &c., ter editum Latine et Gallice.* Genev. 1599, folio. This is the title given it by Tornæsius, who translated it into Latin from the French, in which language it was first published. 2. *Paraphrase de l'Astrolabe, avec un amplification de l'usage de l'Astrolabe.* Lyons, 1555. Paris, 1617, 8vo. 3. *Mathematica Genethliaca.* 4. *Arithmetica.* 5. *Musica secundum Platonem.* 6. *De Mathesi in genere.*

BASSE Terre, capital of the island of St Christopher, one of the Caribbee Islands. See Christopher's Island, St.

BASSEIN, a town in the Burmese territory, formerly included within the possessions of the sovereign of Ava, but now belonging to the British. It is the chief place of a district of the same name, and forms part of the province or kingdom (for such it once was) of Pegu, recently incorporated by the British Government with the dominions under its administration. Bassein is seated on one of the channels by which the great river Irawaddy finds its way to the sea; which from its divergence down to the town, is called Bassein River, and subsequently the Negrais. In the first war with Burmah (carried on under the government of Lord Amherst), this place was taken without opposition; the governor having abandoned the town and burnt it on the approach of the British force. In 1852 its capture was again sought and was obtained, but not without a struggle. On the 17th May in that year, a military force of between 700 and 800 men, with some seamen of one of H. M. ships, embarked on board several steamers at Rangoon, and proceeded up the river to Bassein, abreast of which place the squadron anchored on the 19th. The assailants were landed forthwith; a pagoda was immediately carried; a strong mud fort was then gallantly stormed, and a stockade on the opposite side of the river was simultaneously attacked with success. The loss of the British was not great: that of the enemy was believed to be considerable.

Basset.

The port of Bassein is stated to have a greater depth of water than that of Rangoon; but it is not considered to be so advantageously situated for trade; and intercourse with the northern portion of the Burmese territories by water can be maintained during only part of the year. Lat. 16. 45. Long. 94. 50. (E. T.)

BASSET, or Basette, a game with cards, said to have been invented by a noble Venetian, who was banished for his invention. It was first introduced into France by Signior Justiniani, the Venetian ambassador, in 1674. Severe laws were made against it by Louis XIV., to elude which they disguised basset under the name of *pour et contre*, which occasioned new *arrêts* and prohibitions of parliament.

The parties concerned in this game are a dealer or banker; his assistant, who supervises the losing cards; and the punter, or any one who plays against the banker. Besides these, there are other terms used in this game. 1. The *fasse* or *face* is the first card turned up by the tailleur belonging to the pack, by which he gains the value of half the money laid down on every card of that sort by the punters. 2. The *couch* is the first money which every punter puts on each card; each person who plays having a book of thirteen several cards before him, on which he may lay his money, more or less, at discretion. 3. The *paroli* is, when a punter, having won the first stake, and having a mind to pursue his good fortune, crooks the corner of his card, and lets his prize lie, aiming at a *sept et le va.* 4. The *masse* is, when having won the first stake, the punter is willing to venture more money on the same card. 5. The *pay* is, when the punter, having won the first stake, be it a shilling, half-crown, guinea, or whatever he laid down on his card, and not caring to hazard the paroli, leaves off, or *goes the pay;* in which case, if the card turn up wrong, he loses nothing, having won the couch before; whereas if it turn right, he by this adventure wins double the money staked. 6. The *alpiew* is much the same with paroli, and is used when a couch is won by turning up or crooking the corner of the winning card. 7. *Sept et le va* is the first great chance or prize, when the punter, having won the couch, makes a paroli, and goes on to a second chance, so that if his winning card turns up again, it comes to *sept et le va*, which is seven times as much as he laid down on his card. 8. *Quinze et le va* is the next higher prize, when the punter, having won the former, is resolved to push his fortune, and lay his money a second time on the same card, by crooking another corner; in which case, if it comes up he wins fifteen times the money he laid down. 9. *Trent et le va* is the next higher prize, when the punter, crooking the fourth corner of his winning card, if it turn up, wins thirty-three times the money he first staked. 10. *Soixant et le va* is the highest prize, and entitles the winner to sixty-seven times his first money, which, if it be considerable, may chance to break

Basset-horn || Bassi.

the bank; but the bank has many chances of first breaking the punter. This cannot be won but by the tailleur's dealing the cards over again.

The rules of the game of basset are as follow: 1. The banker holds a pack of fifty-two cards, and having shuffled them, he turns the whole pack at once, so as to discover the last card; after which he lays down all the cards by couples. 2. The punter has his book of thirteen cards in his hand, from the king to the ace, and out of these he takes one card or more at pleasure, upon which he lays a stake. 3. The punter may, at his choice, either lay down his stake before the pack is turned, or immediately after it is turned, or after any number of couples are down. 4. Supposing the punter to lay down his stake after the pack is turned, and calling 1, 2, 3, 4, 5, &c., the places of those cards which follow the card in view, either immediately after the pack is turned or after any number of couples are drawn; then, 5. If the card upon which the punter has laid a stake come out in any even place except the first, he wins a stake equal to his own. 6. If the card upon which the punter has laid a stake come out in any even place except the second, he loses his stake. 7. If the card of the punter come out in the first place, he neither wins nor loses, but takes his own stake again. 8. If the card of the punter come out in the second place, he does not lose his whole stake, but only one-half; and this is the case in which the punter is said to be *faced*. 9. When the punter chooses to come in after any number of couples are down, if his card happen to be but once in the pack, and is the last of all, there is an exception from the general rule; for, although it comes out in an odd place, which should entitle him to win a stake equal to his own, yet he neither wins nor loses from that circumstance, but takes back his own stake.

This game has been the object of mathematical calculation; and M. de Moivre solves this problem: To estimate at basset the loss of the punter under any circumstance of cards remaining in the stock when he lays his stake, and of any number of times that his card is repeated in the stock. From the solution he has formed a table showing the several losses of the punter in whatsoever circumstances he may happen to be. From this table it appears, 1. That the fewer the cards in the stock, the greater is the loss of the punter: 2. That the least loss of the punter, under the same circumstances of cards remaining in the stock, is when his card is but twice in it; the next greater when but three times; the next greater when four times; and the greatest of all when but once. The gain of the banker upon all the money adventured at basset is 15s. 3d. per cent.

BASSET-HORN. See MUSIC, § *Musical Instruments*.

BASSET, *Peter*, a gentleman of good family, chamberlain to King Henry V., whom he attended in his campaigns. He wrote *Acta Regis Henrici V.*, which is said to exist in MS. in the Heralds' College.

BASSETING, in the coal mines, denotes the rise of the vein of coal towards the surface of the earth. This is also called by the workmen *cropping*; and stands opposed to *dipping*.

BASSI, LAURA MARIA CATERINA, an Italian lady eminently distinguished for her learning and her virtues, was born at Bologna in 1711. On account of her extraordinary attainments she received a doctor's degree, and was appointed professor in the philosophical college, where she delivered public lectures on experimental philosophy till the time of her death. In 1738 she married Giuseppe Verrati, a physician, and left several children. She died in 1778.

Bassia || Bastard.

BASSIA, a genus of plants of the nat. ord. of Sapoteæ. The species are found in India and Africa. *B. Butyracea* is a tree of 50 feet in height, found in the Almorah hills in India. The seeds afford a concrete oil of considerable economic importance. *B. longifolia* is also a considerable tree, the seeds of which yield a valuable oil for lamps, soap, and in the kitchens of the poor a seasoning for rice. *B. latifolia* yields a greenish oil coarser than the last; and its flowers on distillation yield an ardent spirit. The wood of all the species is hard and durable.

BASSO-RILIEVO, or BAS-RELIEF, a piece of sculpture where the figures or images do not protuberate or stand out much above the plane on which they are formed. When cut, stamped, or otherwise wrought, so that not the entire body, but only part of it, is raised above the plane, it is said to be done in *relief* or *rilievo*; and when the work is flat, or little raised, it is called *low relief*. If a piece of sculpture, a coin, or a medal, has its figure raised so as to be well distinguished, it is said to be in *bold*, *strong*, or *high* relief, *alto-rilievo*.

BASSOON. See MUSIC, § *Musical Instruments*.

BASSORA. See BUSSORAH.

BASSUS. See ENTOMOLOGY.

BASTARD, *bastardus* (fancifully derived from the Greek *βασσάρα*, *meretrix*, but with more reason from the British *bastærd*, *nothus*, *spurious*, or from the German *bastart*, composed of *bas*, low, and *start*, risen, Saxon *steort*, an upstart, *homo novus*), one whose father and mother were not lawfully married previous to his or her birth, or, as it has sometimes been loosely expressed, one born out of lawful wedlock.

The civil and canon laws do not allow a child to remain a bastard if the parents afterwards intermarry; and this is also the law of Scotland, in which the principle of legitimation by subsequent marriage has been often and solemnly recognized. But herein they differ most materially from the English law; which, though not so strict as to require that a child shall be begotten, yet makes it an indispensable condition that it shall be born after lawful wedlock. Blackstone thinks that the reason of the English law is in this respect much superior to that of the Roman or of the derivative systems, if the principal end and design of establishing the contract of marriage, taken in a civil light, be considered; but this opinion, however natural in an English lawyer, does not seem to be borne out by considerations either of principle or of expediency. For although the learned commentator may be perfectly correct in his estimate of the motives which actuated the parliament of Merton A.D. 1235, when they refused to enact that children born in bastardy should be legitimated by the subsequent marriage of their parents; yet the question still remains whether such an enactment would not have been highly beneficial on grounds of public policy, as well as for the protection of private morals, and whether the experience since acquired has not decided in its favour; points concerning which lawyers, in Scotland at least, have long ceased to entertain any doubt.

Be this, however, as it may, one thing is certain, that all children born before matrimony are bastards by our law; and so are all children born so long after the death of the husband, that by the usual course of gestation, they could not be begotten by him. But this being a matter of some uncertainty, the law is not exact as to a few days; and although the child is born some time after the usual period of forty weeks, this only affords presumption, not proof, of illegitimacy.[1] But if a man dies, and his widow soon after

[1] According to information furnished by the late celebrated anatomist Dr John Hunter, it appears, 1*st*, That the usual period of gestation is nine calendar months, or from 270 to 280 days; but there is very commonly a difference of one, two, or three weeks. 2*dly*, That a child may be born alive at any time three months after conception, but none are born with powers of being reared or attaining manhood before seven calendar months or thereby. 3*dly*, That he, Dr Hunter, had known a woman bear a living child, in a perfectly natural way, fourteen days beyond the completion of nine calendar months; and he believed that two women had each been delivered of a living child, in a natural way, above ten calendar months from the hour of conception. It is owing to these natural irregularities that the law has been obliged to admit of considerable latitude in the application of the ordinary rule.

Bastard. marries again, and a child is born within such a time as that by the course of nature it might have been the child of either husband, in this case he is said to be more than ordinarily legitimate, for when he arrives at years of discretion, he may choose which of the fathers he pleases. To prevent this, among other inconveniences, however, the civil law ordained that no widow should marry *infrà*, or more classically *intrà*, *annum luctus*; a rule which obtained as early as the reign of Augustus, if not of Romulus himself; and the same constitution was probably handed down to our early ancestors from the Romans, during their stay in this island, since we find it established under both the Saxon and the Danish governments.

But as bastards may be born before the coverture or marriage state is begun, or after it is determined, so also children born during wedlock may in some circumstances be bastards; as if the husband be out of the kingdom of England, or, as the law loosely phrases it, *extra quatuor maria*, for above nine months, so that no access to his wife can be presumed, her issue during that period is to be accounted bastard. But generally during the coverture, access of the husband is presumed, unless the contrary be shown; which is such a negative as can only be proved by showing him to be elsewhere; for the general rule is, *præsumitur pro legitimatione*.

The law of adulterine bastardy was recently commented on by the late Lord Langdale, Master of the Rolls, in the case of *Hargrave* v. *Hargrave*, 9 Beavan's *Reports*, 555. His lordship observes:—"A child born of a married woman is, in the first instance, presumed to be legitimate. The presumption established by law is not to be rebutted by circumstances which only create doubt and suspicion; but it may be wholly removed by proper evidence, showing that the husband was, 1. Incompetent; 2. Entirely absent, so as to have no intercourse or communication of any kind with the mother; 3. Entirely absent at the period during which the child must, in the course of nature, have been begotten; or, 4. Only present under such circumstances as afford clear and satisfactory proof that there was no sexual intercourse. Such evidence as this puts an end to the question, and establishes the illegitimacy of the child of a married woman. It is, however, very difficult to conclude against the legitimacy, in cases where there is no disability, and where some society or communication is continued between husband and wife during the time in question, so as to have afforded opportunities of sexual intercourse; and in cases where such opportunities have occurred, and in which any one of two or more men may have been the father, whatever probabilities exist, no evidence can be admitted to show that any man other than the husband may have been, or probably was, the father of the wife's child. Throughout the investigation, the presumption in favour of the legitimacy is to have its weight and influence, and the evidence against it ought, as it has been justly said, to be strong, distinct, satisfactory, and conclusive."

In a divorce *a mensa et toro*, if the wife have children they are bastards, because the law presumes the husband and wife to live conformably to the sentence of separation, unless access be proved; but in a voluntary separation, by agreement, the law supposes access, unless the negative be shown. If a man or woman marry a second wife or husband, the first being living, and have issue by such second wife or husband, the issue is spurious. Again, if a man have issue a son by a woman before marriage, and afterwards marry the same woman and have issue a second son born after the marriage; the first of these, who would be legitimated *per subsequens matrimonium* in Scotland, is termed in England a *bastard eigné*, and, by the common law of that country, is as incapable of inheriting as if his father and mother had never married; the second, by a species of legal Hibernicism, is denominated a *mulier*, or *mulier puisné*, and succeeds to the exclusion of the bastard eigné. Again, if there be an apparent impossibility of procreation on the part of the husband, as if he be only eight years old, or the like, then the issue of the wife is bastard. Likewise, in case of divorce in the spiritual court *a vinculo matrimonii*, all the issue born during the coverture is bastard; because such divorce is always upon some cause that rendered the marriage unlawful and null from the beginning. Bastard.

The duty of parents to their bastard children consists principally in maintaining them. For although bastards are not looked upon as children to any civil purpose, yet the ties of nature, of which maintenance is one, are not so easily dissolved; and these hold good even in other respects, as, for example, that a man shall not marry his bastard sister or daughter. The enactments relating to the maintenance and affiliation of bastards are numerous. The law is now regulated by the 7th and 8th Vict. cap. 101, as amended by the 8th and 9th Vict. cap. 10. The mother of a bastard is entitled to its custody in preference to the putative father, during the age of nurture; and by an earlier act (4th and 5th Will. cap. 76, § 71, amended by the 2d and 3d Vict. cap. 85) she was bound, so long as she remained unmarried or a widow, to maintain it as a part of her family until it attained the age of sixteen, or married, if a female; and by § 57 this liability attached, on the mother's marriage, to her husband, until her death or the child attained the age of sixteen. But under the 7th and 8th Vict. cap. 101, § 2, any single woman who may be with child, or who may be delivered of a bastard child, may either before, or within twelve months from, the birth of such child, or at any time thereafter, on proof of the payment of money by the alleged father for its maintenance within such period, obtain from a justice of the peace the issue of a summons to the petty sessions of such putative father. Thereupon the justices (or, in the metropolitan police district, a single magistrate, under the 8th and 9th Vict. cap. 10, § 9) may make an order for maintenance and costs, and enforce the same by distress and commitment. But it is necessary that the mother's evidence be corroborated in some material particular by other testimony to the satisfaction of the justices. The order by § 5 is determined upon the child attaining the age of thirteen years, or after the marriage of its mother, or after the death of the child; and the putative father is entitled under § 4 to appeal to the quarter sessions, upon entering into recognizances in the form provided by the 8th and 9th Vict. cap. 10, § 3. The 6th section declares the mother to be punishable for neglect or desertion of her bastard child as "an idle and disorderly person," and on a second conviction as "a rogue and vagabond," under the 5th Geo. IV. cap. 83 (amended by the 1st and 2d Vict. cap. 38), and any misapplication of moneys paid for the support of, or withholding proper nourishment from, or otherwise abusing and maltreating, such bastard child, is punishable under § 8 by a penalty of L.10.

The rights of a bastard are very few, being only such as he can acquire; for civilly he can *inherit* nothing, being looked upon as the son of nobody, and sometimes called *filius nullius*, sometimes *filius populi*. Yet he may gain a surname by reputation though he has none by inheritance, and may even be made legitimate and capable of inheriting by the transcendent power of an act of parliament. All other children have their primary settlement in their father's parish; but a bastard has his in the parish where he was born, unless such birth has been procured by fraud, or happened under an order of removal, in a state of vagrancy, in the house of correction, or under certificate; for in law he has no father. The incapacities attaching to a bastard consist principally in this, that he cannot be heir to any one; for being *nullius filius*, he is therefore of kin to nobody, and has no ancestor from whom an inheritable blood can be derived. Therefore, if there be no other claimant upon an inheritance than such illegitimate child, it escheats to the lord.

Bastard.

And as bastards cannot be heirs themselves, so neither can they have any heirs but those of their own bodies. For as all collateral kindred consists in being derived from the same common ancestor, and as a bastard has no legal ancestor, he can have no collateral kindred, and consequently no legal heirs, except such as claim by a lineal descent from himself. And hence, if a bastard purchase land, and die seised therefor without issue, and intestate, the land escheats to the lord of the fee. But under § 11 of the New Savings-Bank Act, 7th and 8th Vict. cap. 83, the trustees or managers are empowered to pay the money deposited by an illegitimate depositor to the persons who would have been entitled to the same, according to the statute of distributions, if he had been legitimate. Originally a bastard was deemed incapable of holy orders, and disqualified by the fact of his birth from holding any dignity in the church; but this doctrine is now obsolete, and in all other respects there is no distinction between a bastard and another man.

These are the principal incapacities attaching to bastardy in England. By the law of Scotland a bastard is not only excluded from his father's succession, because the law knows no father who is not marked out by marriage; and from all heritable succession, whether by the father or mother, because he cannot be pronounced lawful heir by the inquest in terms of the brief; but also from the movable succession of his mother, because he is not her lawful child, and legitimacy is implied in all succession deferred by the law. But a bastard, although he cannot succeed *jure sanguinis*, may succeed by destination, where he is specially called to the succession by entail or testament. In Scotland, as in England, a bastard can have no legal heirs except those of his own body; and hence, failing his lawful issue, the king succeeds to him as last heir. In Scotland bastards may be legitimated in two ways; either by the subsequent intermarriage of the mother of the child with the father, as already mentioned; or by letters of legitimation from the sovereign. With respect to the last, however, it is to be observed, that letters of legitimation, be their clauses ever so strong, cannot enable the bastard to succeed to his natural father; for the king cannot, by any prerogative, cut off the private right of third parties. But, by a special clause in the letters of legitimation, he may renounce his right to the bastard's succession, failing descendants, in favour of him who would have been the bastard's heir had he been born in lawful wedlock, such renunciation encroaching upon no right competent to any third party.

The number of illegitimate births (exclusive of still-born) registered during the year 1851 for England, appears from the fourteenth report of the Registrar-General, dated 24th June 1853, to have been 42,000 against 615,865 legitimate births, or a proportion of nearly 2 to 29. The following table, compiled (with the exception of the last item) from the Registrar-General's Sixth Report, and from Dr Stark's *Vital Statistics of Scotland*, exhibits the proportion of illegitimate births in various European states and one American.

States.	Year.	Total Births.	Illegitimate Births.	Ratio of Illegit. Births to 100 Births.	Proportion of Illegitimate Births.
Sardinia	1828 37	1,457,193	30,471	2·09	1 to 44·54
Sweden	1831 5	467,799	31,289	6·56	.. 15·23
Norway	1831-5	181,363	12,111	6·67	.. 14·97
England	1842	517,739	34,796	6·72	.. 14·88
Belgium	1842	138,135	9,354	6·77	.. 14·66
France	1842	982,896	69,928	7·11	.. 14·05
Prussia	1841	591,505	42,129	7·12	.. 14·03
Scotland (part of)	1835-45	4,305	328	7·61	.. 13·12
Denmark	1835 9	64,376	6,020	9·35	.. 10·69
Hanover	1842	55,559	5,487	9·87	.. 10·12
Austria	1842	894,711	101,821	11·38	.. 8·79
Wurtemburg	1842	75,456	8,859	11·74	.. 8·51
Saxony	1841	70,094	10,512	14·99	.. 6·66
Bavaria	1838-9	149,185	30,729	20·59	.. 4·85
Chili	1848	46,143	10,235	22·18	.. 4·50

Bastards || Bastia.

It is a remarkable fact, as connected with the proportion of illegitimate children in the large towns, that in all the large towns in England the proportion of children born out of wedlock is much below what it is in the country districts. On the continent of Europe, on the other hand, the proportion of illegitimate births in the large towns greatly exceeds that of the country districts; and statists are pretty generally agreed that the existence of foundling hospitals in these towns has much to do with this result, encouraging and fostering bastardy as they do. The following table, compiled from the Registrar-General's Sixth Annual Report exhibits these facts.

Towns.		Total Births.	Illegitimate Births.	Proportion of Illegitimate per 100 Births.
Liverpool	English Towns.—The proportion of Illegitimate Births over all England in 1842 was 6·7 per cent.	9,923	274	3·0
London		60,240	1,925	3·2
Birmingham		5,094	207	4·1
Plymouth		1,199	50	4·2
Bristol		2,088	93	4·5
Sheffield		3,490	174	5·0
Leeds		6,376	349	5·5
Manchester		6,969	403	5·8
Bath		1,846	110	6·0
Salford		2,828	181	6·4
Newcastle-on-Tyne		2,449	156	6·4
Brighton		1,299	84	6·5
Wolverhampton		3,097	215	6·9
Genoa		33,034	2,665	8·0
Berlin		29,914	4,472	14·9
Frankfort		3,784	652	17·2
St Petersburg		9,625	1,809	18·8
Turin		36,313	6,867	18·9
Department of Seine (Paris)		40,005	11,527	28·8
Stockholm		13.291	5,409	40·7
Vienna		47,191	21,763	46·1

BASTARDS is also an appellation given to a kind of faction or troop of banditti, who rose in Guienne about the beginning of the fourteenth century, and joining with some English parties, ravaged the country, and set fire to the towns. They are supposed to have derived this name from having been headed by the illegitimate sons of noblemen, who were excluded from the rights of inheritance.

BASTARDY, ARMS OF, should be crossed with a bar, fillet, or traverse, from the right to the left. See HERALDRY.

BASTARNÆ, an ancient people in European Sarmatia, who, according to some authors, had emigrated from Germania. They were a powerful nation, occupying the country between the rivers Tyras and Borysthenes, about the mouth of the Danube, and seem to have belonged to the great race of the Celts.

BASTARNICÆ ALPES, in *Ancient Geography*, called also the *Carpates*, now the Carpathian Mountains.

BASTERNA, in *Antiquity*, a kind of litter or sedan-chair, in which the Roman ladies were carried by two mules. It was very similar to the *lectica*, which was borne by slaves. See LECTICA.

BASTIA, a fortified town and seaport on the eastern coast of the island of Corsica, and capital of an arrondissement of the same name. It occupies a very picturesque situation, rising from the sea in the form of an amphitheatre; but the town itself is ill built, and the streets narrow and crooked. The harbour, which is defended by a citadel, is only fit for small craft, and its entrance is narrow and difficult. Bastia is the seat of a royal court for the island, and of tribunals of commerce and primary jurisdiction; and has a communal college, a model school, and a museum. Its principal manufactures are soap, leather, liqueurs, and wax; and it exports oil, wine, coral, &c. Lat. 42. 41. 36. N. Long. 9. 27. 22. E. Pop. (1851) 14,523. Bastia was at one time the capital of Corsica. It was taken

Bastiat || Bastille.

by the English in 1745, and again in 1794. The arrondissement of the same name contains 20 cantons and 94 communes. Pop. in 1851, 70,288.

BASTIAT, FRÉDÉRIC, a celebrated French economist, born at Bayonne on the 29th June 1801. He studied in the colleges of Saint Sever and Sorèze, and then entered the commercial house of his uncle at Bayonne. He was made a justice of the peace in 1831, and some time afterwards a member of the general council of Landes. In 1840 he visited Spain and Portugal, where he paid especial attention to the customs and institutions of those kingdoms. His first literary essay, entitled *De l'influence des tarifs Français et Anglais sur l'avenir des deux peuples*, appeared in the *Journal des Economistes* in 1844, and contains the germs of the economic theory of the author, who afterwards appears as the decided opponent of the system of protection. He visited England soon after; and on his return to Mugron, where he resided, he continued his exertions in favour of free trade; as afterwards at Paris also. After the revolution of 1848, he became a member of the legislative assembly; and he died on the 24th December 1850, during a tour in Italy. His writings are as follow:—*Sophismes économiques; Propriété et Loi; Protectionisme et Communisme; Capital et Rente; Paix et Liberté; Incompatibilités Parlementaires; L'Etat, maudit argent; Harmonies économiques.*

BASTILLE, or BASTILE (from the French *bastir, bâtir*, to build), denotes a small antique castle, fortified with turrets. Such was the famous Bastille of Paris, which seems to have been the last castle that retained the name. It was commenced in 1370, by order of Charles V., and finished in 1382, under the reign of his successor. This building was strongly fortified, with numerous massive towers, which were united by a wall eight feet in thickness. The whole was surrounded by a ditch twenty-five feet in depth; and at subsequent intervals other additions were made to the fortifications, so as to render it an almost impregnable fortress. When Charles VII. retook Paris from the English in 1436, all his opponents in the city took refuge in the Bastille, which they were prepared to defend with vigour, but the want of provisions obliged them to capitulate. In 1588 the Duke of Guise took possession of the Bastille, and gave the command of it to Bussy-Leclerc. Soon afterwards he shut up the whole parliament within its walls, for having refused their adherence to the League. When Henri IV. became master of Paris he committed the command of the Bastille to Sully, and there he deposited his treasures, which at the time of his death amounted to the enormous sum of 1,870,000 livres. On the 11th of January 1649, the Bastille was invested by the forces of the Fronde, and, after a short cannonade, capitulated on the 13th of that month. The garrison consisted of only twenty-two men. The Frondeurs concluded a peace with the court on the 11th of March; but it was stipulated by treaty that they should retain possession of the Bastille, which in fact was not restored to the king till the 21st of October 1651. In that year took place the famous fight of the Porte Ste Antoine, between Condé and Turenne, on which occasion the forces of Condé owed their safe retreat into Paris to the cannon of the Bastille.

The chief use of the Bastille, however, was for the custody of state prisoners, or, more properly speaking, for the clandestine atrocities of a corrupt and cold-blooded despotism. Nowhere else upon earth, even in the dungeons of the Inquisition, had human misery by human means been rendered so lasting, so complete, and in many cases so irremediable, as in the Bastille. Of this one striking instance related by M. Mercier may serve as an example.

Upon the accession of Louis XVI. to the throne, the ministers then in office, anxious to obtain popularity by an act of clemency and justice, began their administration by inspecting the registers of the Bastille, and setting many prisoners at liberty. Amongst these was an old man, who had been a prisoner for forty-seven years. The sudden change from the solitude of his cell to the light and bustle of the outer world was too great for him; and finding that of the friends of his youth none now survived, he begged to be restored to the dungeon which had become his only home. The offence which had been visited by so terrible a punishment consisted in some unguarded expressions respecting Louis XV. These had been reported, very probably exaggerated, by some informer or enemy; a lettre-de-cachet had been issued; and the offender seized, committed to the Bastille, and forgotten.

Bastinado || Bastion.

Among the more distinguished personages who were confined in this fortress during the reigns of Louis XIV., XV., and XVI., were the famous *Man of the Iron Mask*, the Marshal Richelieu, Le Maistre de Sacy, De Renneville, Voltaire, De Latude, Le Prévost de Beaumont, Labourdonnais, Lally, Cardinal Rohan, Linguet, and La Chalotais. But, besides the numerous illustrious prisoners who at various times occupied the Bastille,—of whom many were more or less guilty,—its dreadful dungeons became the tombs of thousands of obscurer victims, whose very names were made to perish out of record, having been designedly defaced in the registers of the governors, or committed to loose leaves, that no trace of their fate might survive to satisfy the anxiety of friends or the curiosity of posterity. Thus in the reign of Louis XIV. the Bastille was a receptacle for innumerable innocent victims of religious tyranny; and, under the more degrading sway of his successor, for the fathers and brothers of the unhappy inmates of the *Parc aux Cerfs*.

At the breaking out of the French revolution, the Bastille was attacked by the Parisians, and, after a vigorous resistance, taken and razed to the ground. This memorable event occurred on the 14th July 1789. At the time of its capture only seven prisoners were found in it. A very striking account of this siege will be found in Carlyle's *French Revolution*, vol. i.

The site of the Bastille is now marked by a lofty column of bronze, dedicated to the memory of the patriots of July 1789 and 1830. It is crowned by a gilded figure of Mercury, spreading its pinions in the act of flight.

See the *Histories* of the Bastille by Renneville (7 tom. 12mo, 1713–24); Fougeret (8vo, 1833); Dufey de l'Yonne (8vo, 1834); Arnould (7 tom. 8vo, 1843–44); and the *Memoirs* of Linguet (12mo, 1821, new ed.); Carra (3 tom. 8vo, 1787); Charpentier (3 tom. 8vo, 1789); and Latude (edited by Thierry, 3 tom. 18mo, 1791–92).

BASTINADO, or BASTINADE, the punishment of beating or drubbing a criminal with a stick. The word is formed from the French *baston*, a stick, staff, or cudgel. The bastinado was a punishment used among the ancient Greeks, Romans, and Jews, and still obtains among the Turks. The Romans called it *fustigatio, fustium, admonitio, fustibus cædi;* which differed from the *flagellatio* in being done with a stick instead of a rod or scourge. Fustigation was a lighter punishment, and inflicted on freemen; flagellation a severer, and reserved for slaves. This was also called *tympanum*, because the patient was beaten with sticks like a drum. The punishment of the bastinado is much in use in the East at this day; and it is chiefly administered on the soles of the feet, which are sometimes beaten almost to a jelly.

BASTION, in modern fortification, a huge mass of earth, usually faced with sods, sometimes with brick, and rarely with stone, standing out from a rampart of which it is a principal part. This is what, in the ancient fortification, was called a *bulwark*. *Solid bastions* are those which have the void space within them filled up entirely, and raised of an equal height with the rampart. *Hollow bastions* are those surrounded only with a rampart and parapet, having the space within unoccupied, where the ground is so low that no retrenchment can be made in the centre, in the event of

Baston || Batavia.

the rampart being taken. *Flat bastion* is a bastion built in the middle of the curtain, when it is too long to be defended by the bastions at its extremes. *Cut bastion* is that which, instead of a point, has a re-entering angle. *Composed bastion* is when two sides of the interior polygon are very unequal, which makes the gorges also unequal. *Deformed bastion* is when the irregularity of the lines and angles puts the bastion out of shape; as when it wants a demigorge, one side of the interior polygon being too short. *Demi-bastion* is composed of one face only, with but one flank, and a demigorge. *Double bastion* is that which is raised on the plane of another bastion. *Regular bastion* is that which has its true proportion of faces, flanks, and gorges. See FORTIFICATION.

BASTON, *Baton*, or *Batune*, a staff or cudgel, borne in English coats of arms, as a badge of illegitimacy. In architecture it denotes the round moulding at the base of a column, also called a *torus*.

BASTON, *Robert*, a Carmelite monk, afterwards prior of the convent of that order at Scarborough, and also poet-laureate and public orator at Oxford, flourished in the fourteenth century. Edward II., in his expedition into Scotland in 1304, took Robert Baston with him in order to celebrate the victories he was to gain over the Scots; but the poet having been taken prisoner, was obliged to change his note and sing "the Bruce of Bannockburn." He wrote several pieces in Latin, on the Wars of Scotland, the Luxury of Priests, Synodical Sermons, &c.; and also a volume of tragedies and comedies, in English. He died about the year 1310.

BASTWICK, Dr JOHN, born at Writtle, in Essex, in 1593, was a physician at Colchester, who applied himself to writing books against popery. About 1633 he printed in Holland a Latin treatise entitled *Elenchus Religionis Papisticæ*, with *Flagellum Pontificis et Episcoporum Latialium;* in which the English prelates thinking themselves also aimed at, he was fined L.1000 in the High Commission Court, excommunicated, prohibited from practising physic, while his books were ordered to be burnt, and the author himself consigned to prison. Instead of recanting, however, he wrote *Apologeticus ad Præsules Anglicanos*, and another book called *The Litany*, in which he exclaimed vehemently against the proceedings of that arbitrary court, and taxed the bishops with an inclination towards popery. Prynne and Burton coming under the lash of the Star-chamber court at the same time, they were all censured as scandalous and seditious persons, condemned to pay a fine of L.5000 each, to be set in the pillory, to lose their ears, and to undergo perpetual imprisonment in three remote parts of the kingdom. The parliament in 1640 reversed these proceedings, and ordered Bastwick a reparation of L.5000 out of the estates of the commissioners and lords who had persecuted him. The civil commotions which ensued prevented his receiving this *solatium* for his sufferings; but, in 1644, his wife had an allowance ordered for her own and her husband's maintenance. The place and time of his death are unknown.

BAT. See MAMMALIA, *Index.*

BAT, BATE, or BATZ, a small silver coin, mixed with a large quantity of copper, current in several parts of Germany and Switzerland.

BATÂVI or BATĀVI. See BATAVORUM INSULA.

BATAVIA, a large city and seaport on the north coast of the island of Java, and the capital of all the Dutch settlements in the East. It is situated on the river Jacatra, in a swampy plain, at the bottom of a very capacious bay, and long was noted for the insalubrity of its atmosphere. More recently, however, the late Baron Capellen, one of the most enlightened governors that the Dutch ever sent out, sensible of the superior advantages which Batavia possessed as a place of trade, exerted himself to have the causes of its unhealthiness removed. He accordingly widened several of the streets, filled up some of the canals, cleansed others, demolished useless fortifications, cut down trees, &c.; and by the introduction of a number of judicious regulations, Batavia has been rendered as healthy as any other town on the island. Batavia.

The bay is formed by an indentation in the northern shore of Java; and it is protected from the swell of the sea by fifteen or sixteen small islands, interspersed in every direction across its mouth. It is perfectly secure at all seasons, the water being seldom disturbed in any violent degree by the winds. The city is of an oblong form, and the streets are quite straight and regular, crossing each other at right angles. Each street is from 114 to 204 feet broad, and has a canal in the middle, cased with stone, with a low parapet on the two margins, and is planted with a row of evergreen trees, under the shade of which are erected little open pavilions of wood, surrounded with seats, on which the Dutch inhabitants, in the cool of the evening, take their favourite refreshment of smoking. Beyond the trees is a gravelled road from 30 to 60 feet wide, for the various kinds of traffic, and it is terminated on the opposite side by a row of evergreens. The river Jacatra, which rises in the Blue Mountains to the south, flows through the middle of the town, and encircles it by several branches and canals connected with the main stream. Numerous other streams, such as the Ankee and the Tangerang, &c., besides artificial canals, intersect the swampy plain of Batavia in all directions, and connect the town with the surrounding country.

According to Sir Stamford Raffles, in his account of Java, there are now scarcely any remains of the splendour and magnificence which formerly procured for this capital the proud title of the Queen of the East. The public buildings consist of a Lutheran and a Portuguese church, a Mahometan mosque, a Chinese temple, the stadthouse, where the supreme court of justice and magistracy still assemble, the infirmary, the chamber of orphans, and some other institutions. The great church of Batavia, which was finished in 1760, at an expense of L.80,000, was taken down in consequence of its foundation having given way. The market is convenient and extensive, and well supplied with provisions. The fortifications by which the city was formerly surrounded, consisting of a wall defended by bastions, were all pulled down before Batavia was captured by the British in 1811. General Daendels directed the demolition of the ramparts, with a view of improving the health of the city by a freer circulation of air; and with the materials he built the new cantonment of Weltevreeden, about three miles inland, in a higher and more healthy situation. The castle of Batavia, which is on the north side of the town, next to the bay, is very spacious, and contains numerous buildings and extensive warehouses; but its situation was so unhealthy, that the troops were withdrawn to another place, and it was converted into a depôt for naval and military stores and other articles. The town of Batavia has been deserted by almost all of the more wealthy inhabitants, who now have their residences in the environs, principally on two roads leading to Weltevreeden; the one east, the other west, through Molenvliet and Ryswick. These elegant roads, shaded with rows of trees, and having on each side sumptuous houses surrounded with fine gardens and plantations, form the fashionable resort at Batavia. Here are situated some of the public buildings of the town, namely, the grand assembly-room, used by government on great occasions; also a large building which contains the treasury and all the other public offices.

Batavia, being a great trading city, is resorted to by many different nations in the East; and its population consists of a mixture of all these, as well as of Europeans. The inhabitants may be divided into the following classes, namely,

Batavia. the Dutch residents, who form but a small class, and can hardly be termed European, so completely are they intermixed with Portuguese and Malay colonists; the different Indian nations, originally slaves; the Moors and Arabs, an active and intelligent race, principally engaged in navigation; the Javanese, who are cultivators; the natives of Bali, of Celebes, Borneo, Macassar, Amboyna, and Madura. The Malays are numerous; they are chiefly boatmen and navigators, and profess the Mahometan faith. The Chinese form the most numerous class in Batavia. They are here, as everywhere else, ingenious, industrious, and mercantile in their habits. Many of them have acquired large capitals; and their industry embraces the whole system of commerce, from the greatest wholesale speculations to the most minute transactions in the retail trade. In their hands are all the manufactories, distilleries, potteries, &c.; they have large coffee and sugar plantations, and gardens well stocked with all sorts of vegetables; and they are the principal traders, smiths, carpenters, stone-masons, shoemakers, shopkeepers, butchers, &c., in the country. But though they form so useful a class in Batavia, they have always been severely oppressed by the tyrannical and arbitrary exactions of the Dutch government. All their religious festivals, every public ceremony and popular amusement, as well as every branch of industry, were subjected to taxation. They were obliged to pay for a license to wear their hair in a long plaited tail, according to the custom of their country, as well as for permission to bring their greens to market, and to sell their produce and manufactures in the streets. A better system was introduced under the British administration of Sir Stamford Raffles; but on the restoration of the island to the Dutch, they again had recourse to their former narrow and severe policy. The mean annual temperature at Batavia is 78°·3 Fahr., being in winter 78°·1, and in summer 78°·6; at mid-day it is from 80° to 90°, and at night 70°. There are several churches, the finest of which is the Protestant church in Koninghs Plaetse, several schools and hospitals, a theatre, museum, bank, and a society of arts and sciences. According to the census taken in 1842, the population consisted of 3025 Europeans and their descendants, 23,108 natives, 14,708 Chinese, 601 Arabs, and 12,419 slaves, making in all 53,861 persons, exclusive of the garrison; and may now (1853) be estimated at about 60,000.

Batavia is a great commercial depôt, and is resorted to by vessels from all the Asiatic islands, as well as from China, the East Indies, and Europe. Its trade was indeed heavily oppressed by the restrictions of the Dutch East India Company, who claimed the monopoly or pre-emption of almost all the staple articles of commerce; and who further restricted by their regulations the freedom of navigation. A greater latitude was allowed under the French regulations of General Daendels, though it was still sufficiently severe; and in 1811, when Batavia was captured by the British, the trade was set free from the shackles which had been imposed on it, and it accordingly began to flourish, and is now the principal trading port of those seas.

The exports from Batavia to the other islands of the archipelago, and to the ports in the Malayan peninsula, are rice, salt, oil, tobacco, teak timber and planks, Java cloths, brass ware, &c., and European, Indian, and Chinese goods. The produce of the Eastern islands is also collected at its ports for re-exportation to India, China, and Europe; namely, gold-dust, diamonds, camphor, benjamin, and other drugs; edible bird-nests, biche-de-mer, rattans, bees' wax, tortoise-shell, and dyeing woods from Borneo and Sumatra; tin from Banca; spices from the Moluccas; fine cloths from Celebes and Bali; and pepper from Borneo. From Bengal are imported opium, drugs, and cloths; from China, teas, raw silk, silk piece goods, varnished umbrellas, coarse China ware, nankeen, paper, and innumerable smaller articles for the Chinese settlers. Of late, however, the Chinese have been superseded by the introduction of British manufactures. A trade is also carried on with Japan, to which cloths, spices, elephants' teeth, wood, tin, tortoise-shell, &c., are sent; and the return is chiefly made in fine copper, China ware, lackered ware, and silk goods. Batavorum Insula || Batenites.

Batavia owes its origin to the Dutch general John Pieterson Coen, who, in 1619, took the town of Jacatra by assault, destroyed it, and founded in its stead the present city, which soon acquired a flourishing trade, and increased in extent and importance. The Dutch enjoyed unmolested possession of this place until the year 1811, when the states of Holland having been incorporated with France, a British armament was sent against the Dutch settlements in Java, and to this force the city of Batavia surrendered on the 8th of August. Batavia was restored to the Dutch by the treaty of 1814. Long. 106. 51. E. Lat. 6. 10. S.

See Stavorinus's *Voyages to the East Indies*; Barrow's *Voyage to Cochin China*; Sir George Staunton's *Embassy to China*; Thorn's *Memoir of the Conquest of Java*; Sir Stamford Raffle's *History of Java*; Temminck's *L'Inde Archipélagique*. (D. B—N.)

BATAVORUM INSULA, the island of the Batavi, was bounded, according to Tacitus, by the ocean, the Rhine, and the Vahalis, now the Waal. Cæsar extends it to the Mosa, or Meuse; but Pliny's description coincides with that of Tacitus. This island was, however, of greater extent in the time of Tacitus than in that of Cæsar; for, by a new canal, Drusus, the father of Germanicus, conveyed the waters of the Rhine into the ocean, a considerable way north of the former mouth of that river. The Batavi were a branch of the Catti, who, having been expelled their country in consequence of a domestic sedition, occupied the extremity of the coast of Gaul, at that time uninhabited, together with this island situated among shoals. The name of Batavi they carried with them from Germany. The modern name of this island is *Betu* or *Betaw*.

BATE, George, an eminent physician in the time of Charles I. and II. After having been principal physician to Charles I., he accommodated himself so well to the times, that he became afterwards principal physician to Oliver Cromwell. Upon the Restoration, he was again made principal physician to the king, and fellow of the Royal Society. He wrote in Latin an account of the civil commotions in England, and some other pieces.

Another George Bate wrote a work entitled *The Lives, Actions, and Execution, of the prime Actors and principal Contrivers of that horrid Murther of our late pious and sacred King Charles I.*

Bate Isle, an island of Hindustan, belonging to the province of Guzerat, situated at the south-western extremity of the Gulf of Cutch. This island has a good harbour, well secured from the prevailing winds, but with a rocky anchorage. The island of Bate is a great resort of Hindu pilgrims; and the town contains a large number of houses chiefly inhabited by Brahmins. Bate Isle was formerly a rendezvous for pirates, who were the dread of all traders on the western coasts of India. The castle is a place of considerable strength. In 1803 a naval force, consisting of a British frigate and two Bombay cruisers, succeeded in destroying several of the pirate boats and vessels; but an attack upon the castle, though conducted under the fire of the ships, was repulsed with some loss. In 1807 a treaty was entered into with the chiefs of the island, by which it was agreed that a free and open commerce should be permitted to all British vessels. The chiefs at the same time consented to relinquish their piratical practices, and the British government stipulated to afford every just support and protection to the Hindu temple of the island. Distance from Baroda W. 265 miles. Lat. 22. 8. Long. 69. 10. (E. T.)

BATENITES, a sect of apostates from Mahometan-

Bates ‖ Bath.

ism, dispersed throughout the East, who professed the same abominable practices with the Ismaelians and Kirmatians. The word properly signifies *esoteric*. See ASSASSINS.

BATES, WILLIAM, D.D., an eminent Nonconformist divine, born in November 1625. He was admitted to Emanuel College, Cambridge, and thence removed to King's College in 1644. He was one of the commissioners at the conference in the Savoy, for reviewing the public liturgy, and was concerned in drawing up the exceptions against the Common Prayer; notwithstanding which, he was appointed chaplain to King Charles II. soon after the Restoration, and became minister of St Dunstan's in the West; but he was afterwards deprived of his benefice for nonconformity. Dr Bates bore a good and amiable character; and was honoured with the friendship of the Lord-keeper Bridgman, the Lord-chancellor Finch, the Earl of Nottingham, and Archbishop Tillotson. He published *Select Lives of Illustrious and Pious Persons*, in Latin; and after his death, all his works, except his *Select Lives*, were printed in one vol. fol.; again in 1723; and in 4 vols. 8vo, in 1815. He died in July 1699, in the seventy-fourth year of his age.

BATH, the chief town of Somersetshire, is, from the elegance of its buildings and the beauty of its situation, allowed to be one of the handsomest cities in Britain. It stands on both sides of the river Avon, inclosed by an amphitheatre of hills belonging to the great western oolitic range. The town is well laid out, rising in beautiful terraces and crescents from the river; and its sheltered position renders the temperature mild and agreeable. It contains many fine public walks, and the vicinity presents a great variety of beautiful landscapes. The houses are mostly built of white freestone quarried in the vicinity. The abbey church is a handsome cruciform edifice, with a quadrangular tower 162 feet high, rising from the point of intersection. It is 210 feet in length from E. to W., and 126 in breadth from N. to S. There are 25 other parish churches and Episcopal chapels in Bath, besides numerous chapels belonging to the Independents, Baptists, Wesleyans, Roman Catholics, &c. There is a free grammar school founded by Edward VI., and free and other schools for boys and girls. The Roman Catholics have a college here; and a Wesleyan college has lately been erected. The literary and scientific institution, founded in 1826, is a handsome building of the Doric order, with a laboratory, lecture-room, library, and a museum containing a very valuable collection of Roman remains found here. Among its public buildings are the guild-hall, with an elegant Grecian front, founded in 1766; the assembly-rooms, opened in 1771, the ball-room of which is 106 feet in length by 43 in breadth and 42½ in height; the prison; market-house; theatre, one of the best out of London; and the pump-room of the king's bath, 85 feet in length by 56 in breadth, and 34 high, containing a marble statue of the celebrated Beau Nash, to whom the city is indebted for much of its prosperity. Bath has five banks; a new savings-bank, built in 1842; a number of charitable institutions; a mechanics' institute; and a school of arts. The thermal springs, to which the city principally owes its importance, rise near the centre of the city. They were known to the Romans, who had a station here under the name of *Aquæ Calidæ*, or *Aquæ Sulis*, commonly *Aquæ Solis*; and very extensive remains of Roman baths have been discovered here. The springs supply five distinct establishments, viz., King's, Queen's, Hot, Cross, and Abbey baths. The temperature varies in the different springs from 90° to 117° Fahrenheit, and the specific gravity of the hot bath is 1·002. Mr R. Phillips obtained from a quart of this water about 30 grains of foreign matter, viz., carbonic acid, 2·4 inches; sulphate of lime, 18·0 grains; chloride of soda, 6·6; sulphate of soda, 3·0; carbonate of lime, 1·6; silica, 0·4; oxide of iron, a trace; but much carbonic acid escapes from the springs. When fresh drawn, it has a slight chalybeate taste; and, taken internally, it acts as a stimulant. It is very beneficial in cases of palsy, rheumatism, gout, leprosy, cutaneous and scrofulous diseases. During the season, the city receives sometimes as many as 14,000 visitors. The Sydney Gardens have been open since 1795, and are frequently employed for horticultural exhibitions and other amusements. Negotiations are now in progress for the purchase of these grounds for the erection of a handsome proprietary college. The Victoria Park was opened in 1830. Bath now carries on no extensive manufactures, the fabrication of the coarse woollens known as "Bath coating" having much declined.

Knights of the Bath.

The earliest extant charter of the city is that granted by Richard I., which was afterwards confirmed by Henry III and extended to its present state by George III. The corporation consists of a mayor, 14 aldermen, and 42 councillors, and the town returns two members to parliament.

The Great Western Railway connects Bath with London and Bristol; from the former of which it is 107 miles distant, and from the latter 12 miles. The Kennet and Avon canal, which joins the Thames at Reading, connects Bath with London by water. The river Avon is here crossed by two stone, two iron, and three suspension bridges. Lat. 51. 23. N. Long. 2. 22. W. By the census of 1851, it contained 7744 inhabited houses, and 54,240 inhabitants.

BATH, a seaport town, county of Lincoln, state of Maine, North America, one of the principal commercial towns in the state, being advantageously situated on the western bank of the river Kennebec, 12 miles from its mouth. Ship-building is extensively carried on here. Pop. (1850) 8002. There are several other places of this name in the United States.

Knights of the BATH, a military order in England, concerning the origin of which antiquaries differ in their accounts. The earliest intimation we have of the order is in the reign of Henry IV., when we find a degree of knighthood under the express denomination of *the Bath*. On the day of his coronation in the tower of London, that king conferred the insignia of the order upon forty-six esquires, who had watched all the night before, and had bathed themselves. Thenceforth it was customary for our kings to confer this dignity on the occasion of their own coronations or those of their queens; on the birth or marriage of royal issue, and their first advancement to honours; upon the eve of intended expeditions against foreign enemies; at the installations of knights of the Garter; and when some grand anniversary festivals were celebrated. The last knights of the Bath so made were in 1661, at the coronation of Charles II.; after which the order was neglected until the year 1725, when George I. was pleased to revive it, and to command a book of statutes to be framed for the government of the order. By this code the number of knights was fixed at thirty-eight, namely, the sovereign and thirty-seven knights-companions. But, in the reign of George IV., the statutes of the order were relaxed; and, under the denominations of companions and grand crosses, a great additional number of persons, chiefly military men who had distinguished themselves in actual service, have been admitted.

The apparel of a knight of the Bath is a red surcoat, lined and edged with white, and girt with a white girdle, but without any ornament; the mantle, of the same colour and lining, is fastened about the neck with a lace of white silk, to which is attached a pair of white gloves, with tassels of silk and gold at the end; and on the left shoulder it is adorned with the ensign of the order, consisting of three imperial crowns *or*, surrounded with the ancient motto, *Tria juncta in uno*, wrought upon a circle *gules*, with a glory or rays issuing from the centre, and under it the lace of white silk worn by the knights of the Bath. Red breeches and stockings, and white hats surmounted with plumes of white feathers, complete the knightly apparel. The chapel of Henry VII. is the chapel of the order, and every knight's

Bath-Kol ‖ Bathing.

banner, with plates of his arms and style, is placed over his respective stall, in the same manner as those of the knights of the Garter in St George's chapel, Windsor; and the knights are allowed supporters to their arms.

Bath-Kol, "the daughter of the voice," a species of oracle, frequently mentioned in the Jewish books, especially the Talmud. (See Vitringa's *Observ. Sacr.* ii. pp. 341–363.) This was a fantastic method of divination invented by the Jews, though called by them a revelation of God's will made to his chosen people after all verbal prophecies had ceased in Israel. It was, in fact, analogous to the *Sortes Virgilianæ* among the Romans. For as, with the latter, the first words they happened to turn to in the works of the Mantuan bard were considered a kind of oracle prognostic of future events, so with the Jews, when they appealed to Bath-kol, the first words they heard from any man's mouth were regarded as a voice from heaven, directing them in the matter they inquired about. Even the Christians were not quite free from this superstition, often making the same use of the Scriptures as the Romans did of the works of Virgil; and it descended, through them, to later times. In France it was the practice for several ages to use this kind of divination at the consecration of a bishop, in order to discover his life, manners, and future behaviour; and the usage came into England with the Norman conquest; for we are told that at the consecration of William, the second Norman bishop of the diocese of Norwich, the words which first occurred on dipping into the Bible were, "Not this man, but Barabbas." William died soon after, and was succeeded by Herbert de Lozinga, chief simony broker to king William Rufus, on whose consecration the Bible opened at the words in which Jesus accosted Judas Iscariot: "Friend, wherefore art thou come?" This circumstance so affected Herbert that it brought him to a thorough repentance of his crime, in expiation of which he built the cathedral church of Norwich, the first stone of which he laid in the year 1096.

BATHGATE, a town and parish of Scotland, county of Linlithgow, on the great road between Edinburgh and Glasgow. Population in 1851, 3341, chiefly employed in weaving, and in working the limestone, coal, and ironstone in the neighbourhood.

BATHING, the act of using or applying a bath; that is, of immersing the body, or part of it, in water or other fluid.

Bathing is a practice of great antiquity. It prevailed among the Greeks as early as the heroic age; and we even find mention made by Homer of hot baths in the Trojan times, although these seem to have been rare; indeed Athenæus speaks of hot baths as unusual even in his age. Public baths were in fact discouraged, and even prohibited, by the ancient Greeks, who were content to perform their ablutions in private, and without either luxury or parade. The method of lavation among this people consisted in heating water in a large three-footed vessel, and thence pouring it on the head and shoulders of the bather while seated in a tub, and he, on coming out, was anointed with oil.

It was also long before the Romans came into the use of baths; the very name of which, *thermæ*, shows that the practice had been borrowed from the Greeks. As the ancient Romans were chiefly employed in agriculture, their custom was, every evening after work, to wash their arms and legs, that they might sit down to supper with more decency; for it is to be observed that the use of linen was then unknown, and the people of that age went with their arms and legs bare, and consequently exposed to dust and filth. But this was not all. Every ninth day, when they repaired to the city, either to the nundinæ or to attend at the assemblies of the people, they bathed in the Tiber, or some other river which happened to be nearest them. This seems to have been all the bathing known till the time of Pompey, when the custom of bathing every day appears to have been introduced. Bathing.

The Celtic nations were not unacquainted with bathing, although it must be confessed that some of their descendants have evinced but little taste for scrupulous ablution. The ancient Germans bathed every day in warm water during winter, and in cold water during summer. In England, the famous bath in Somersetshire is said by some to have been in use eight centuries before Christ. Of this, however, it must be owned, we have but slender evidence; although Dr Musgrave makes it probable that it was a place of considerable resort in Geta's time, the remains of a statue erected to that general, in gratitude for some benefactions he had conferred upon it, being still in existence.

Although bathing, among the ancients, made, as it were, a part of diet, and was used as familiarly as eating or sleep; yet, as we learn from Strabo, Pliny, Hippocrates, and Oribasius, it was in high esteem among their physicians as a cure for certain diseases; and hence their frequent exhortations to washing in the sea and plunging into cold water. The first instance of cold bathing for medicinal purposes is that of Melampus, who bathed the daughters of the king of Argos; and the first instance of warm bathing is that of Medea, who was said to boil people alive, probably with some reason, since Pelias king of Thessaly died in a hot bath under her hands. The cold bath was used with success by Antonius Musa, physician to the emperor Augustus, for the recovery of that prince; but it fell into neglect after the death of Marcellus, who was believed to have met his death from indulging in it to excess. Towards the close of the reign of Nero, however, it was again brought into vogue by a physician of Marseilles named Charmis; but the fashion proved short-lived, and, during the succeeding ages, when the physical condition of the people became as much deteriorated as their intellectual and moral character, this cleanly practice was altogether abandoned.

Medical and physiological effects of bathing.

A methodical arrangement of the medical and physiological effects of the practice of bathing, referred to the respective divisions of therapeutic agencies, would be of great use in enabling us to attain a distinct idea of their nature; but such an arrangement is, in fact, a matter of extreme difficulty, for two reasons: *first*, because the temperature, the continuance, and the impregnation of the bath, are capable of being so varied, as materially to vary the nature of the remedy without any distinct limit between its different forms; and, *secondly*, because the classes of medical agents to which several of these effects belong are by no means distinctly defined, to say nothing of the additional complexity arising from the division of the effects into immediate and remote, which is often extremely important. The remote effects, however, being of a more general nature, and relating chiefly to the improvement or deterioration of the actions of the whole system, it is only the immediate effects that require to be accurately analyzed and distinguished, and these we must endeavour to reduce to some methodical classification of therapeutic powers.

Baths, as depending on water, have been naturally referred to the class of *diluent* remedies, in which water is comprehended; and they have sometimes even been recommended as *nutrients:* they may also act as *excitants* of cutaneous sensation; as stimulants, or rather *calefacients*, increasing the velocity of the circulation of the blood; as *sudorifics*, as *diuretics*, as "sorbentia" or *sorbefacients*, as refrigerants or *astringents*, as *tonics*, and as *retardants* of the pulse, a capacity in which some would call them re-

Bathing. laxants, while they seem in many cases to be useful as antispasmodics, or to relieve certain nervous affections, by something like a *narcotic* or *sedative* power. We might also refer the mechanical effect of ablution, in removing the natural secretions of the skin, to the dietetic *habits* conducive to the preservation of health; but this process, though highly necessary for our comfort, is perhaps less essentially important to health than has often been imagined; and, in some particular cases, the practice of the very frequent removal of the unctuous and volatile secretions of the skin has even appeared to be injurious, and to occasion indolent tumours of the absorbent glands belonging to the parts concerned.

If we admit that baths are ever, strictly speaking, either *diluent* or *nutrient*, we must suppose the cutaneous absorbents to be the channels of these actions; and the majority of authors, both ancient and modern, have certainly considered the skin as imbibing, with great facility, not only water, but also any kind of substance capable of being dissolved in it; nor is there any doubt that, under some circumstances, the cutaneous absorbents have been found to possess such a power in a certain degree; but M. Séguin and Dr Currie have shown that, in common cases, very little or no effect is to be expected from this absorption;[1] that the strongest medical agents, when dissolved in the water of a bath, exhibited no operation on the system while the skin was entire; and that no perceptible advantage was obtained from a continued immersion in a bath of nutritive fluids, notwithstanding the extreme exhaustion of the system in a case of completely obstructed deglutition; and they suppose that where weight has been gained during immersion in a bath, the absorption occasioning its increase has been principally performed by the lungs retaining the moisture, which they receive in abundance with the air inhaled.

The other immediate effects of bathing must depend on the contact of the fluid with the skin, either as simply moistening and softening the cuticle, or as *exciting* a peculiar sensation in the cutaneous nerves, whether of touch only, or of heat or cold, or, in some cases, of slight pain, where the skin has been previously in a state of irritation, especially if the water contains a saline impregnation; or, *lastly*, as altering the state of the circulation by any of these means, especially by the change of temperature; this effect being also often modified by the change of the position of the body, and by the distribution of the pressure or resistance which supports its weight throughout almost the whole surface, instead of its being confined, as usual, to the parts on which we sit or stand. The excitement of the nerves of the skin appears to be salutary in many cutaneous diseases, which are benefited by warm bathing, whether in fresh or in salt water, or in sulphureous or other mineral waters, as at Harrowgate, and at Baden, and Pfeffer and Leuck in Switzerland, the bathers sometimes remaining whole days in the water for weeks together, until a peculiar efflorescence has appeared on the skin, and has again disappeared.[2] The mud baths in the north of Italy are of a nature somewhat similar, and are said to be of considerable advantage in some paralytic cases. But if we allow the truth of the opinion of Séguin and Currie, we must infer that there are few instances in which the effects of bathing on the system in general can depend much on the impregnation of the water; and we ought perhaps to attribute the acknowledged advantage of sea-bathing, in a variety of diseases, in a great measure to the mildness and equability of the temperature of the sea. It is true, that persons accidentally wetted with salt water are but little liable to take cold; and this fact has been supposed to indicate some stimulant property in the contents of the fluid; but it may be explained with greater simplicity from the slower evaporation of salt water, which causes it to carry off heat much less rapidly than fresh, the cooling process being also retarded by the greater moisture of the sea air. Bathing.

In order to determine how far any kind of bathing may properly be called a stimulant or *calefacient*, we must consider what are the tests by which we judge of the increased rapidity of the circulation of the blood. The term calefacient is, indeed, somewhat objectionable, as implying that animal heat depends solely or principally on the motion of the blood, which is not, in the present state of our knowledge, the most probable opinion; and besides this etymological inaccuracy, the definition of the term, as implying an accelerated circulation, involves a considerable difficulty, since we have no means of ascertaining whether increased frequency of pulsation compensates or not, in any particular instance, for diminished fulness and strength. On the other hand, the operation of almost all medical agents is such as to relieve us from this ambiguity in the application of the definition; for we can scarcely mention any remedy which materially accelerates the pulse without at the same time increasing its strength. There are, indeed, many medicines which are often designated by the vague denomination of stimulants, and which have no effect whatever on the circulation, but either simply *awaken* the nervous energies in general, or *excite* local sensations of heat or pain; and this multiplicity of significations is a sufficient reason for rejecting the term from a correct classification. It happens, however, not unfrequently, that astringent and febrifuge medicines will reduce the frequency of the pulse, and increase its fulness; and it becomes necessary, for an accurate analysis of the operation of remedies which affect the circulation, to distinguish the *accelerants* of the pulse from the *augmentatives* and the *intensitives*, all of which may possibly be independent of the production of an increase of temperature; and this increase may also in some cases be produced, at least in the extremities and the superficial parts, and apparently also in the whole system, without any change in the circulation, by the operation of certain remedies, which might be called *thalptics*, if it were necessary to distinguish them as independent agents: and to these four classes we might add four others of an exactly opposite nature, which might be called *retardants*, *diminutives*, and *remissives* of the pulse, and *psyctics*, or direct refrigerants; and the last four classes would belong to a general division of remedies comprehending those which lessen the force of animal actions; a division which it has not commonly been found necessary to establish, for any practical classification of the materia medica.

Now it appears that a hot bath, of a temperature exceeding 98°, the usual heat of the human body, will commonly act both as an accelerant and an augmentative of the pulse, but probably not as an intensitive; it may, however, very properly be classed as a calefacient, if such a description of remedies be admitted. Dr Parr[3] says, that a bath of 100° rendered the pulse fuller and more frequent; but that, after the bath, it was slower than usual; at higher temperatures the effects were still more marked; and in Marcard's experiments, p. 71, the results were nearly similar. Dr Haygarth observed (Marcard, p. 67), that in a bath of 114° the pulse was considered more fre-

[1] Currie's *Medical Reports on the Effects of Water*, 8vo, Liverpool, 1798, p. 244.
[2] *Marcard über die bäder*, 8. Hanov. 1793. Traduit par Parant. 8. Par. 1801, p. 40–1.
[3] *De Balneo, Med. Comm. Ed.* i. 297; or Marcard by Parant, p. 66.

Bathing. quent, and the arteries were evidently dilated. In Finland, according to Martin (Marcard, p. 223), the vapour baths are usually heated to about 120°, and they often increase the frequency of the pulse from 70 in a minute to 110 or 120. Fourcroy mentions a bath of 66°, which must have been of the centigrade scale, making 151° of Fahrenheit, and not 181°, as Marcard supposes (p. 216), which was followed, an hour afterwards, by a fatal apoplexy. Whatever exaggeration there may be in this report, it may still serve to explain to us the excesses which were frequently committed in the use of baths by the Greeks and Romans, and the pernicious effects attributed to them by the ancient physicians. Hippocrates observes (*Aph.* v. 16), that the too frequent employment of hot bathing causes a softness and debility of the muscles, a want of firmness of the nerves, and a dulness of the faculties, with occasional hemorrhages and faintings, sometimes even terminating in death; and in the *Clouds* of Aristophanes we have a mock defence of warm bathing deduced from the usual dedication of hot springs to Hercules, which implies a perfect confidence in the opinion of the pernicious tendency of the practice, accompanied, or followed, as it frequently was, by other indulgencies, to which it has too often given occasion. This traditional condemnation of hot bathing has been erroneously transferred by some of the moderns to warm or tepid bathing; and since it has been asserted by authors of high celebrity that air above 60° will generally occasion a sensation of warmth, it seems to have been inferred that water above 60° must constitute a warm bath, and consequently produce enervating and debilitating effects. The fact is, however, that a bath below 100° is scarcely ever heating in any material degree; and even at 100°, the pulse, though somewhat accelerated, is often not at all augmented in fulness; nor are the subsequent effects materially different from those which usually result from an equal acceleration produced by any kind of moderate exercise. It is observed by Galen, in his *Treatise on the Pulse* (*Opp.* vol. iii. p. 3, ed. Bas.), that "baths, when moderately warm, cause the pulse to be full, and strong, and frequent; when excessively hot, small and obscure, but frequent and hard, sometimes, however, after a time, becoming slow, though still feeble." Of this retardation of the pulse in a very hot bath we have no experience in modern times: it is obvious, that what Galen calls moderately warm, we should at present term a hot bath; and probably his excessively hot baths somewhat resembled that which is mentioned by Fourcroy. "Cold baths," he says, "at first make the pulse slow and weak; afterwards, if they disagree, and produce torpor, the pulse remains weak; but if the bath is likely to strengthen the system, producing a salutary glow, then the pulse becomes full and strong, and natural in point of frequency."

It is, however, remarkable, that the cold bath not uncommonly renders the pulse considerably more frequent at the first immersion; a circumstance which was particularly observed by Athill,[1] and which, notwithstanding Marcard's doubts, has been since fully confirmed by Dr Stock.[2] This increased frequency seems principally to depend on the painful sensation of cold occasioned by the first immersion, especially while it is incomplete; it is commonly very transitory, and is succeeded by a retardation, while the fulness of the pulsations is diminished from the first.

The *sudorific* effect of the hot bath seems to be, in a great measure, the natural consequence of the acceleration of the circulation, and to be nearly proportional to this acceleration, being also favoured by the softening of the cuticle, and perhaps by the dilatation of the cutaneous exhalants. It is principally recommended in rheumatism, and it is also considered as conducive to the cure of some cutaneous affections; and when this effect is thought particularly desirable, it is usual to take the bath late in the evening, and to promote its operation by going into a warm bed immediately after it. Bathing

In considering these and other changes produced in the system by bathing, we must be careful to avoid the very common error of applying inaccurately and indiscriminately the laws of mechanical and physical agents to the effects produced in the animal economy. Some of the latest and best authors on therapeutics have talked of the expansion of the fluids contained in the vessels, in consequence of the elevation of temperature occasioned by the warm bath, and of the contraction of the vessels themselves by the cold bath, as if they were phenomena of the same kind, and simply opposed to each other. The truth is, that the mean temperature of all the fluids in the body is seldom elevated more than a degree or two by the effect of a bath of any kind; and even if the elevation were 10°, the expansion of all the circulating fluids would not exceed the bulk of a single additional ounce of blood or of water. The mechanical effect of cold, on the other hand, would immediately tend to lessen the tension of the vessels, by contracting the fluid contained within them more than the vessels themselves; but this effect would be scarcely more sensible than the former, even if we allowed that the general temperature might be depressed 10° or 12°, as it seemed to be in some of Dr Currie's experiments; and the actual contraction, which is really observable in the superficial parts during immersion in the cold bath, can only be referable to the action of living powers, which fall decidedly under the description of involuntary muscularity Dr Parry's late experiments have very clearly shown the existence of such powers, and exhibited their temporary and local action.[3] He found, that when the carotid of a ewe was laid bare, its circumference was 525 thousandths of an inch; "but it almost immediately shrunk, through the whole space which was exposed, so as to become in circumference only ·470; at the same time, a portion of the artery, before the contracted part, and which had been more recently exposed, was ·635; the pulse in the dilated part was very strong and full, that in the contracted part very weak and soft." Dr Parry has chosen to distinguish these effects from those which are observed in other muscular parts by a peculiar denomination; but the distinction appears to be perfectly arbitrary; and Dr Young, whom he quotes as denying the muscular powers of the arteries, on account of the chemical nature of their coats, has expressly asserted their muscularity, in contradiction to the conclusions of Bichât and Berzelius. (*Medical Literature*, 8vo, Lond. 1813, p. 502.) But by whatever term we choose to denote the effect, there is little doubt that an unusual degree of cold has a tendency to produce such a general contraction of the coats of all the superficial capillary arteries; and the diminution of their diameter must necessarily increase that part of the resistance to the blood's motion, which is derived from its friction against the sides of the vessels, and must, therefore, tend materially to lessen its velocity. Again, if the contractions of the heart are at all proportional in magnitude or

[1] *On Cold Bathing*, Marcard, p. 239; *Med. Comm. Edinb.* vi. 62.
[2] *Medical Collections on the Effects of Cold*, 8vo. Lond. 1805, App.; Traill, *Dissert. Inaug.*, 1802.
[3] *Experimental Inquiry on the Arterial Pulse*, 8vo, Bath, 1816, p. 41.

Bathing. in frequency to the quantity of blood entering it, and acting as a stimulus to its motions, it is not unnatural to suppose that its pulsations will be rendered feebler by the diminution of that quantity, occasioned by the increase of the resistance, and that the primitive retardation will be redoubled by the operation of this cause. At the same time, however, that the cutaneous vessels are contracted, those of the internal parts must necessarily be enlarged. Hence arises the sensation of oppression on the chest, with the sobbing or panting for breath, which generally occurs at the first immersion in cold water, from the fulness of the vessels of the lungs, and which is increased, in some measure, when the immersion becomes total, by the pressure of the water on the abdomen, and consequently of the contents of the abdomen on the diaphragm. From the same cause arises also the pulsation in the descending aorta, which has been observed to be much more distinguishable after swimming than at other times (*Medical Transactions*, vol. v.); the internal vessels being distended so as to exhibit the effects of the heart's action more violently, and the heart itself beating with more than usual force in consequence of the exertion, while the contents of the abdomen are compressed, and are enabled, by the presence of the surrounding fluid, to transmit the pulsation very completely to the superficial parts, to which the hand is applied. The *diuretic* effect of a cold bath may be partly explained from a similar distension of the renal vessels, which must be favourable to the secretion of the kidneys; and if the same effect is sometimes produced in a hot bath, when the superficial vessels are rather dilated than contracted, it is in this case much less considerable than in the cold bath, and probably only takes place in consequence of the increased rapidity of the circulation, which affects the whole sanguiferous system.

The glow which succeeds to the first sensation of cold may be attributed in a great measure to the increased sensibility of the nerves after a partial torpor, rendering them more susceptible of the sensation of heat, which is always relative to the actual temperature of the skin; but it appears, from Dr Currie's experiments, that there is also sometimes a real increase of heat as measured by the thermometer; and it is probable that the causes concerned in the production of animal heat are called up into a more vigorous exertion, in a strong constitution, whenever they are required for the purposes of life; so that they first supply the superficial parts of the body, during the immersion, with as much heat as is necessary to overcome the painful sensation of cold, and afterwards, by a continuation of the same action, occasion an actual elevation of temperature above the natural standard. Dr Currie found, that, during the affusion of a bucket of cold salt water on the heads and whole bodies of two healthy persons, no depression of temperature was observable; but in a minute or two afterwards, although they remained without motion, the mercury rose 2°; in a third person of a feebler constitution, although the temperature remained equally unchanged during the affusion, it sunk, in a minute after, half a degree. These effects seem to be almost entirely independent of any change in the state of the circulation, which must be rather retarded than accelerated, while the generation of heat is increased. It is true, that the heart might be called into more powerful action at the same time that the pulsation at the wrist became feeble, from the permanent contraction of the radial artery; but the action of the heart would still be exhibited by the carotids, undisguised by this modification; and the carotids have not been observed to beat more strongly in the cold bath than at other times, although Dr Currie has remarked, that when "the pulse could hardly be felt at the wrist, the heart pulsated with great steadiness and due force;" a fact precisely analogous to Dr Parry's interesting experiment on the carotid of the ewe. Bathing.

Warm baths may be classed with propriety among the most useful *sorbefacient* remedies; but it is not easy to decide whether they are much more active in promoting absorption than other sudorifics, or than evacuants in general. When the weather deprives a valetudinarian of his accustomed walk, the bath often affords him a valuable substitute, increasing the appetite and promoting the digestion; but too great an appetite without muscular exercise is sometimes an evil, and this may have been one of the causes of the inconveniences occasioned by an abuse of bathing. A warm bath has often been of advantage in promoting the absorption of dropsical fluids, especially when they are of limited extent, as in cases of partial anasarcous swellings; but the most important sorbefacient effect of bathing is exhibited in the cure of glandular diseases, for which sea-water, whether in the form of a warm or a cold bath, has long been considered as a specific remedy; and there is no doubt that a residence by the sea-side, with a judicious employment of bathing, and the occasional internal use of sea-water, or of some equivalent remedy, has been of the most essential service to many constitutions which have exhibited these symptoms of general debility and languid absorption, the tonic and sorbefacient powers of the remedy being happily combined for invigorating and calling into activity the diminished energies of the constitution.

The refrigerant or *astringent* powers, both of warm and of cold bathing, have been abundantly elucidated by the late Dr Currie, who has introduced the remedy into general practice as a febrifuge, especially in the form of cold or tepid affusion, with the most salutary effects. It is not easy to determine how far the contraction of the superficial vessels by the astringent powers of cold, and how far the *retardation* of the pulse, which may possibly be dependent on that contraction, are concerned in the advantage derived from bathing in fevers; but it is at least obvious that the remedy does not operate simply by the abstraction of heat, since the tepid affusion is often more rapidly successful in abating fever than the cold. We may also collect from the experiments of Marcard, that a bath at about 90° is more efficacious in abating the frequency of the pulse, than at any lower or higher temperature; and these facts appear to afford a very strong argument against the hypothesis, that the principal utility of the cold affusion depends on the sudden shock which is given to the nervous system. Dr Currie has frequently found the pulse reduced by a single cold affusion from 120 or 130 to 80 or 90, and the heat from 104° or 106° to the natural standard. But he very properly limits the employment of the remedy to those cases in which the temperature is considerably elevated, and the arterial system is in strong action, without local inflammation; and where there is less vigour in the system, he often employs the tepid instead of the cold affusion, or even contents himself with moistening the face and the extremities; for instance, in hectic fever, the hands and feet only, which he finds actually hotter than the rest of the body. A late writer on consumption has very justly remarked how much of Dr Currie's reasoning on the effects of cold bathing had been anticipated by Galen, although, for want of a thermometer, he had not been able to employ the remedy in fever with safety. "Bathing," says Dr Young (*On Consumptive Diseases*, 8vo, Lond. 1815, p. 135), "is very strongly recommended in the Method of Healing, and the process is very minutely described: first warm air is employed, next warm water, and then cold water, and, lastly, the sweat is wiped off. When we are fatigued or dried up by exercise, the bath restores us to comfort, and defends us from fevers.

Bathing. A strong young man in the country will plunge into cold water at once when heated, and be much refreshed by it. Animals also wash themselves when they are hot, by a natural instinct, as they eat when they are hungry and seek warmth when they are cold. In fevers, if we had sufficient powers of discrimination, we might probably sometimes derive material advantage from the use of the cold bath, without premising the hot; and some persons have been actually benefited by this remedy. But without a more intimate knowledge of diseases than we possess, we cannot generally venture on the practice; and least of all in hectic fever, where there is not strength enough to bear the shock. A stout young man having a fever in warm weather, without visceral inflammation, would bring on a salutary perspiration by bathing in cold water; and if he were in the habit of cold bathing, he might have recourse to it with the more confidence; but for the hectic it is unsafe, especially when there is much emaciation: thus, in a hot and a dry summer, those who have travelled far, and are become thin and weak, have no need of being cooled, nor would it be safe for them to use the cold bath without first going into the warm. For we seem to be hardened by the cold bath like iron, when heated first; and if we previously warm ourselves by exercise, the effect is the same." Dr Currie's relation of an adventure of his own might almost be supposed to have been intended as a commentary on these remarks of Galen. (*Reports*, p. 120.) "On the 1st of September 1778, two students of medicine at Edinburgh set out on foot on a journey, a considerable part of which lay along one of the rivers of Scotland. They started by sun-rise, and proceeded with alacrity in the cool of the morning. At the end of eight miles they breakfasted, rested for an hour, and then resumed their journey. The day grew warm as it advanced, and after a march of eight miles more, they arrived heated, but not fatigued, on the banks of the river above-mentioned, about eleven in the forenoon. Urged by the fervour of the day, and tempted by the beauty of the stream, they stripped instantly, and threw themselves into the river. The utmost refreshment followed; and when they retired to the neighbouring inn, this was succeeded by a disposition to sleep, which they indulged. In the afternoon they proceeded, and travelling sixteen miles further at a single stretch, arrived at the inn where they were to sleep, a little after sunset. The afternoon had been warm, and they perspired profusely; but the evening was temperate, and rather cool. They had travelled for some miles slowly, and arrived at the end of their journey stiffened and wearied with their exercise. The refreshment which they had experienced in the morning from bathing induced, however, one of them to repeat the experiment, and he went perfectly cool into the same river, expecting to relax his limbs in the water, and afterwards to enjoy profound sleep. The consequences were very different. The Tweed, which was so refreshing in the morning, now felt extremely cold; and he left the water hastily. No genial glow succeeded, but a feverish chill remained for some time, with a small frequent pulse, and flying pains over the body. Warm liquids and frictions brought on at length considerable heat, and towards morning perspiration and sleep followed. Next day about noon they proceeded on foot, but the traveller who bathed was extremely feeble; and though they had to perform a journey of a single stage only, as some part of it was difficult and mountainous, he was obliged to take the assistance of a carriage which overtook them on the road. It was several days before he recovered his usual vigour."

The experiments of the same judicious author, published in the *Philosophical Transactions* for 1792, afford some striking illustrations of the effects of severe cold. He employed baths at the temperature of 44° and 40°; the natural pulse of the person subjected to the experiment was about 70 in a minute, and it was generally raised to 85 or more by the preparation for immersion; but in the water it invariably sunk to about 65, becoming firm, regular, and small. The change of temperature, as measured under the tongue, was still more remarkable, and greater than could have been expected either from reasoning or from former observations; for the mercury fell, within a minute or two after immersion, from 90° or 100° to 87° or 88°; it then rose gradually, but not regularly, in a quarter of an hour, to about 96°. Upon a second exposure to the wind, it fell to about 90°, and was in one instance lowered 2° more at the first immersion in a bath of 97½°, in which the natural temperature was by degrees recovered, although not much more rapidly than it had risen during the former immersion in the very cold water; but what raised it by far the most speedily was the application of very hot water to the region of the stomach. When, however, Dr Currie himself went slowly into a bath of 36°, in a light flannel dress, and remained in it for two minutes, no observable alteration was produced in the heat of his body; and this circumstance might almost induce us to suspect that the other subjects of his experiments had incautiously allowed their mouths to be cooled by the inhalation of the cold air. Dr Marcard's experiments (p. 71) not only confirm the fact of the general retardation and diminution of the pulse by the cold bath; but they show that the retardation commonly extends to all temperatures below that of the human body, becoming, indeed, much more remarkable in the tepid bath than in a bath of the ordinary temperature of the atmosphere, which does not appear to produce the effect with equal uniformity. Thus, in a bath at 60° and at 63° the pulse was rather accelerated than retarded. In six experiments from 70° to 80° inclusive, taking the mean of all the quantities in order to obtain a result less liable to accidental errors, and representing all the experiments in a compendious form, the temperature was 75°, and in 20 minutes the pulse was reduced from 78° to 70°; in four from 80° to 90°, the mean temperature was 87°, and the pulsations were reduced in 54 minutes from 91° to 75°; in three at 90°, the mean reduction in 36 minutes was from 97° to 75°; and three experiments above 90° give for a mean temperature 92°, and a reduction from 82° to 70°, effected in 35 minutes. Martean found a slight reduction of frequency at 93°; but at 96°, according to Dr Parr, there is commonly no observable change. (Marcard, p. 63, 66.)

From these experiments Dr Marcard very justly infers, that in a great variety of cases, the warm bath affords the only direct and certain mode of lowering the pulse without inconvenience (p. 88); and we must be contented with the empirical knowledge of this fact, without attempting to explain why a temperature of 90° is more favourable for the retardation of the pulse, than a much lower temperature, at which the thermometrical heat would certainly be more rapidly reduced. Dr Stock has also made several observations on the effect of cold bathing on the pulse; but, in his experiments, the retardation was much less constantly observable than the diminution; a variation which frequently occurs when the temperature is very low.

The salutary effects of cold applications, in some cases of gout, were well known to Hippocrates, and have been more lately extolled by Homberg, Floyer, and Pietschen. Marcard (p. 256) very properly states the objections to their employment; and, notwithstanding all that Dr Kinglake has done to recommend them, they have not been adopted by prudent practitioners, except in very recent

Bathing. cases, and in young and unbroken constitutions. Aretæus prescribes the affusion of cold water for giddiness and headache, and it has certainly been successful in some obstinate cases of this kind (Marcard, p. 255); and has even appeared to be a powerful palliative in some descriptions of mania. In fevers, Dr Currie found its effects more permanent than those of the tepid affusion, although not always so speedy.

We have ample experience of the *tonic* powers of bathing in more than one of its forms, although for a long period the great majority of practitioners in Great Britain were disposed to confine these powers within the limits of the cold, or at most of the tepid bath. But travellers in warmer countries had often informed us of the invigorating effect of a warm bath taken after fatigue; and Bruce, in particular, extolled its comforts and its salubrity, from having used it in Egypt. The opinions of Marcard on the same subject were partly made known through Beddoes. Count Rumford, in his thirteenth essay, has exhibited, in a popular point of view, the benefits which he himself derived from taking the warm bath habitually in the middle of the day rather than at night; and Dr Alexander Buchan, in his work on sea-bathing, has assisted in dissipating the remaining prejudices against its employment as a mild tonic. For feeble or enervated constitutions, and for persons who have suffered from great fatigue, it is decidedly preferable to the cold bath; but as the strength is gradually recovered, it may often increase its efficacy to lower the temperature by degrees. We may begin, for instance, with a warm bath at 96° or 98°, and lower it by degrees to 90° or a little less; and hence the transition to the open sea in the middle of a summer's day will not be too abrupt, the water being often heated to 70° or more on a coast well suited for bathing; and if the constitution appears to acquire strength under the experiment, the hour of bathing may be made earlier and earlier, until the temperature is no higher than about 60°. The time of remaining in the water may also be modified according to the powers of the constitution, a single immersion being the most easily supported, and a longer continuance in the water, till the sensation of cold has subsided, calling forth the faculty of generating heat into fuller action; observing always not only how the health appears to be affected, but which mode is the most conducive to the pleasure or comfort of the individual, which will often throw some light on the operation of the remedy. In most cases it will be found, that where either warm or cold bathing agrees with the constitution, it is followed by a sense of youth and vigour, and self-complacency, which is equally agreeable and salubrious. We must also make allowances for peculiarities of constitution, which may require a deviation from the temperature usually recommended. Thus there are some persons who have so singular a sensibility as to feel a bath of 110° not too warm, and to be absolutely chilled by a bath of 100°; and in such cases it is probable that at 105° the pulse would not be materially accelerated. In other instances the cold bath produces headache and dejection of spirits. This inconvenience is sometimes obviated by proper evacuations, which should also always be premised to bathing, where there is any appearance of visceral disease, or of congestion of any kind. The sea-water will answer this purpose sufficiently well, either alone or mixed with warm milk, or with some chamomile flowers infused in it; but it has no material advantage over any other cathartic which may be preferred by the patient. It is also recommended by all authors on cold bathing to plunge in head foremost, and this precaution is highly proper where there is any apprehension of headache; but in other cases it is of little moment. If, after all, the cold bath continues to disagree, it will be generally advisable to exchange it for the warm; and after a time it may be proper to give the cold a second trial. Bathing.

It is unnecessary to enter into a minute detail of the diseases in which bathing is useful as a tonic. It is, however, particularly indicated in a variety of complaints which are peculiar to females; and to weakly children, especially such as are ricketty and scrofulous, sea bathing is most essentially necessary. On the other hand, cold bathing is almost universally to be avoided where there is any consumptive disease, or any inflammatory affection of any of the internal parts; an exception which is easily understood, from the natural tendency of cold to cause a congestion of blood in the vessels of those parts, in consequence of the contraction of the superficial vessels. The sudorific effect of the warm bath, followed by the refrigerant quality of the tepid, and the tonic powers of the cold, exhibit a succession of remedies nearly analogous to the mode of treatment which is usually found to be most successful in fevers of various kinds; in most of which we begin with sudorific medicines, and proceed to astringents and tonics. Hippocrates, in his book on the use of liquids, observes that gout is one of the diseases in which both hot and cold applications afford effectual relief; and the remark is equally just with respect to some cases of rheumatism; but, more commonly, the best mode of using baths in rheumatism is to begin with a bath raised, during the immersion, to as high a temperature as the patient can bear, so as to act as a powerful sudorific, and to continue the course, when the pain has been relieved, at lower and lower temperatures, ending it with cold bathing in the open sea.

Notwithstanding the acknowledged utility of warm bathing in a variety of circumstances, there may possibly have been some exaggeration in the marvellous opinions which have been sometimes entertained of its utility for the prolongation of life. Galen has indeed mentioned a number of persons who had attained a great age, and who were in the habit of making daily use of the bath, which is enough to prove that such a habit cannot be extremely pernicious; and if we supposed a constitution to retain all its energies, but to have them concealed and obscured for want of proper stimuli, the warm bath might tend to remove the evil; but it is more natural to believe that the approach of old age has a tendency to weaken the radical powers of the constitution, which cannot afford to be roused into disproportionate exertion; and to apprehend that the temporary vivacity and activity superinduced by any foreign agent, whether by warm bathing or by a removal to a warmer climate, would only tend still more to exhaust the already diminished store of vitality.

The *narcotic* and *sedative*, or *specifically* antispasmodic, effects of bathing are most effectually exhibited, in ordinary cases, by the warm or tepid bath, which is often employed for the relief of pain, and for the removal of any irregular or convulsive affection. Possibly also the effect of the warm bath in retarding the pulse may be partly derived from its sedative power as affecting the heart; and if we take this connection for granted, we may infer from it, that the antispasmodic effect will be most advantageously obtained from a bath at 90°, which has been found to retard the pulse most effectually. But where there is internal inflammation, it may be desirable to dilate the superficial vessels by a bath somewhat hotter than this, so as to relieve the internal parts from a part of the fluid which distends them, but without increasing the velocity of the circulation by too high a temperature. The cold affusion is also a powerful remedy in many cases of tetanic disease. Hippocrates (*Aph.* v. 21) has remarked, that it often creates a glow which overpowers

Baths. the convulsive contraction, especially where the subject is young and athletic, the weather hot, and the disease independent of local injury; and the modern experience of Dr Wright and Dr Currie has confirmed and extended the observation. In another passage he tells us (*Aph.* v. 25), that the abundant affusion of cold water generally relieves and removes swellings and pains in the limbs, as well as spasms, producing a moderate degree of torpor, which supersedes the pain; but, in fact, the relief of inflammatory affections by cold is rather to be referred to its astringent than to its sedative powers. This is, indeed, a point which has been much discussed by modern theorists; but it must be confessed that all our theories are of little importance in physic, any further than as they assist us in clearly comprehending and distinctly remembering the facts which we derive from immediate experience in the treatment of diseases. (T. Y.)

BATHS, *Balneæ* (βαλανεῖα), large ornamented buildings erected by the ancients for the sake of bathing. Baths formed a part of the ancient *gymnasia*, though they were frequented more for the sake of pleasure than of health.

The most magnificent baths were those of Agrippa, Nero, Titus, Caracalla, Paulus Æmilius, and Diocletian. The baths of Agrippa, or *Thermæ Agrippinæ*, were built of brick, but painted in enamel. Those of Nero, *Thermæ Neronianæ*, were not only furnished with fresh water, but had the sea brought into them: those of Caracalla were adorned with 200 marble columns, and furnished with 1600 marble seats; and which, Lipsius assures us, were so large, that 1800 persons might conveniently bathe in them at the same time. But the baths of Diocletian, *Thermæ Diocletianæ*, surpassed all the rest in magnificence; 140,000 men having been employed many years in building them. A considerable portion of this vast structure, as well as of the baths of Caracalla, still remains; and, from the dimensions of the arches, the beauty of the pillars, the profusion of foreign marble, the curious moulding of the roofs, the multitude of spacious apartments, and a variety of other circumstances, these ruins may be regarded as among the most remarkable relics of ancient luxury and splendour. It is said that at Rome there were 856 public baths. Fabricius justly observes, that the excessive luxury of the Romans appeared in nothing more than in their baths. Seneca complains that the baths of plebeians were filled from silver pumps, and that the freedmen trod on gems; and Valerius Maximus and Pliny make mention of one Sergius Orata, who had baths suspended in the air. This, however, appears to have reference to the invention of the vapour bath, in which the flooring of the chamber was suspended over the hollow cells of the *hypocaustum*. (See Ausonius, *Mosella*.)

According to Dion Cassius (lv. 7), Mæcenas was the first who erected warm swimming baths at Rome; but there were public baths prior to his time, although they were small, poorly decorated, and of cold water only. Agrippa, while ædile, built 160 places for bathing, where the citizens might be accommodated either with hot or with cold water gratis; and, following his example, Nero, Vespasian, Titus, Domitian, Severus, Caracalla, Gordian, Aurelian, Maximian, Diocletian, and most of the emperors who studied to gain the affections of the people, erected baths inlaid with the richest marble, and wrought according to the rules of the most delicate architecture. The wealthy had baths, frequently of great magnificence, at their own residences, especially after the practice of pillaging the provinces had commenced; but these they only used on extraordinary occasions. The great men, and even the emperors themselves, sometimes bathed in public with the rest of the people. Alexander Severus was the first who allowed the baths to be opened in the night-time during the heats of summer.

The Greek baths were usually annexed to the *palæstræ* or *gymnasia*, of which they were considered a part; and consisted of seven different apartments, usually separated from one another, and intermixed with other buildings belonging to different sorts of exercises. These were, the cold bath, *frigida lavatio;* the *elæothesium*, or room where they were anointed with oil; the *frigidarium*, or cooling room; the *propnigeum*, or entrance of the *hypocaustum* or stove; the vaulted room for sweating in, or vapour bath, called *concamerata sudatio*, or *tepidarium;* the *laconicum*, or dry stove; and the hot bath, called *calida lavatio*. With respect to the baths disjoined from the palæstræ, they appear to have been usually double; one for men and another for women, but so near that the same furnace heated both. The middle part was occupied by a large basin, which received water by several pipes, and was surrounded by a balustrade, behind which there was an area for the reception of those who waited to use the bath. These baths were vaulted over, and only received light from the top.

In the Roman baths, the first part which appeared was a large basin, called κολυμβήθρα in Greek, and *natatio* or *piscina* in Latin. In the middle was the *hypocaustum*, which had a row of four apartments on each side, called *balnearia;* these were the stove, hot bath, cold bath, and *tepidarium*. The two stoves, called *laconicum* and *tepidarium*, were circular, and joined together; and their floor was hollow and suspended, in order to receive the heat of a large furnace, which communicated with the stoves through the vacuities of their floor. This furnace also heated another room called *vasarium*, in which were three large brazen vessels called *milliaria*, containing respectively hot, warm, and cold water, and so disposed that, by means of siphons and pipes, the water might be made to pass out of one or other of them into the bath, in order to adjust its temperature. Such is the description given by Vitruvius.

At three in the afternoon, which Pliny calls *hora octava et nona*, the Romans repaired to the baths, public or private. This was called the *hora balnei*, or the "bath hour." In summer the earliest hour of admission was eight, and in winter nine; whence the expression of Pliny applied to the hour of general resort. The public baths were opened at the sound of a bell, and always at the same hour. Those who came too late stood a chance of obtaining only cold water The bathers commenced with hot water; but when the pores had been thus opened, and a profuse perspiration produced, they thought it prudent to close them again, either with the cold bath, or at least with a sprinkling of cold water. During the bath the body was scraped with a kind of blunt knife or *strigil*, such as may still be found in the cabinets of the curious. Bathing was succeeded by unction and perfuming, after which they went fresh to the *cœnaculum*.

The Romans, when they found their stomachs overcharged, proceeded to the bath. This we learn from Juvenal, who inveighs against those who, having gorged themselves with eating, were forced to go into the baths to seek relief. They also repaired to a bath to refresh themselves after any considerable fatigue or travel; and hence Plautus says, on one occasion, that all the baths in this world were not sufficient to remove the weariness he felt. After Pompey's time the passion for bathing was carried to such excess that many were ruined, and some had brought themselves to such a state that they could not take food without first bathing. The Emperor Titus is said to have lost his life in consequence of the artificial habit thus induced. Hence Pliny inveighs against those physicians who held that hot baths aided digestion; and the Emperor Hadrian laid a restraint on the immoderate humour of bathing, by a public edict prohibiting all persons from bathing before the eighth hour.

BATHS, *Modern*. The modern baths consist of hot, warm, tepid, and cold baths, shower baths and vapour baths, in which the water and vapour used are either pure or variously medicated. With the exception of Russia and Turkey, baths are not used to any great extent among the inhabitants of

Baths. Europe. It is chiefly in warm countries that the bath is an indispensable luxury to the people, and in these countries the necessity of frequent ablutions and of attention to personal cleanliness is so recognized, that it has been embodied in the religious ceremonies of the Mahometans, Hindus, &c., and constitutes an essential part of their worship.

The Turkish and Persian baths, in their general construction, make a close approach to the ancient Roman baths. Lane, in his *Account of the Manners and Customs of the Modern Egyptians*, has given a full description of the Turkish baths as they exist at Grand Cairo. In that city there are between 60 and 70 public baths, some of which are kept exclusively for the men, others for the women, while others are used in the forenoon by the men, and in the afternoon by the women. "The building," says Lane, "consists of several apartments, all of which are paved with marble, chiefly white, with an intermixture, in some parts, of black marble, and small pieces of fine red tile. The inner apartments are covered with domes, which have a number of small round glazed apertures for the admission of light. The bather, on entering, if he has a watch and a purse containing more than a trifling sum of money, gives these in charge to the mallim or keeper of the bath, who locks them in a chest; his pipe and sword he commits to a servant of the bath, who takes off his shoes, and supplies him with a pair of wooden clogs, the pavement being wet. The first apartment is called the meslukh. It generally has two, three, or four leewans (raised part of the floor used as a couch), cased with marble, and a fountain of cold water, which rises from an octagonal basement, constructed of stone cased with marble, in the centre. One of the leewans, being designed for the accommodation of persons of the higher and middle orders, is furnished with mattresses and cushions; upon the other or others, which are for the lower orders, there is usually no furniture except mats. In many baths, there is also in the meslukh a small kind of stall for coffee.

"In warm weather the bathers mostly prefer to undress in the meslukh; in winter they undress in an inner closed apartment, called beytowwal, between which and the first apartment is a short passage with two or three latrinæ on one side. Beytowwal signifies 'first chamber;' and this name is given to the chamber here mentioned, because it is the first of the warm apartments; but it is less warm than the principal apartment, of which it is the ante-chamber. In general it has two mustubahs (raised seats). The bather receives a napkin in which to put his clothes, and another to put round his waist; this reaches to the knees or a little lower, and is termed makhzam; a third, if he requires it, is brought to him to wind round his head, in the manner of a turban, leaving the top of the head bare; a fourth to put over his chest, and a fifth to cover his back. When the bather has undressed, and attired himself in the manner above described, the lawingee (attendant) opens to him the door of the inner and principal apartment, which is called khararah. This, in general, has four leewans, like those of most rooms in private houses, which gives it the form of a cross, and in the centre a fountain of hot water rising from a small shallow basin in the middle of a high octagonal seat, cased with white and black marble, and pieces of red tile. The khararah, together with several chambers connected with it, may generally be described as occupying almost an exact square. The beytowwal is at one of the angles; two small chambers which adjoin each other, the one containing a tank of warm water, the other containing a trough, over which are two taps, one containing hot and the other cold water, termed the khanafeeyeh, occupy two other angles; while the fourth angle of the square is occupied by the chamber which contains the fire, over which is the boiler.

"The bather having entered the khararah, soon perspires profusely from the humid heat, which is produced by the hot water of the tanks and fountain, and by the boiler. The operator of the bath, called mookeyyisatee, immediately comes to him. The bather sits on one of the marble seats, or lies on a napkin on one of the leewans, or by the edge of one of the tanks, to submit to the first operation, which is that of cracking his joints. The operator cracks almost every joint of his frame: he wrings the body first one way and then the other, to make several of the vertebræ crack. Even the neck is made to crack twice by wrenching the head round, which produces a sensation rather alarming to an inexperienced person. Each ear is twisted round until it cracks; the limbs are twisted with apparent violence, but with such skill that an untoward accident is never heard of. The object of this process is to render the joints supple. The operator also kneads the bather's flesh. After this he rubs the soles of the feet with a kind of rasp of baked clay. There are two kinds of rasps used for the purpose, one very porous and rough, and its rasping surface scored with several lines, the other of a fine close clay; and those used by the ladies are usually encased in thin embossed silver. The next operation is rubbing the bather's flesh with a small coarse woollen bag, after which the bather dips himself in one of the tanks. He is next taken to a khanafeeyeh, and a napkin having been hung before its entrance, the operator lathers the bather with leef (fibres of the palm tree), and soap and sweet water. The soap is then washed off with water from the khanafeeyeh, when the bather, having finished washing, and covered himself with dry towels, returns to the beytowwal, and reclines on a mattress provided with cushions. Here he generally remains from half an hour to an hour or more, sipping coffee and smoking, while an attendant rubs the soles of the feet, and kneads the body and limbs; then dresses and goes out. One piastre is the common sum to pay for all the operations above described."

The Persian bath, and the processes followed there, as described by Sir R. Ker Porter, are almost entirely the same as those of the Turkish bath, so that it is unnecessary to enter into details on the subject.

The Russian bath is more properly a vapour bath, and is well described by Kohl in his *Russia*. His description is graphic and complete, though what he styles the "torture" of the process is considerably exaggerated. "On Saturday evening," he says, "an unusual movement may be seen among the lower classes in St Petersburg; whole companies of poor soldiers who have got a temporary furlough, troops of mechanics and labourers, whole families, men, women, and children, are eagerly traversing the streets with towels under their arms, and birch twigs in their hands. From the zeal and haste manifested in their movements, they would seem to be engaged on important business, as in fact they are, the most important and agreeable of the whole week. They are going to the public baths, to forget, in the enjoyment of its vapours, the sufferings of the past week, to make supple the limbs stiffened with past toil, and invigorate them for that which is to come. The Russians are such lovers of vapour baths, that Petersburg contains an immense number of these establishments. Before the door the words, 'Entrance to the Baths,' in large letters, invites the eye; within the doorway, so narrow that only one at a time can work his way in, sits the money-taker, who exchanges a ticket for the bath for a few copeks. Men, women, boys, and girls, all hurry to secure their tickets, as if proceeding to some favourite show.

"The passage is divided into two behind the check-taker's post, one for the male, and one for the female guests. We first enter an open space, in which a number of men are sitting in a state of nudity on benches, all dripping with water and perspiration, and as red as lobsters, breathing deep, sighing, puffing, and gossipping, and busily employed in drying themselves and dressing. These have already bathed, and now, in a glow of pleasurable excitement, are puffing and blowing like Tritons in the sea. Even in the winter, I have seen these people, all melting from the hot

Baths.

baths, drying and dressing in the open air, or, at most, in a sort of booth forming an outhouse to the bath. Round this space or apartment are the doors leading to the bathing-rooms, large wooden apartments, in which a heat of 40° or 50° Reaumur (122° to 145° F.) is maintained. Dr Robert Lyall mentions, that the heat is maintained by means of a large stove filled with stones, which are heated by means of burning wood, and over which water is thrown. The steam thence raised fills the apartment, which is surrounded with a wooden platform of ascending stairs or steps, and according to the degree of heat desired the person ascends the higher.

"The first sensations on entering this apartment are very singular, chiefly from the difficulty of breathing such a hot and moist atmosphere. On the platforms, which are raised in the form of an amphitheatre, lie an immense number of persons apparently inflicting torture on themselves; if not dead, they actually seem struggling with death, for the air they are breathing can only serve to stifle. Other persons, their tormentors, are employed in scourging them with birchen rods, steeped in cold water, as if to increase the smart. Others, standing by the glowing stoves, and steaming at every pore, have ice-cold water poured over them by pailfuls. When the first disagreeable effect of the heat is overcome, and the transpiration commences in full activity, then a beneficent spirit of warmth pervades the whole frame, and a divine sense of pleasure is all that remains to us of our existence, our whole being seeming dissolved in fleeting vapour. All pains and stiffnesses vanish from the limbs, and we feel light and buoyant as feathers. The rubbing and flogging with birchen twigs increases the transpiration, and consequently the enjoyment. All bodily pain, be it what it may, disappears in these baths; of headache, toothache, cramps, convulsions in the limbs or face, gout, or rheumatism, there remains not a trace. It is an extraordinary excitement, a kind of intoxication of the whole nervous system. By one of these baths a man is washed out like a sponge; for a sensual people I can imagine no higher enjoyment." (See also Acerbi's *Travels*.)

The baths in Germany, France, Italy, and Britain, are simply hot baths, in which the person, by himself, immerses the body for a longer or shorter time; and are chiefly used for purposes of personal cleanliness. The baths used by the modern Europeans and by the Americans, differ essentially from the Turkish and Russian baths, in that the vapour of water or steam is rarely made use of during the process of bathing; the operation being limited to washing or immersing the body in water of varied temperature, according as the person wishes a tepid or a hot bath. The form of the bath, therefore, differs essentially from those above described, consisting of a large or smaller building, containing a number of separate dressing-rooms, in each of which, or adjoining it, is an oblong trough of marble, slate, metal, or wood, furnished with two taps, one for the supply of the cold, the other for that of the hot water. The demand for these baths is very small over the greater portion of Europe, so that even large and populous towns cannot support above one or two bathing establishments of moderate dimensions.

One of the greatest improvements in modern times would be the general introduction of the Russian bath into the towns of Great Britain, &c. The vapour bath is infinitely superior to the warm bath for all the purposes for which a warm bath can be given; and as a medical agent in the removal and alleviation of certain chronic diseases can scarcely be over-praised. An effective vapour bath may be easily had in any house, and applied even to the greatest invalid at little cost or trouble. A pretty large firebrick is made red hot in the kitchen fire, and placed on an iron tray, which is raised on short feet. Over this is set a wooden chair, on which the person who is to take the vapour bath is seated; a four-leaved screen covered with painted canvass or cloth is then put round him, and a blanket or thick sheet thrown over the top of the screen, so as to convert it into a narrow closet or chamber. The person being provided with a small jug or watering-pan of hot water, pours the water very slowly over the red-hot brick, when, being converted into steam, it fills immediately the limited space, and almost instantaneously induces the most violent and general perspiration. We have for many years had experience of this mode of procuring an effective vapour bath, and can confidently recommend it. (J. S—K.)

Bathurst.

BATHURST, Allen, Earl of Bathurst, one of the last luminaries of Queen Anne's reign, was born in the year 1684. His studies and education were equally conducive to the brilliant figure he was destined to make in social life and in the senate, as a polite scholar, patriot, and statesman. These talents he had an opportunity of displaying as early as the year 1705, when, at the request of his father, Sir Benjamin Bathurst, and the solicitation of the constituency of Cirencester, he represented that borough in parliament. He distinguished himself particularly in the struggles and debates relative to the union between the two kingdoms; firmly supporting a measure which he thought calculated to strengthen the government and add to the prosperity of the country. Though he was contented to act a subordinate part in the opposition planned by Mr Harley and Mr St John, his intimate friends, in order to sap the credit of the Duke of Marlborough and his adherents, nevertheless he did good service to his party by arraigning, with more eloquence than truth, the conduct of the general and of the Earl of Godolphin, whom he accused of lavishing the treasures of the nation on conquests more splendid than serviceable. The loss of the battle of Almanza, which happened about this time, seconded his efforts and those of his associates in dispelling what they called the intoxication of former successes, and disparaging achievements which reflect immortal honour on the British name. But his personal regard for Lord Somers, president of the council, suffered no abatement, although they were of different opinions in politics; and when that great man was deprived of office, Mr Bathurst acted with such tenderness and delicacy as to preserve his esteem in a private station. In consideration of his zeal and services, the queen, in 1711, advanced him to the peerage by the title of Baron Bathurst, of Battlesden, in Bedfordshire.

His lordship continued to speak his sentiments with undaunted freedom in the upper house, and became a vigorous opponent of the court measures in the reign of George I., and during Sir Robert Walpole's administration. The acrimony of the prosecutions carried on against the Earl of Oxford, Lord Bolingbroke, and the Duke of Ormond, stimulated his indignation against such vindictive proceedings; and he observed, "that the king of a faction was but the sovereign of half his subjects."

The South Sea Scheme having infected all classes with a spirit of wild speculation, when the people awoke from their delirium a vast number of families were involved in ruin. Lord Bathurst publicly impeached the directors, whose arts had enabled them to amass enormous fortunes during the prevalence of the mania; he represented that the national honour was concerned in stripping them of their ill-gotten wealth; and he moved for having all the directors of the South Sea Company punished for their sordid knavery, by the forfeiture of their estates.

When the bill was brought into the House of Lords against that learned prelate Dr Atterbury, bishop of Rochester, his lordship spoke against it with great vehemence. He concurred with all his might in the opposition to Sir Robert Walpole; and when, after an obstinate struggle, this minister was forced to resign all his employments, Lord Bathurst was sworn of the privy council, and made captain of the gentlemen pensioners, a post which he resigned in 1744. In 1757 he was appointed treasurer to George III. (then

Bathurst || Bathycles.

Prince of Wales), and continued in the list of privy counsellors at that monarch's accession to the throne; but, on account of his advanced age, he declined embarking again in political contentions.

Lord Bathurst's integrity gained him the esteem even of his opponents, while his humanity and benevolence procured him the affection of all who knew him more intimately; and he added to his public virtues all the good breeding, politeness, and elegance, of social intercourse. Congreve, Vanbrugh, Swift, Prior, Rowe, Addison, Pope, Arbuthnot, Gay, and most of the men of genius of his own time, cultivated his friendship, and were proud of his correspondence. Pope, in his *Epistle on the Use of Riches*, which is addressed to Lord Bathurst, compliments his friend in some highly characteristic lines. Sterne, too, in his letters to Eliza, speaks of him in terms of affectionate admiration. "This nobleman," says he, "is a prodigy; for at eighty-five he has all the wit and promptness of a man of thirty; a disposition to be pleased, and a power to please others, beyond what I ever knew; added to which, a man of learning, courtesy, and feeling."

Lord Bathurst was elevated to an earldom in 1772, and lived to see his eldest son promoted to the peerage by the title of Baron Apsley, and several years lord high chancellor of Great Britain. His lordship married Catharine, daughter of Sir Peter Apsley, by whom he had two other sons and five daughters. He died, after a few days' illness, at his seat near Cirencester, on the 16th of September 1775, in the ninty-first year of his age.

BATHURST, *Ralph, M.D.*, uncle of the preceding, was born in the year 1620. He studied divinity in Trinity College, Oxford; but, on the breaking out of the civil war, he changed the course of his studies, and, applying himself to physic, took a doctor's degree in that faculty. By dint of assiduous application, he soon rose to eminence in his profession, and in the time of the Commonwealth was appointed physician to the state. At the Restoration, however, he quitted the practice of physic; was elected a fellow of the Royal Society, and president of his college; and, having entered into holy orders, was made chaplain to the king, and afterwards dean of Wells. Soon after, he filled the office of vice-chancellor of Oxford, and was nominated by King William and Queen Mary to the see of Bristol; but this honour he declined. To the accomplishments of an orator, philosopher, and poet, he added an inexhaustible fund of wit. Ridicule—of which he was an absolute master—was the weapon with which he used to correct the delinquents of his college. His poetical pieces in the *Musæ Anglicanæ* are excellent in their kind; besides which he wrote several poems, both in English and Latin. He died June 14. 1704, in his eighty-fourth year.

BATHURST, a county in the colony of New South Wales, lying between the rivers Lachlan and Macquarie. In the Bathurst mountains the first great gold digging began in May 1851. See AUSTRALIA. The town of Bathurst, 98 miles W.N.W. of Sydney, has since that time greatly increased in size and importance. Pop. of county in 1851, 6405.

This is also the name of a seaport town of Western Africa, capital of the British colony of Senegambia, at the mouth of the Gambia river, in N. Lat. 13. 28. W. Long. 16. 32.

BATHURST ISLAND, on the north coast of Australia. See AUSTRALIA.

Another island of the same name lies in the arctic seas, in Lat. 75. N. Long. 100. W. Parry traced, in 1819, its southern coast for 75 miles, and describes it as desolate, rugged, and precipitous.

BATHYANI. See HUNGARY.

BATHYCLES, of Magnesia in Lydia, the celebrated sculptor of the throne or shrine of the Amyclæan Apollo, so minutely described by Pausanias (*Laconia*). This eminent artist gave a stimulus to the genius of Grecian sculpture. He came into Greece about 600 years B.C., at the time when the invasion of the Scythians and of the kings of Lydia harassed the Ionian states, and fixed his abode at Sparta.

Bathyllus || Batnears.

BATHYLLUS of Alexandria, a freedman of Mæcenas, was a celebrated pantomimic dancer in the reign of Augustus. See BALLET.

BATILUS, a musical instrument of percussion, made of metal, in the form of a staff, furnished with metallic rings. It was used by the Armenians in their church-service.

BATISTE, in *Commerce*, a fine kind of cloth, of mixed silk and woollen, manufactured in Flanders and Picardy.

BATMAN, in *Commerce*, a kind of weight used at Smyrna and several other places, usually containing six okes of 400 drachms each.

BATMANSON, JOHN, prior of the Carthusian monastery, or Charter-house, London. He studied at Oxford, and wrote against Erasmus and Luther, at the instigation of Lee, archbishop of York. He died in 1531.

BATNÆ (Sarug), an ancient city of Osroëne in Mesopotamia, celebrated for its great fair, which was attended by merchants from Syria and India.

BATNEARS or BATTIES, a people of the northern part of Hindustan, inhabiting the tract of country now included within the British district of Bhutteeana, the eastern frontier of which is situated 125 miles N.W. of Delhi. The Batties present many peculiarities in manners and customs, distinguishing them from the other people of Hindustan. They consist of two distinct races; the one being composed of Mahometans of Rajpoot descent, who constitute the influential class, and who report among themselves that their ancestors emigrated some centuries ago from the district of Jessulmere, and, after various vicissitudes, settled in the Batnear country; the other comprising the common people known as Jauts, who have adopted the religion of their superiors, and are consequently treated with great moderation. Most of these people are descended from dwellers on the western bank of the Sutlej, who were invited by a rajah of the Batties to cross the river and settle in his country. Though tillers of the soil, the Batties are more generally characterized as shepherds; and although principally restricted to the territory whence their name is derived, various tribes of them are to be found in the Punjab, and they are also scattered over the high grounds to the east of the Indus.

Notwithstanding they are Mahometans, yet their customs are in some respects at variance with those observed by the majority of the followers of the prophet, particularly in the females appearing, without any reserve, unveiled in public, and in their associating promiscuously with the men. The wives of the Rajpoot chiefs form an exception.

The territory above described, anterior to British sway, was under the dominion of a supreme prince or rajah, whose authority was acknowledged by inferior chiefs. This potentate could bring 20,000 or 30,000 men into the field, but they were quite undisciplined, and despised the necessary principle of subordination. His revenue arose chiefly from the plunder of his troops; for their wars were directed more to predatory purposes than to open contest, and the rajah, instead of repressing the ravages of this immense banditti, willingly participated in the spoils.

While under the influence of native rule, the Batties appear to have formed a collection of hordes of freebooters. They have been described as of a cruel, savage, and ferocious disposition; entertaining an utter abhorrence of the usages of civilized life; being thieves from their earliest infancy, and during their predatory incursions into the neighbouring districts, not scrupling, though unresisted, to add murder to robbery.

Many of the Batties appear to be entirely nomadic; changing their residence from place to place as subsistence

Batnears. fails. Their exports are horses, camels, bullocks, buffaloes, and ghee; and occasionally they sell some surplus grain above what is necessary for their own consumption; but their traffic is very inconsiderable. A large portion of the country is unproductive, but along the banks of the river Cuggur, from Batnear to the town of Sirsuh, and also in the vicinity of the Nullah, called the Nyewal, the soil is uncommonly rich, and well adapted for cultivation. The inundations of these rivers fertilize their banks, and the subsidence of the waters leaves them to a great distance prepared for plentiful crops of wheat, rice, and barley, amply rewarding the labours of the husbandman.

We are unacquainted with any river of note in this district, excepting the Cuggur, and even this is lost in the sands to the westward. It is, however, in contemplation to construct a canal from Roopur on the Sutlej, communicating with the Cuggur near the town of Putteeala, whence a never-failing supply of water for purposes of irrigation would be available to a considerable portion of the Bhattee territory.

The former capital of the Batties was Batnear, which lies in a situation almost inaccessible to an enemy, for no water is to be procured within twelve miles but what supplies the inhabitants. It was taken, however, in 1398 by Timour, more recently by the military adventurer George Thomas, and finally in 1805, by the rajah of Beykaneer, who still retains authority over it. The principal town is Sirsuh, between which and Bahawulpore a route for commercial purposes has been opened. Numbers of the Batties have emigrated from their native country, to establish themselves in the western parts of the dominions of Oude; and several families of them are to be met with in Rohilcund. They are practised travellers, and well trained to emigration by the laborious journeys undertaken in crossing the great desert to the west of their territories. During the independence of their native rulers, expeditions were frequently made in large parties for the purpose of a predatory incursion on some peaceable country more remote; and these banditti exemplified both skill and determination in attaining their object. Camels previously laden with provisions were despatched to different stations in the desert, which is about 130 miles in breadth, and their loads deposited there. The most intelligent of the party about to follow were then selected as guides, and enforced the most implicit obedience from their companions during the journey, which closed at the frontier of the hostile country, or rather that against which their hostility was directed. The guides by long experience became expert without compass or landmark, and seldom failed to conduct the party to the appointed station where the provisions were deposited, and thence across the remainder of the desert in safety. If accidentally they missed the points of rendezvous, or those where alone their necessities could be relieved, they were exposed to inevitable destruction. The adventurers steered their course by the sun in the day-time, and by the polar star at night; and by similar aids they were enabled to retrace the way they had travelled.

The history of the Batties has attracted the notice of few European authors. They seem to have carried on frequent wars with neighbouring states, and were the most formidable enemies opposed to the rajah of Beykaneer. The latter, however, invaded their territories in the beginning of the present century, and obtained some temporary advantages. He erected a fortress in Batinda, now a possession of the rajah of Putteeala, and this contributed to overawe them for a time, and repressed their incursions into his own dominions; as, independently of the garrison, he stationed a large body of cavalry in the fort, whose frequent sallies and captures of cattle annoyed the Batties so much, that they contemplated a total emigration from their own country. But George Thomas, the military adventurer already noticed, an Irishman by birth, who, endowed with singular talents and intrepidity, had founded for himself an independent state in the north-west of India, was then at war with the province of Beykaneer. Having reached its frontiers, the Batties solicited his alliance, and, to induce him to espouse their cause the more readily, offered him 40,000 rupees if he would reduce the obnoxious fort. It appears that the Beykaneer forces were now masters of Batnear, the capital, whither General Thomas, who had accepted the proposals of the Batties, marched to dislodge them. He found a numerous garrison, and, having brought up his artillery, began to batter the place preparatory to an assault. This, however, the enemy avoided by capitulation, and they were allowed to evacuate the city with the honours of war, when the Batties immediately took possession of it. In further prosecution of the war, several actions ensued, and various fortresses were taken; but it would appear that one of the Battie chiefs, at variance with General Thomas, commenced hostilities against him about the period now alluded to; and in this new warfare with his late allies his forces were so much reduced by repeated encounters, that being scarcely able to stand an engagement he fortified his camps. The Batties, after frequent attacks, withdrew their troops by night; whereupon General Thomas took and burnt Futtehabad and other places, and might have occupied the whole country, had not a neighbouring chief concluded an alliance with the Batties, and sent 1000 cavalry to their aid. General Thomas retreated to Jyjur, a town within his own territory, leaving the Batties in possession of their capital, which, however, as already mentioned, was subsequently captured by the rajah of Beykaneer.

Baton Rouge || Batsch.

The triumphs of the British arms proved fatal to the European adventurers who at that period had established themselves in Northern India, and the arrangements made with Scindia brought the British into contact with the country of the Batties, against whom they were compelled in 1810 to march a force, which expelled the chief and transferred the greater part of the territory to his son, who had voluntarily proceeded to the British camp. The previous evils continued, however, in a great degree to prevail. In 1818 further steps became necessary, and up to a comparatively recent period much irregularity continued to prevail. The attention of the British government, however, has been seriously turned to its abatement. (E. T.)

BATON ROUGE, a town in the state of Louisiana, North America, situated on the left bank of the Mississippi, 120 miles above New Orleans. It has a court-house, jail, state penitentiary, college, &c., and in 1849 was made the capital of the state. Pop. (1850) 4200.

BATON, or *Batoon*. See BASTON.

BATONI, *Pompeo Girolamo*, a native of Lucca, who was considered in Italy as a great painter in the eighteenth century; but his altar-pieces in various parts of Italy, and his works in Lisbon, where some of his best are exhibited, show the decay of the Roman school in that century from the grandeur of the preceding epoch. He was born in 1708, and died at Rome in 1787. Lanzi, *Storia Pittorica;* Reynolds's *Lectures*.

BATRACHIANS. See REPTILES.

BATRACHOMYOMACHIA, or "battle of the frogs and the mice," the title of a mock heroic poem generally ascribed to Homer, though without any good foundation. The subject of the work is the death of Psycharpax a mouse, son of Toxartes, who having mounted on the back of Physignathus a frog, was being conveyed to her palace to which she had invited him; but being seized with fear at seeing himself in the middle of the pond, he tumbled off and was drowned. Physignathus being suspected of having intentionally shaken off Psycharpax, the mice demanded satisfaction, and unanimously declared war against the frogs.

BATSCH, AUGUSTUS JOHN GEORGE CHARLES, a dis-

tinguished naturalist born at Jena in 1761. He was the author of *Elenchus Fungorum*, and numerous other works, chiefly botanical, by which he acquired a high reputation. He died in 1802.

BATTA, a Hindustanee word applied to the allowance given to East Indian troops in the field. In garrison they are allowed *half batta*.

BATTALIA, an army ranged in order of battle, or ready for engagement.

BATTALION, the lowest integral denomination in an army or national military force. Hence two or more battalions constitute a regiment, two or more regiments a brigade, two or more brigades a division, two or more divisions a corps d'armée, and two or more corps d'armée a grand army. A battalion is the unit or integer in all the combinations of an armed force. A battalion usually contains from 500 to 800 men; but the number is not determined. They are divided into eight or more companies, one of which is grenadiers. Some regiments consist of but one battalion, others are divided into four or five. See ARMY.

BATTAS, a fertile and populous country in the island of Sumatra. See SUMATRA.

BATTEL, or *Trial by the Wager of Battle*, in English law, a species of trial of great antiquity, but now abrogated by positive statute. See APPEAL. It seems to have owed its origin to the military genius of our ancestors, joined to a superstitious belief that Heaven would interpose, and give the victory to him who had the right. The decision of suits, by an appeal to the God of battles, is believed by some to have been invented by the Burgundians, one of the northern or German clans who established themselves in Gaul; and it is certain that the earliest written injunction of judiciary combats to be found is in the laws of Gundebal, which are preserved in the Burgundian code. Yet it does not seem to have been merely a local custom peculiar to particular tribes, but the common usage of all those warlike nations from the earliest times. From a passage in Velleius Paterculus, it appears that the Germans, when they first became known to the Romans, were accustomed to decide all contests of right by the sword; for when Quintilius Varus endeavoured to introduce among them the Roman laws and method of trial, it was looked upon, says the historian, as a *novitas incognitæ disciplinæ, ut solita armis decerni jure terminarentur:* and among the ancient Goths in Sweden we find the practice of judicial duels established upon much the same footing as they formerly were in our own country.

This species of trial was introduced into England, along with other Norman customs, by William the Conqueror; but it was only used in three cases; first, in the court martial, or court of chivalry and honour; secondly, in appeals of felony; and thirdly, upon issue joined in a writ of right, the last and most solemn decision of real property. In the two former cases this method of trial may seem natural enough in a military and superstitious age, but the reason or ground of its admission in the last is not so obvious. That usually assigned is the difficulty, in writs of right, of determining the *jus proprietatis;* but another and more plausible pretext for allowing it, in such cases, was for the sake of those claimants who might have the true right, but yet by the death of witnesses or other defect of evidence might be unable to prove it to a jury.

The last trial of battel that was waged in the court of common pleas at Westminster,—though there was afterwards one in the court of chivalry in 1631, and another in the county palatine of Durham in 1638,—took place in the thirteenth year of Queen Elizabeth, A.D. 1571, as reported by Sir James Dyer, and was held in Tothillfields, Westminster, *non sine magna jurisconsultorum perturbatione*, says Sir Henry Spelman, who was himself a witness of the ceremony. In this trial by battel, on a writ of right, the battle was waged by champions, and not by the parties themselves; because in civil actions, if any party to the suit die, the suit must abate, and be at an end for the present; and therefore no judgment could be given for the lands in question if either of the parties were slain. Another reason was, that no person might claim an exemption from this trial, as was allowed in criminal cases. An account of the form and laws of the judicial combat, which are now merely matters of history, may be found in any of the institutional works on English law.

BATTEN, a name given to a plank of wood 7 inches wide, $2\frac{3}{4}$ inches thick, and of length varying from 6 to 50 feet. Battens are now always imported with their length in *even feet;* formerly they were sent cut of all lengths as the tree would allow. When the batten is under 6 feet in length it is styled a *batten end*, but its other dimensions are the same as that of the batten.

BATTERING, the attacking with heavy artillery a fortification or strong post possessed by an enemy, in order to demolish the works.

BATTERING-RAM (*Aries*), a military engine used before the invention of gunpowder, for beating down the walls of besieged fortresses. Generally speaking, it consisted of a long heavy beam of timber, armed at the extremity with iron fashioned something like the head of a ram, which being violently propelled with constant successive blows against a rampart or tower, shook the fabric of masonry, and in time caused it to tumble down.

In its simplest form it consisted of a beam such as we have described, which the soldiers carried in their arms, and with one end of which they assailed the walls by main force. The improved ram was composed of a vast beam, like the mast of a ship, shod with iron at one end, and suspended either by the middle, or from two points, from another beam laid across two posts; and hanging thus equally balanced, it was successively drawn backwards and driven forwards with accumulated momentum against the wall or rampart. This is the kind described by Josephus as having been used at the siege of Jerusalem (*B. J.* iii. 7. § 19). It was also covered over with a roof, shell, or screen of boards, to protect the men employed in working it from the stones, darts, and other missiles discharged by the besieged from the walls; whence it was called *testudo arietaria*. It was also provided with wheels, which greatly facilitated its operations. (Vitruv. x. 19.)

Plutarch informs us that, in the Parthian war, Mark Antony made use of a ram 80 feet in length; and Vitruvius states that this engine was sometimes 106, sometimes even 120 feet in length; a circumstance to which we are to ascribe its prodigious force when vigorously worked. The battering-ram required a century of soldiers at a time to manage it; and as the working parties were regularly relieved as they became exhausted, it was kept in continual action, and from incessant iteration produced the most extraordinary effects. In fact, the momentum of a battering-ram 180 feet in length, 28 inches in diameter, armed with a head of iron weighing a ton and a-half, and moved by the united strength of a hundred men, must have been equal to the momentum of a thirty-six pound shot discharged point blank from a modern piece of heavy ordnance; and hence it is not difficult to conceive how effective the constant reiteration of such impulses would become in the work of demolition.

BATTERY, in the military art, any place where cannon or mortars are mounted, either to attack the forces of the enemy or to batter a fortification. Hence batteries have various names, according to the purposes which they are designed to effect.

Gun-Battery is a defence constructed of earth faced with green sods or fascines, sometimes of gabions filled with earth. It consists of a breastwork, epaulement, or parapet, about 8

Battery. feet in height, and 18 or 20 feet in thickness, with a ditch 12 feet broad at the bottom, 18 at the top, and 7 feet in depth. The open spaces through which the muzzles of the cannon are pointed are called *embrasures*, and the solid masses between the embrasures, *merlons*. The distance from the centre of one embrasure to that of another is 18 feet, and this is also the distance at which the guns are placed from each other; consequently the merlons are 16 feet within and 7 without. The *genouillères*, or those parts of the parapet which cover the carriage of the gun, are generally made 2½ feet in height from the platform to the opening of the embrasures; but this height must be regulated by the semi-diameter of the wheels of the carriage and the nature of the gun. The platforms are plank floors made to prevent the cannon from sinking into the ground, and they are generally 18 feet in length, 15 feet in breadth behind, and 9 feet before, with a rise of 9 or 10 inches from the parapet to check the recoil of the guns, and to render it more easy to bring them forward again when loaded.

Mortar-Batteries differ from gun-batteries in this, that the parapets have no embrasures, and the platforms have no slope, but are exactly horizontal; the shells being fired quite over the parapet, commonly at an elevation of 45°.

Open Battery is a number of cannon, commonly field-pieces, ranged in a row abreast on some natural elevation of ground, or on an artificial bank raised for the purpose.

Covered or *Masked Battery* is when the cannon and gunners are covered by a bank or breastwork, commonly made of brushwood, faggots, and earth.

Sunk or *Buried Battery* is when the platform is sunk or let down into the ground, so that trenches must be cut in the earth opposite the muzzles of the guns, to serve as embrasures to fire through.

Cross-Batteries are two batteries which play athwart each other upon the same object, forming there an angle, and battering with more effect, because what one battery shakes the other beats down.

Battery d'Enfilade is one that sweeps the whole length of a straight line, or the face or flank of any work.

Battery en Echarpe is that which plays obliquely.

Battery de Reverse is one which plays upon the rear of the troops appointed to defend a place.

Camerade Battery is when several guns are discharged upon one point at the same instant.

Redan Batteries are such as flank each other at the salient and re-entrant angles of a fortification.

Ricochet Battery, so called by its inventor Vauban, was first used at the siege of Aeth in 1697. It is a method of discharging cannon with a very small charge of powder, and with just elevation enough to fire over the parapet. When properly managed, its effects are most destructive; for the shot, rolling along the opposite rampart, dismounts the cannon and disperses or destroys the troops. Ricochet practice is not confined to cannon alone; small mortars and howitzers may be effectually employed for the same purpose.

Floating Batteries are such as are erected either on rafts or on the hulls of ships.

Fascine and *Gabion Batteries* are batteries constructed of those machines where sods are scarce, and the earth very loose or sandy. See ARTILLERY.

BATTERY, in *Law*, is the unlawful beating of another. The least touching of another's person wilfully, or in anger, is a battery, for the law cannot draw the line between different degrees of violence, and therefore totally prohibits the first and lowest stage of it; every man's person being sacred, and no other having a right to meddle with it, in any the slightest manner. Upon a similar principle, the Cornelian law *de injuriis* prohibited *pulsation* as well as *verberation*; distinguishing verberation, which was accompanied with pain, from pulsation, which was attended with none. But battery is in some cases justifiable or lawful; Batticaloa || Battle. as where one having authority, a parent or master, bestows moderate correction on his child, his scholar, or his apprentice. It is justifiable on the principle of self-defence; for if one man strike another, or only assault him, the latter may strike in his own defence, and if sued for it, may plead that it was the plaintiff's own original assault which occasioned it. It is likewise justifiable in defence of goods or possession, and in the exercise of an office, as that of church-warden or beadle; but the person pleading such justification in a civil suit, or in a criminal prosecution, must be prepared to instruct that he has observed the *moderamen inculpatæ tutelæ*. By reason of these and other grounds of justification, battery is defined the *unlawful* beating of another; and the remedy is, as for assault, by action of trespass or damages, in which the jury will or ought to give adequate compensation.

BATTICALOA an island within an extensive lagune on the east coast of Ceylon, in Lat. 7.44. N. Long. 81. 52. E. It is of importance on account of the adjacent salt works. The territory of the same name contains a population of 30,000.

BATTIE, or BATTY. See BATNEARS.

BATTLE, a market-town in the rape of Hastings and county of Sussex, 56 miles from London. It is situated in a valley, and consists of one street. This was the scene of the conflict in 1066 which insured to William the Norman the crown of England. The abbey founded by him forms a most magnificent pile of ruins, and the ancient gatehouse is still in good preservation. The place is now celebrated for its gunpowder manufactories. Much business is done at its weekly and monthly fairs. Pop. in 1851, 3849.

BATTLE, an action or engagement between the forces of two armies. A battle is either general or partial; general, where the whole, or the greater part, of each army is brought into action; and partial, where only brigades, divisions, or corps d'armée are engaged. But, however the numbers may vary, the great principles to be applied in delivering battle are in almost every case the same.

It has indeed been said, by a high military authority, that there is nothing invariable in the art of combats; and looking to the endless diversity of circumstances under which battles have been fought, as well as to the apparent results, which are often at variance with the profoundest calculations of science, the observation would seem to have some foundation in truth. But a closer examination will be sufficient to convince us that this is not the case, and that the maxim in question, like many others which pass current in the world, involves a fallacy equally glaring and dangerous. It is no doubt true that, in the circumstances under which battles are fought, there is nothing invariable; on the contrary, it is scarcely possible to suppose two cases, we do not say alike in every particular, but resembling each other even in their great or leading features. From the very nature of things, the data of the problem are variable; but the grand principles by which the solution is to be evolved continue immutably the same. The elements which enter into the calculations of a general are constantly changing; and it is this circumstance which affords scope for the exercise of his genius, his sagacity, and his military science. But it would be manifestly absurd to maintain, that because the conditions are incessantly diversified, the principles of the art experience equal mutations. The issue of battle is always uncertain; because the calculations of the general may be defective, his combinations unscientific, his foresight limited, or his temperament rash and impetuous; and because, even where none of these causes of failure exist, events which no human sagacity could have divined may occur to defeat the wisest plans and the ablest dispositions. But all this implies, that if everything could have been foreseen and provided for, the result would not have been doubtful; and that

Battle. the "grand chances" are always on the side of him who forms his plan with the greatest sagacity, and executes it with corresponding vigour and ability. For, variable as the results of battles appear, the most decisive success has generally crowned the exertions of the greatest commanders; and victory in the long-run has seldom failed to pay homage to science. There is nothing, therefore, invariable in the art of combats, except those principles which science has established as, *mutatis mutandis*, universally applicable.

A battle is not only the most imposing, but also the most important event in war. It is the consummation to which all the previous combinations of commanders necessarily tend; it is that grand act of war which may decide the fate of kingdoms and empires, as well as that of armies and campaigns. The highest and dearest interests of nations, nay even of humanity itself, may be involved in its issue; and the mighty cause of civilization may be accelerated or retarded according as the scales of the battle turn. It cannot, therefore, we should think, be uninteresting or uninstructive, if we endeavour, by recurring to the works of the great masters, to exhibit a condensed digest of those general principles, by the skilful application of which the fate of battles, in all ages, has more or less been determined.

All the combinations of a battle may be reduced to three systems. The first, which is purely defensive, consists in waiting for the enemy in a strong position, without any other object than that of maintaining it against him. Such were the dispositions of Marshal Daun at Torgau, and of the Comte de Marsin in the lines at Turin; dispositions, we may add, which proved wholly unavailing against Frederick and Eugene, and forcibly exemplify the danger of receiving an attack even in the strongest position. The second system, on the other hand, is entirely offensive. It consists in attacking the enemy wherever he can be found, as Frederick did at Leuthen and at Torgau, Buonaparte at Jena and at Ratisbon, and the allied armies at Leipsic. The third system is in some sort a mean term between the first and second. It consists in choosing a field of battle possessing certain advantages both in a strategical and tactical point of view, in order to wait there for the enemy, and, even in the day of battle, to watch the favourable moment for assuming the initiative, and falling upon the adversary with every chance of success. The combinations of Buonaparte at Rivoli and at Austerlitz, and those of Wellington at Waterloo, as well as in the greater part of his defensive battles during the Peninsular war, are examples of the mixed system, and must therefore be classed under this head.

It would be difficult, not to say impossible, to lay down any fixed rules for determining when either of these last two systems, which are the only suitable ones, ought to be employed. Regard must be had to the moral condition of the troops of each party; to the national character, considered as more or less solid or impetuous; and, lastly, to the obstacles presented by the ground. These are circumstances which must always influence the decision of a general; but allowing sufficient latitude for such considerations, the following principles will nevertheless be found generally applicable: 1*st*, That with veteran troops, and in an open country, the absolute offensive or initiative of attack is always most advantageous; 2*dly*, That in ground which, by reason of its physical conformation or other causes, is of difficult access, the better course is to allow the enemy to arrive in a position which has been previously reconnoitred, and to assume the initiative as soon as his troops shall have been exhausted by their first efforts; 3*dly*, That the strategical situation of the two parties may nevertheless sometimes require that the positions of an adversary be attacked by main force, without regard to any local consideration whatever; as, for example, when it is necessary to prevent the junction of two hostile armies, or to fall upon a portion of an army detached, or upon a corps isolated beyond a river. In these and in all similar cases a skilful general will direct an immediate and combined attack, without concerning himself about any consideration extrinsic to the main object of overwhelming the body opposed to him before it can be reinforced. Battle-Axe.

Orders of battle, or the dispositions best suited for conducting troops to the combat, ought to have for their object to insure at once mobility and solidity; and hence they ought neither to be too extended nor too profound. An attenuated order is weak: and troops crowded together in too dense an order are paralyzed; for as the head of the mass only is engaged, disorder is easily introduced, and the enemy's artillery causes frightful ravages. To avoid this double evil, and to fulfil both the conditions of a good order of battle, troops which remain upon the defensive should be partly deployed and partly in columns of battalions, like the Russian army under Beningsen at the battle of Eylau. But troops disposed for the attack of a decisive point ought to be drawn up in two lines of battalions, each of which, instead of being deployed, should be formed in columns by divisions. This order presents infinitely more solidity than a deployed line, the fluctuations of which deprive it of the impulsion necessary for such an attack, and render it impossible for the officers to exercise the necessary control over the troops. Nevertheless, in order to facilitate the march, to avoid too great depth in the mass, and to extend the front without materially lessening the consistence of an army, it may be advantageous to draw up the infantry in two ranks. The battalions will thus possess greater mobility; and, besides, they will have all the force desirable, since the three divisions deployed will possess six ranks in depth, which is more than sufficient; while the extended front will increase in a corresponding ratio the effect of the musketry. In grounds of difficult access, as vineyards, inclosures, gardens, and wooded heights, the defensive order of battle should be composed of battalions deployed, covered by numerous platoons of sharpshooters. But the troops destined for the attack, as well as the reserve, may be advantageously disposed in columns of attack by the centre. The reserve, however, may be kept in part deployed until the moment of advance, in order, by its apparent extent, to impose on the enemy. In a defensive battle upon open ground, squares of battalions may be substituted for columns, by doubling the lines of two ranks so as to form four deep; and each battalion will thus present a sufficient mass, with a front varying from forty to fifty files. This order, which was that employed by the Duke of Wellington at Waterloo, appears advantageous when there is reason to apprehend attacks of cavalry; for it affords at once safety to the infantry, and protection to the cannoneers and train of artillery. But as it has both less mobility and less impulsion than that in columns of attack, the latter has been judged preferable; because, with well-disciplined troops, squares may be easily formed in each battalion by a simple conversion to the right and left of the division of the centre. The Duke of Wellington, it is true, commonly fought deployed; but, to say nothing of the incomparable military qualities of his troops, his lines were generally formed four deep; so that, after all, the exception is more apparent than real.

See Jomini, *Traité des Grandes Opérations Militaires;* Archduke Charles, *Der Strategie;* Rogniat, *Considérations sur l'Art de la Guerre;* Guibert, *Essai Général de Tactique;* Bulow's *Principles of War*, translated by Malortie. (J. B—E.)

Battle-Axe, an ancient military weapon. Axes formed a principal part of the offensive arms of the Celtæ. At the siege of the Capitol by the Gauls under Brennus, one of the most distinguished of their warriors was armed with a battle-axe; and Ammianus Marcellinus, many centuries afterwards, describing a body of Gauls, states that all of them were armed with battle-axes and swords. Some of these

Battlement || Baudius.

weapons have been found in the sepulchres of the ancient Britons on the downs of Wiltshire and in the north of Scotland. Four or five centuries ago the Irish went constantly armed with axes. On the morning of the battle of Bannockburn, King Robert the Bruce cleft an English warrior to the chin with one blow of his battle-axe. The Lochaber axe remained long a formidable weapon in the hands of the Scottish Highlanders; and it was the principal weapon of the City Guard of Edinburgh till the year 1817, when that body was abolished.

BATTLEMENT. See ARCHITECTURE, *Glossary*.

BATTORY, a name given by the Hans Towns to their magazines or factories abroad.

BATTU, an island lying off the western coast of Sumatra, 40 miles in length by 10 in average breadth, and entirely covered with wood. It is almost immediately under the equinoctial line. Its exports are cocoa-nuts, oil, and sea-slugs.

BATTUE, a French word in common use among sportsmen to denote the practice of beating the bushes in order to start the game, or to drive it within circumscribed limits.

BATUM, a seaport town of Asiatic Turkey, in the pashalic of Trebizonde, and 110 miles N.E. of the town of that name. It is situated on the Black Sea, at the mouth of the river Tchorak. Its harbour is safe and commodious. A British vice-consul resides there. Pop. about 3000.

BAUCIS and PHILEMON, in *Fabulous History*, an aged couple who dwelt in a cottage in Phrygia. Jupiter and Mercury, disguised as mortals, were well received by this venerable pair, after having been refused entertainment by every body else. To punish the people for their inhumanity, they laid the country under water, but removed Baucis and Philemon to the top of a mountain, where they saw the deluge, and their own little hut above the waters changed into a temple. Here the grateful gods promised to confer on their entertainers whatever boon they might solicit. They expressed a desire to officiate in this temple as priest and priestess, and to die at the same moment; both of which requests were granted. Ovid, *Met.* viii.

BAUDELOCQUE, JEAN-LOUIS, an eminent French surgeon and accoucheur, appointed by Napoleon to attend the Empress Maria-Louisa in the latter capacity. He was the author of *L'Art des Accouchements*, and numerous other works on the diseases of women and children. He died in 1810, aged sixty-four.

BAUDELOT DE DAIRVAL, CHARLES-CÉSAR, a learned advocate in the parliament of Paris, distinguished by his skill in ancient monuments. He wrote a *Treatise on the Advantages of Travelling; Letters and Dissertations on Medals*, &c. He was admitted into the *Academie des Inscriptions* in 1705, and died in 1722, aged seventy-four.

BAUDIER, MICHEL, a gentleman of Languedoc, who lived in the reign of Louis XIII., and published several copious and laborious historical works. Among these were, *An Inventory of the General History of the Turks; History of the Seraglio and Court of the Sultan; History of the Religion of the Turks; History of the Court of the King of China; The Life of Cardinal Ximenes*, &c. The latter is considered the most valuable of his works. He died in 1645.

BAUDIUS, DOMINICUS, professor of history in the university of Leyden, was born at Lisle in 1561. He studied at Aix-la-Chapelle, at Leyden, and at Geneva, and was admitted doctor of law in 1585. Soon after he accompanied the ambassadors from the states to England, where he became acquainted with several persons of distinction, particularly the famous Sir Philip Sidney. He was admitted advocate at the Hague in January 1587; but becoming weary of the bar, he went to travel in France, where he remained ten years. In 1592, Achilles de Harlai, first president of the parliament of Paris, obtained for him the appointment of advocate of the parliament of Paris. In 1602 he went to England with Christopher de Harlai, the president's son, who was sent as ambassador to England by Henry the Great. In the course of the same year he was made professor of eloquence at Leyden, and settled in that university. In 1611 the states conferred upon him the office of historiographer in conjunction with Meursius; and in consequence of this appointment he wrote *The History of the Truce*. The disgrace he brought on himself by his irregular life is said to have hastened his end. He died at Leyden in 1613. As a Latin writer, both in prose and verse, Baudius was excelled by few of his contemporaries.

Baugé || Bauhin.

BAUGÉ, an arrondissement, department of Maine and Loire, in France, comprehending six cantons and sixty-six communes. Area 543 square miles; pop. 79,713. The chief place of the same name is situated on the river Couanon; pop. in 1851, 3147, principally employed in making serges and other woollen goods.

BAUGE, a drugget manufactured in Burgundy of thick spun thread and coarse wool.

BAUHIN, JEAN, a distinguished botanist, born at Basle, in 1541. He was the son of an eminent physician, who quitted France, his native country, on account of religion, and settled at Basle. In early life he travelled with Gesner, the celebrated naturalist, and collected plants in the Alps, in France, and in Italy, for the great botanical work which he afterwards accomplished. He first practised medicine at Basle, where he was elected professor of rhetoric in 1566. He then resided for some time at Yverdun; and in 1570 was invited to be physician to the Duke of Wirtemberg at Montbelliard; a situation in which he spent the remainder of his life. He devoted his time chiefly to botany, on which he bestowed great labour. He likewise prosecuted other branches of natural history, and published an account of *Medicinal Waters throughout Europe*. His great work on plants was not completed at his death, which happened in 1613. A society at Yverdun published in 1619 the *Prodromus;* but it was not till 1650 and 1651 that the work itself appeared, in three vols. folio, entitled *Historia Plantarum nova et absolutissima, cum Auctorum consensu et dissensu circa eas*. This performance, with all its defects, has been pronounced by Haller to be without an equal. It is still considered a standard work; and the names of John Bauhin and his brother rank high among the founders and first promoters of botanical science.

BAUHIN, *Gaspard*, brother of the former, was born at Basle in 1560. He was early devoted to physic, and pursued his studies at Padua, Montpellier, and some of the celebrated schools in Germany. In his journeys he collected a number of plants which had escaped his brother's notice. Returning to Basle in 1580, he was admitted to the degree of doctor, and gave private lectures in botany and anatomy. In 1582 he was appointed to the Greek professorship in that university, and in 1588 to the chair of anatomy and botany. He was afterwards made city physician, professor of the practice of medicine, rector of the university, and dean of his faculty. Haller gives him the character of being assiduous and laborious in collecting plants, by which means he surpassed his brother in the number of them, as he also did in the accuracy of his figures; but he possessed less acuteness of judgment in distinguishing varieties, and in detecting the same species under different names. He published several works relative to botany, of which the most valuable is his *Pinax Theatri Botanici, seu index in Theophrasti, Dioscoridis, Plinii, et botanicorum qui a seculo scripserunt opera, plantarum fere sex millium nomina, cum synonymiis et differentiis. Opus XIV. annorum*, 4to. The confusion that began to arise at this time from the number of botanical writers who described the same plant under different names, rendered such a task as this highly necessary; and though there are many defects in the execution, the *Pinax* of Bauhin is still a useful key to all the writers before his time. An-

Baumans Höhle. || Baumé.

other great work which he planned was a *Theatrum Botanicum*, meant to be comprised in twelve parts folio, of which he finished three; only one however was published. He also gave a very copious catalogue of the plants growing in the environs of Basle; and edited the works of Matthiolus with considerable additions. He likewise wrote on anatomy: his principal work on this subject is *Theatrum Anatomicum infinitis locis auctum*, 4to, Frankf. 1621; which is a kind of *pinax* of anatomical facts and opinions. He died in 1624.

BAUMANS HÖHLE, a celebrated series of natural caverns, described and figured by Leibnitz in his *Protogæa*. They obtained this name from an unfortunate miner who, in 1670, ventured to explore the cave, and being there lost for three days and nights, died of exhaustion soon after escaping from its recesses. The cave is in a bed of limestone of transition, about two miles from the town of Elbingrade, and 18 from Goslar. The entrance is 15 feet wide, and 5 feet high; and leads by a rapid descent to a grand chamber, between 40 and 50 feet in diameter, and from 10 to 20 feet in height. From the roof depend stalactites; and the floors of the cavern have been all covered with stalagmite, much broken up in the search for the fossil bones that abound there. The bones, like those in other German caves, are those of the fossil elephant, rhinoceros, bear, hyæna, &c., imbedded in mud and sand mixed with water-worn pebbles. This detritus incloses the antediluvian bones, but the human bones found in this and other similar caves have evidently a more recent origin, being the remains of persons who have accidentally perished there. (Leibnitz, *Protogæa;* Buckland's *Reliquiæ Diluvianæ.*) (T. S. T.)

BAUMÉ, ANTOINE, a Parisian apothecary, distinguished by his knowledge of chemistry, and by his practical application of that knowledge, was born at Senlis in 1728. He was the son of an innkeeper, and was put as apprentice to the eminent chemist Geoffroy. He had to contend with the disadvantages of a defective education; yet he nevertheless prosecuted his scientific researches with great success. In 1752 he was admitted a member of the College of Pharmacy; soon after he was appointed professor of chemistry at that establishment; and in his lectures he displayed the excellent arrangement which is seen in his published works. He carried to a great extent his commercial establishment in Paris for the preparation of drugs for medicine and the arts, such as the acetate of lead, the muriate of tin, mercurial salts, and antimonial preparations. At the same time he published a number of papers on chemical science, and on arts and manufactures. He established the first manufactory of sal-ammoniac in France, a substance which before that time had been obtained from Egypt. He was the first also who devised and set on foot a process for bleaching raw silk. Having acquired a competency by the success of these different undertakings, he retired from trade, and devoted his time to the application of chemistry to the arts. He improved the process for dyeing scarlet at the manufactory of the Gobelins, and published a cheap process for purifying saltpetre. By the revolution he lost his fortune, but this calamity, instead of disheartening him, stimulated him to resume his trade. He was chosen a correspondent of the Institute in 1796, and died in 1804, at the age of seventy-six. He was temperate, active, and regular in his habits. Many of his papers are published in the *Memoirs of the Academy of Sciences*. Of his separate publications, the following may be mentioned here: *Dissertation sur l'Ether*, in 12mo; *Plan d'un Cours de Chimie Expérimentale*, 1757, in 12mo; *Opuscules de Chimie*, 1798, in 8vo; *Elémens de Pharmacie Théorique et Pratique*, 2 vols. 8vo; *Chimie Expérimentale et Raisonnee*, 3 vols. 8vo, 1773.

Baumgarten || Bautzen.

BAUMGARTEN, ALEXANDER GOTTLIEB, an eminent German philosopher, born at Berlin in 1714. He pursued his studies at Halle, and afterwards became professor of philosophy at Frankfort on the Oder; in which city he died in the year 1762. He was a disciple of Leibnitz and Wolf, and was particularly distinguished for his æsthetical speculations, having been the first to develop and establish the *Theory of the Beautiful* as an independent science. Baumgarten, however, cannot properly be regarded as the founder of æsthetics. Plato, in the Phædrus and the Hippias, had already made the Beautiful the object of a special analysis, and though confounding the two qualities of *goodness* and *beauty*, the profoundness of his speculations has thrown into the shade Baumgarten and all the other followers of Wolf who have pursued the same subject. The very name (*Æsthetics*) by which Baumgarten distinguished the science of the Beautiful, though now very generally adopted for the sake of convenience, indicates the imperfect and partial nature of his analysis, pointing as it does to an element so variable as *feeling* or *sensation* as the ultimate ground of judgment in questions pertaining to beauty. Yet the labours of Baumgarten will only be contemned by those who deny the possibility of a science of æsthetics. The principal works of Baumgarten are the following: *Disputationes de nonnullis ad poema pertinentibus; Æsthetica; Metaphysica; Ethica philosophica; Initia philosophiæ practicæ primæ.*

BAUR, JOHANN WILHELM, an eminent Flemish painter, and a disciple of Brendel. He spent some time at Rome, where his studies were wholly devoted to architecture and landscapes. He painted small figures in distemper on vellum, and etched with great spirit. His largest works are historical. He was born at Strasburg in 1600, and died at Vienna in 1640.

BAUTZEN, or BUDISSIN, one of the four provinces into which the kingdom of Saxony is divided, comprehends the greater part of Upper Lausatia, the rest of which, together with Lower Lausatia, was ceded to Prussia in 1815. It has an area of 970 square miles, and is divided into the districts of Bautzen, Camenz, Löbau, and Stolpen; containing 14 cities, 658 villages and hamlets: pop. in 1851, 290,589. See SAXONY.

BAUTZEN, the capital of the above province, occupies an eminence on the right bank of the Spree, 680 feet above the level of the sea, and 32 E.N.E. from Dresden. The town is well built, and has extensive suburbs partly lying on the left bank of the river. It has a cathedral, which is used by both Protestants and Roman Catholics; five other churches, a handsome town-house, an orphan-asylum, several hospitals, mechanics' institute, gymnasium, a normal and several other schools, and two public libraries. Its general trade and manufactures are considerable, including linen, cotton, and woollen goods, tobacco, leather, paper, gunpowder, &c. Pop. (1849) 10,518. The battle of Bautzen was fought here on the 21st and 22d of May 1813, between the French under Napoleon and the allied forces of Russia and Prussia; in which, after a severe loss on both sides, the latter were defeated. Lat. 51. 11. 10. N. Long. 14. 25. 50. E.

BAVARIA,

Bavaria. A COUNTRY in southern Germany, in former times a margraviate and duchy, afterwards an electorate, and, since 1806, a kingdom of considerable extent. It is situated between the forty-seventh and fifty-first degrees of N. Lat. and is of an oblong form, its greatest extent being from N. to S. Its breadth is different in different parts, but we may form a tolerably correct idea of the whole by supposing a rectangular tract of country, of 200 miles in length by 140 in breadth. Such a tract would contain a surface equal to the Bavarian territory, exclusive of the distant province on the Rhine; including that province, however, the extent of the kingdom is nearly 30,000 square miles, or somewhat greater than that of Scotland.

Extent.

History. The name in German, Baiern, is derived, like its old Latin name Boiaria, from Boii, the name of a people of Celtic origin, who were the inhabitants of this country in the reign of Augustus. It then formed part of the Rhætia Vindelicia and Noricum of the Romans. After the fall of the Roman power, the natives were governed by military chieftains of their own till the era of Charlemagne, who succeeded in subjugating this as well as most other parts of Germany. After his death, Bavaria was governed by one of his grandsons, whose successors bore the title of Margrave, or Lord of the Marches. In the year 920 the ruling margrave was raised to the rank of duke, which continued the title of his successors for no less than seven centuries. During this long period Bavaria was connected with Germany, nationally by language, and politically as a frontier province, but in civilization was almost as backward as Austria, and greatly behind Saxony, Franconia, and the banks of the Rhine. At last, in 1620, a formidable insurrection taking place in Bohemia against Austria, the reigning Duke of Bavaria sided with the latter, and having rendered great service to her cause, received an important accession of territory, and was appointed one of the nine electors of the empire. His successors continued faithful members of the Germanic body and allies of Austria until the ambitious projects of Louis XIV. of France led, in the year 1702, to a close connection between that monarch and the elector; the object of which was to threaten and even attack Austria, so as to prevent her from co-operating efficiently with England and Holland in their great contest with France. This hostile attitude of Bavaria, joined to the insurrectionary movements in Hungary, bore so hard on the emperor as to induce the Duke of Marlborough, in the spring of 1704, to march his army above 300 miles from the banks of the Maese to those of the Danube and Iser. Bavaria was now invaded, and the elector put under the ban of the empire; but he remained firm to his alliance with Louis, and a French army under Marshal Tallard advanced from the Rhine to his relief. It was over this army, joined to a strong Bavarian force, that Marlborough and Prince Eugene obtained the signal victory of Blenheim, on the 13th August 1704. The result was decisive of the fate of the electorate; the French fled to the Rhine; the elector fled with them, and Bavaria was governed by commissioners appointed by the emperor. This state of things lasted ten years; the elector and his remaining military force serving in the French armies, until the peace of Utrecht, or more properly that of Baden, in 1714, reinstated him in his dominions.

The son and successor of this elector, untaught by the disasters of his father, was induced to renew his connection with France; and, in 1740, on the death of the Emperor of Germany, he ventured to come forward as a candidate for the imperial crown. In this he succeeded so far as to be named to that high dignity by a majority of the electors, and to overrun a considerable part of the Austrian territory; but his triumph was of short duration, for the armies of Maria Theresa, aided by English subsidies, came forward in superior numbers, and not only repulsed the Bavarians, but obtained, in 1744, possession of the electorate. The elector died soon after, and his son recovered his dominions only by renouncing the ambitious pretensions of his father.

Bavaria. Bavaria.

Bavaria now remained tranquil above thirty years, until 1778, when, by the death of the reigning elector, the younger line of the house of Wittelsbach, the line which had long ruled in Bavaria, became extinct. The next heir was the Elector Palatine, the representative of the elder line of the family of Wittelsbach; but Austria unexpectedly laid claim to the succession, and took military possession of part of the country. This called into the field, on the side of Bavaria, Frederic II. of Prussia, then advanced in years. The armies on each side were formidable and well commanded; they made many threatening marches and countermarches, but happily no bloodshed took place; and at last Austria desisted from her pretensions, on obtaining from Bavaria the cession of the frontier district called the Innviertel, or Quarter of the Inn.

Bavaria again remained at peace for many years, until the great contest between Germany and France began in 1793, when she was obliged to furnish her contingent as a member of the empire. During three years her territory was untouched, the operations being carried on in the Netherlands and on the Rhine; but in the summer of 1796, a powerful French army under Moreau advancing and occupying her capital, the consequence was a separate treaty with France, and the withdrawal of her contingent from the army of the empire. The next war between France and Austria, begun in 1799, was comparatively short; but ending disastrously for the latter, the influence of France in the empire was greatly strengthened, so that, in 1805, when the Austrians, subsidized by England, once more took up arms, Bavaria was the firm ally of France, and for the first time found advantage in the connection. In the short space of three months, the victories of Ulm and Austerlitz enabled Buonaparte to prescribe the conditions of peace, and to confer on his electoral ally the title of king, along with very considerable additions of territory.

These substantial acquisitions rendered Bavaria the willing assistant of France in the invasion of Prussia in the subsequent autumn. The battle of Jena took place, and a further increase of territory to Bavaria followed at the peace of Tilsit. The consequence was, that in 1809, when the absence in Spain of a great part of the French military force encouraged Austria again to try the hazard of war, the Bavarian troops were wholly at the disposal of Buonaparte, and formed a main part of the great army with which he defeated the Austrians at Eckmuhl and Wagram. The peace that ensued gave a further aggrandizement to Bavaria; but a few years more showed how dearly it was purchased, when many thousands of her best troops perished in the disastrous retreat from Russia. This sacrifice of lives, and the horror of Buonaparte's tyranny, excited in Bavaria, as in the rest of Germany, an ardent wish to throw off his yoke. Nor was opportunity long wanting. In the following year (1813) the allied sovereigns advanced into Saxony, and gave assurance to the king of Bavaria, that, in the event of his co-operating vigorously with them against France, he should be maintained in all his late acquisitions. The king received these assurances with satisfaction, but could not in prudence join the allies for some months; at the end of which the retreat of the French from Dresden, and the probability of their falling back to the Rhine, induced him to make an open declaration of hostility against his former allies,

Bavaria. and to march an army to Hanau, on the Maine, the line of their expected retreat. At Hanau, accordingly, in the latter days of October, several obstinate conflicts took place between the Bavarians and the French; and although the latter forced their way, it was with considerable loss. From that time forward Bavaria took a decided part against Buonaparte, and was confirmed in her extended territory by the definitive treaties of 1814 and 1815. She ceded to Austria her ancient possession of the Tyrol, but received equivalents in Franconia and the vicinity of the Rhine.

The duchy of Bavaria, or the country which was subject to the dukes during the middle ages, and before they were raised to the rank of electors, was the southern half of the present kingdom, and lay almost all to the south of the Danube. This is the Bavaria of our old maps, nearly square in its form, extending about 100 miles from the Danube to the Tyrol, and somewhat more from Suabia on the west to Austria on the east. To this limited territory an important addition was made after 1620, at the expense of the Elector Palatine, who having taken an active part in the great insurrection in Bohemia against Austria, forfeited both his title and his dominions to the Duke of Bavaria. His dominions consisted of what was called the Upper Palatinate, a province of full 3000 square miles, situated to the north of the Danube. This country, joined to the duchy of Bavaria, constituted during a century and a half (from 1623 to 1778) the dominions of the elector; their territorial extent being about 15,000 square miles; and their population, in the beginning of that period, less than 1,000,000, but towards its close about 1,500,000.

In 1778 the succession of the Rhenish branch of the reigning family added to the former territory of Bavaria the palatinate of the Rhine, a district of no great extent, but fertile and populous. By this time the nation, hitherto illiterate and backward, became fit for improved institutions, and was fortunate in the character of two successive rulers. She was thus increasing gradually her productive industry and political weight, when, in 1806, her progress received a sudden impulse from political causes. Buonaparte had long laboured to weaken the ascendancy of the greater over the lesser states of the empire; and in 1806 the overthrow, first of Austria, and afterwards of Prussia, enabled him to make a very large addition to the territory of his German allies, above all of Bavaria. This was obtained chiefly in Franconia, a country which, being contiguous to Bavaria, and similar to it in soil and climate, is, in general, more advanced both in agriculture and manufactures. The valuable districts of the Lower Maine and the Rezat, with part of those of the Upper Maine and Upper Danube, were all obtained on this occasion; not to mention the Tyrol, which was afterwards restored to Austria.

Present Divisions of the Kingdom, with their Areas and Populations in December 1852.

Old Circles.	New Circles.	Area in English square miles.	Families.	Males.	Females.	Total.
Iser	Up. Bavaria	6,595	158,059	369,409	365,422	734,831
Lower Danube	Lower Bavaria	4,124	114,347	270,082	279,514	549,596
Rhine	Palatinate	2,243	126,812	303,398	308,078	611,476
Regen	Up. Palatinate	3,700	107,241	223,951	244,528	468,479
Upper Maine	Up. Franconia	2,699	122,506	242,215	257,494	499,709
Rezat	Mid. Franconia	2,919	117,599	257,243	276,587	533,830
Lower Maine	Low. Franconia	3,593	117,614	293,138	302,610	595,748
Upper Danube	Suabia	3,687	132,169	274,656	291,127	565,783
	Total	29,560	996,347	2,234,092	2,325,360	4,559,152

Bavaria. The dense population of the circles of the Rezat and Lower Maine clearly shows the value of the territory acquired in Franconia; while the comparative thinness of inhabitants in the departments of the Regen and Iser proves the inferior soil of the Upper Palatinate, and of the southern or mountainous part of Bavaria. Similar conclusions are suggested by the following sketch of the respective proportions of the soil which lie waste or are in a state of cultivation. It must, however, be considered as only an approximation to the different proportions of land in the kingdom.

Proportions of 100.

Circles.	In Tillage and Pasture.	Forest Land.	Waste.
Rezat	70	22	8
Upper Maine	60	29	11
Lower Maine	58	32	10
Rhine	57	36	7
Lower Danube	50	29	21
Upper Danube	50	25	25
Regen	47	30	23
Iser	35	31	34
Average of the kingdom	53	29	18

Forests. The extent of forest land in Bavaria is double that of the forest land of France, and more than six times that of the land under wood in Great Britain. This is owing to various causes; the great extent of hilly and mountainous country, the insufficient population, and the necessity of keeping a given extent of ground in wood for a supply of fuel. There are, besides, many spots and even districts in the forest lands which are under cultivation for flax, corn, and potatoes. The forests are partly public, partly private property. The gross annual value of the former amounts to nearly L.350,000, but from the heavy expense attending their management, the net value to the state amounts to little more than half that sum.

Mountains. The frontier of Bavaria on the north-east, towards Bohemia, consists of a long range of mountains; and there are also very extensive chains in the neighbouring part of Franconia. These, however, seldom exceed the height of 3000 or 4000 feet; but the ridges in a very different part of the kingdom,—those namely on the south, which separate it from the Tyrol,—partake of all the grandeur of the Alps, several of them being from 9000 to 10,000 feet in height; an elevation approaching to that of Ætna, and more than double that of the highest mountains in Scotland.

Lakes and rivers. There are numerous lakes in Bavaria, particularly in the mountainous parts. In the low country there are several extensive tracts of marshy ground, as in all half-cultivated countries. Of the rivers of Bavaria the most remarkable is the Danube, which, on entering the frontier from Suabia, is of sufficient size to be navigable, and afterwards traverses the whole breadth of the kingdom, making with its windings a course of 200 miles. In this long space it becomes increased by the successive junction of the Iller, the Lech, the Iser, and the Inn, all flowing northward from the Alps. On the north or Franconian side, the Danube receives the Nab, the Altmuhl, and several smaller streams. Though a considerable river even in this early part of its course, it is not large enough to make the erection of bridges a work of so great labour as after the influx of the Inn; so that there are no less than sixteen bridges across the Danube in the course of its passage through Bavaria.

The Inn takes its rise in Switzerland, flows through the Tyrol, and being early swelled by the mountain streams to the right and left of its course, is navigable before it enters the Bavarian territory. It then holds a north and north-east course, and receives the Salsa, a large river flowing from Upper Austria; after which their united waters, between 200 and 300 yards in breadth, fall into the Danube

Bavaria. at Passau. The Iser or Isar has its source in the Tyrolese Alps, flows in a curved direction nearly north-east, passes Munich, becomes navigable, and, after receiving several tributary streams, falls into the Danube half-way between Ratisbon and Passau. The Lech has a similar course, but of less length. In the northern part of the kingdom the Maine is the only river of consequence, either for size or for extent of navigation. It traverses Franconia with a very winding course, and greatly facilitates the trade of that province.

Climate. The climate of Bavaria is in general healthy, although the degree of heat, in this as in the neighbouring country of Austria, is very different according to local differences in the elevation of the soil: hence the cold of Upper Bavaria in the vicinity of the Tyrol, and the warmth of the plains adjoining the Danube and the Maine. On the whole, the temperature of Bavaria is considerably colder than that of England in the winter months, and considerably hotter during the summer and autumn.

Products. The extent of forest land in every province of Bavaria is such as to supply a great quantity of wood for sale; but the transport of it is in many parts difficult, from the badness of the roads, and on account of the distance from navigable rivers. The forests are chiefly on the hills and mountains; and the level country, as well Lower Bavaria extending northwards to the Danube, as the western and middle parts of Franconia, is very productive in wheat, barley, rye, oats; also in hemp, flax, hops, madder, and, in warm situations, in vines. The last are raised chiefly in the vicinity of the lake of Constance, and on the banks of the Maine in the lower part of its course. On the whole, the best cultivated districts are those in which the descent of streams from the high grounds gives facilities to irrigation. Such is the case in the valley of the Danube and in part of the plains of Franconia; but in most other parts of the kingdom a great part of the arable land still remains uncultivated. The quantity of potatoes raised annually in the kingdom has been much increased in the last and present age, particularly in the northern provinces. The Spessart, an extensive tract of forest land in Franconia, formerly neglected, is now rendered very productive in this respect. That much remains to be done before justice is rendered to the soil, is evident, since, with a climate fully as good as ours, and a soil inferior only in the mountainous parts, the average population of Bavaria is not one-third that of England. The government has caused a few of the marshes to be drained; but these are merely incipient operations, and but an inconsiderable part of what ought before this time to have been performed.

Pasture lands. The proportion of land under pasture appears to be nearly the same in one circle or province as another. According to the most recent return, the number, of horses in the kingdom in 1840 was 349,688; cattle, 2,625,294; sheep, 1,889,888; swine, 842,851; and goats, 107,236. Little attention has as yet been given to the improvement of the breed of horses or oxen; but in sheep considerable progress has been made in adopting that improved treatment which has added so largely to the value of the wool of Saxony.

Minerals. The quantity of salt prepared annually in Bavaria is very considerable. The gross produce in each of the three years from 1844 to 1847 amounted severally to 5,033,122, 5,127,057, and 5,237,369 florins; and the net produce to 2,481,276, 2,463,954, and 2,439,543 florins. It is obtained partly from brine springs in the circle of the Iser, partly from salt mines at Halle and other parts; which, like most undertakings of magnitude on the Continent, are, and must, from want of capital on the part of individuals, be wrought on account of the government.

In so mountainous a country the quantity of iron ore is naturally very large. The mines are numerous, but they are on a small scale compared with those of this country. The number of forges at work in 1847 was 169, with 3238 workmen. These mines are found in various parts of the kingdom; in the mountains of Franconia, as well as in those of the south of the kingdom. The coal mines are in like manner numerous, but of small extent compared with ours; the yearly produce of the mines in the Bavarian dominions being only from 60,000 to 70,000 tons. Of quicksilver there are several mines, chiefly in the province of the Rhine. Small quantities of copper, manganese, cobalt, and mercury, are obtained in Rhenish Bavaria. There are numerous quarries of excellent marble, alabaster, gypsum, and building stones; and the porcelain clay is among the finest in Europe. Bavaria.

The population of Bavaria is principally agricultural. Of the 959,099 families and 4,370,977 inhabitants in the kingdom in 1840, 605,693 families and 2,869,702 persons belonged to the agricultural population; the remainder representing the commercial, industrial, and mining portion of the inhabitants.

Manufactures. Manufactures are as yet very backward, even in articles such as hardware, for which the raw material is supplied on the spot. Woollens, linens, and in some towns cottons, are made, but of a quality much coarser than the corresponding manufactures of England, or even of the Netherlands. There are a number of mills in Franconia for making paper, in consequence of two very distinct causes, the frequency of water-falls and the cheapness of linen rags. The extent of the forests, and the command of water-power, have led to the erection of many saw-mills; there being no less than 3366 in the kingdom in 1847. Of glass also the quantity annually made is considerable. As to liquor, the climate of Bavaria being in many parts too cold for the grape, beer is the general drink, and the breweries are very numerous. There are upwards of 5000 breweries in the kingdom, employing about 12,000 workmen. They are not, as in England, confined to the large towns: in a country where the means of carriage by water are so limited, they are necessarily established in almost every district. The other principa. articles of manufacture are leather, tobacco, and earthenware.

Trade. The exports from Bavaria are such as may be expected in a country chiefly agricultural: they consist of salt, timber, cattle, pigs, corn, and madder. The imports consist of sugar, tobacco, cottons, silks, with some woollens, and linen of the finest qualities. The yearly value of the exports is about two millions sterling; that of the imports nearly the same. The government, desirous of removing whatever is pernicious in established usages, abolished, in 1827, the privileges of guilds and corporations; but it must do a great deal more before trade can be raised to a flourishing condition.

Roads, &c. The high roads in Bavaria extend in all over 5500 miles. In 1850 there were about 290 miles of railway in operation. The principal line is that extending from Kaufbeuern to Hof, and thence to Leipzig, traversing nearly the entire length of the kingdom from south to north, and passing in its course through Augsburg, Nuremberg, and Bamberg. A branch of this line proceeds from Augsburg to Munich, and another from Nuremberg to Fürth. The principal canal of Bavaria is the Ludwigs canal recently completed, and which is likely to become one of the most important in Europe. It connects the Rhine with the Danube, and extends from Bamberg on the Regnetz to Dietfurt on the Altmühl.

The increase of the population of Bavaria has been regularly and even rapidly progressive since the beginning of the present century. The following table shows its population in 1818, 1827, and 1846; that of 1849 has already been given. The births during the year 1843–4 were 76,110 males, and 71,256 females (exclusive of 4300 still-born); marriages, 29,490; deaths, 125,382. The immigrants dur-

Bavaria.

ing that period amounted to 972, and the emigrants to 5854, of whom 4104 were to America.

Increasing population.

	1818.	1827.	1846.
Upper Bavaria	585,467	637,299	705,544
Lower Bavaria	450,895	483,741	543,709
Palatinate	446,168	517,081	608,470
Upper Palatinate	403,481	432,165	467,606
Upper Franconia	394,954	437,473	501,163
Middle Franconia	437,838	476,316	527,866
Lower Franconia	501,212	542,475	592,080
Suabia	487,951	518,019	558,436
	3,707,966	4,044,569	4,504,874

The chief towns.

The following gives the principal towns of the several circles, with their populations in 1846:—

		Pop. in 1846.	Order of importance.
Upper Bavaria	Munich	94,830	1
	Ingolstadt	10,285	13
Lower Bavaria	Passau	11,275	10
	Landshut	10,354	12
	Straubing	9,698	16
Upper Palatinate	Ratisbon	23,948	5
	Amberg	10,225	14
Upper Franconia	Bamberg	21,074	6
	Baireuth	17,358	7
	Hof	8,728	17
Middle Franconia	Nuremberg	50,460	2
	Fürth	15,842	8
	Ansbach	12,254	9
	Erlangen	10,770	11
	Eichstädt	7,587	20
	Schwabach	7,125	21
	Rottenburg	5,170	25
	Dinkelsbuhl	5,053	26
Lower Franconia	Wurzburg	29,147	4
	Aschaffenburg	9,815	15
	Schweinfurt	7,660	19
Suabia	Augsburg	38,206	3
	Kempten	8,395	18
	Memmingen	6,821	22
	Neuburg	6,680	23
	Nordlingen	6,523	24
	Lindau	4,470	27
	Kaufbeuern	4,234	28

Spire, the chief town of the palatinate, has a population of about 19,000.

The palatinate or circle of the Rhine is wholly detached from the rest of the kingdom, being nearly 100 miles to the westward, and having the Rhine on the east, Rhenish Prussia and Hesse-Darmstadt on the north, Rhenish Prussia and Hesse-Homburg on the west, and France on the south. This province is an oblong of nearly 55 miles by 40; its extent is 2243 square miles, and its population (see the foregoing table) more dense than that of any other part of the kingdom. Its surface is very uneven, for the Vosges Mountains extend over a part of its territory. In these there are extensive pastures, and, in some places, mines of iron, coal, and quicksilver. In the low grounds the products are wheat, oats, barley, and, in the warmer situations, vines. This province, equal in extent to two of our middle-sized counties, is divided into twelve districts and thirty-one cantons; of which the chief towns are Spire, Landau, Deux Ponts, and Kaiserslautern. After the great successes of the French in 1794 and 1795, this district, formerly the palatinate of the Rhine, became, along with the whole country to the left of the Rhine, subject to France, and so remained for nearly twenty years, until the overthrow of Buonaparte in 1814. At that memorable juncture it was assigned by the congress of Vienna to Austria, and made over by the latter to Bavaria in the subsequent exchanges.

Bavaria. The Rhenish Province.

It may be proper to explain here what was meant by the Circle of Bavaria, although, like the other circles of the empire, it has now ceased to have a political existence. It comprised the territories of the elector of Bavaria, as well as of a number of contiguous petty states, whose respective princes were members of the Germanic body. In addition to Bavaria Proper and the Upper Palatinate, the circle comprised the archbishopric of Salzburg and a number of lesser principalities, which are now mediatized or blended with their greater neighbours; but it contained no part of Franconia, which was a circle by itself. The extent of the circle of Bavaria was about 17,000 square miles, and its capital was Ratisbon. That city was also the residence of the dukes of Bavaria until the fourteenth century, when the acquisition of the upper country towards the Tyrol induced them to fix their residence at Munich.

Former circle of Bavaria.

According to the budget for the financial period from 1849 to 1855, the net annual revenue was fixed at 33,649,799 florins, or L.2,944,357, and the expenditure at 33,675,960 florins, or L.2,957,872. The national debt in 1851 amounted to 136,995,620 florins, or L.11,987,117.

Revenue and expenditure.

Receipts.		Florins.
Direct Taxes.		
Land tax		4,623,586
House, window tax, &c.		592,011
Rent charge tax		262,662
Industry tax		818,237
Capital tax		550,000
Income tax		750,000
Contribution to Widows and Orphans' Fund		51,883
Coin tax of the Palatinate		100,000
		7,748,379
Indirect Taxes.		
Customs		5,364,648
Excise		5,500,000
Stamps		1,020,622
Miscellaneous taxes		2,700,000
		14,585,270
Royalties and State Establishments.		
Salt pits and mines		2,400,000
Post-office		417,482
Railways		800,000
Sundries		37,438
		3,654,920
Domains		7,462,884
Special duties		53,173
Other receipts		145,173
		33,649,799

Disbursements.		Florins.
Public debt		9,966,000
Civil list		2,953,408
Council of state		93,424
Parliamentary expenses		400,000
Royal household and foreign affairs		213,421
Justice		1,305,990
Home department		1,075,000
Provincial administration		1,565,992
Finances		774,678
Trade and public works		94,777
Education	736,765	
Catholic religion	1,186,631	
Protestant religion	355,631	
Health	206,202	
Charities	197,565	
Police	720,031	
Industry, &c.	171,434	
Roads, bridges, &c.	1,743,983	
Sundry expenses	106,353	
		5,424,595
Contributions to the provincial funds		345,495
Army		8,542,000
Agriculture		360,000
Pensions to Widows and Orphans		571,180
		33,675,960

Bavaria. Army.

The military force of Bavaria is raised, as in most of the other German states, by conscription, each conscript being subject to four years' service. The nobility and clergy are exempted, and generally also students and persons indispensable to the maintenance of their families. Besides the permanent army, there is a reserve destined to reinforce it; and in the event of war, the militia, composed of all the males between nineteen and sixty, except the nobility and clergy, may also be called out in aid of the army, but only in the interior. The infantry consists of sixteen regiments of 3080 men each, with six battalions of *chasseurs* having each 907 men, making a force of 54,722 men. The cavalry is composed of two regiments of cuirassiers, and six regiments of light horse, in all 9784. The artillery corps consist of 8130; the sappers, miners, and pontoneers of 1039; and the gendarmerie of 2289 men. The entire force of Bavaria therefore numbers about 76,000 men, but of these a large proportion is generally absent on furlough. It furnishes to the Germanic confederation a contingent of 35,600 men.

The military school at Munich has a high reputation. Arms and ammunition are manufactured in different towns in the kingdom.

Religion.

Christianity appears to have been introduced into Bavaria in the sixth century. The proportion of the different religions in 1840 was as follows:

Roman Catholics	3,060,694
Lutherans	1,181,216
Calvinists	2,717
Jews	59,288
Moravians, Anabaptists, and lesser sects,	4,836
	4,308,751

The exercise of religious worship in Bavaria is altogether free. The Protestants have the same civil rights as the Catholics, and the sovereign may be either Catholic or Protestant. Civil immunities have not yet been extended to Anabaptists, Moravians, or Jews. The latter, as in other countries, follow neither agricultural nor mechanical employments: they are all traffickers in one way or other, the most respectable being merchants, the inferior class brokers and jobbers. Of the Roman Catholic church the heads are two archbishops and six bishops; among the Protestants the highest authority is the general consistory of Munich.

Education.

Bavaria was formerly as backward in regard to education as Austria, or any part of the south of Germany; but in the course of the last and present age considerable efforts have been made to lessen the prevailing ignorance. At Munich there are scientific and literary academies, as well as a university, a lyceum, a gymnasium, and other public schools. The university has a very numerous attendance of students, being 1406 in 1846; and there are two provincial universities on a small scale, one Catholic at Wurzburg, the other Protestant at Erlangen in Franconia. In the kingdom at large there are nine lyceums, twenty-six gymnasia, about sixty progymnasia, besides nine normal, twenty-six trade, three polytechnic, and about 5400 common schools, at which it is computed that about half a million of children or young people of both sexes receive instruction in reading and writing. These certainly form a great contrast to the indifference and neglect of former times; and the government continues to evince much solicitude for the diffusion of instruction. Trade schools here, as in other parts of Germany, have been established for the purpose of affording to mechanics more suitable education than they could otherwise obtain, including mathematics, mechanics, drawing, chemistry, architecture, &c. These schools are supported by the commune, aided when necessary by the province; and commissioners are annually sent by government to examine and report upon them to the minister of trade. The course extends over three years, from the age of twelve to fifteen; after which pupils may enter one of the three polytechnic schools, where a still higher course of instruction is imparted, also extending over three years; but engineers have a special fourth year's course. A building school was established at Munich in 1823, and is chiefly intended for carpenters and masons, who are there instructed in architecture, drawing, geometry, stone-cutting, modelling ornaments, &c.

Bavaria.

The national character of the Bavarians resembles that of the Austrians; being generally marked by fidelity and loyalty. In matters of religion they are credulous, and even superstitious. In short, the will of their superiors is received by the lower orders implicitly as a law in political as in ecclesiastical affairs. A great deal was said fifty years ago about the masonic and other secret societies said to have been formed in this country at the time of the French revolution, and to have aimed at combining their efforts with similar societies in Prussia for the overthrow of the established governments. Such assertions, if not absolutely false, must have rested on a very slender foundation, no people being less inclined than the Bavarians to join in revolutionary projects, or less capable of conceiving that any advantage could possibly result from them.

Govern-ment.

The government of Bavaria in the early ages of the German empire did not descend from father to son: it involved an important military trust, and was conferred by the emperor on princes of different families until the thirteenth century. Towards the close of that century Louis, of the house of Wittelsbach, Duke of Lower Bavaria and Count Palatine of the Rhine, left two sons, Rodolph and Louis, between whom, according to the usage of the age, the father's dominions were shared, the elder receiving the palatinate of the Rhine, the latter the duchy of Bavaria. Small as the Rhenish palatinate was, its comparative civilization made it the more valuable of the two; and its head had the important privileges of an elector of the empire. From the two princes just mentioned descended the rulers of these respective states during five centuries and more; until, in 1778, on the failure of the Bavarian line, Charles Theodore, Count of the Palatinate, obtained the succession, and removed to Munich, since which time the two countries have been governed as one state. Charles Theodore ruled Bavaria above twenty years. He evinced much anxiety for the improvement of his new subjects, but, like his contemporary the Emperor Joseph II. of Austria, he made no sufficient allowance for their deficiency of culture, and their unfitness to comprehend the advantage of many of his proposed changes. He died in 1799, and was succeeded by Maximilian I., a prince of equal philanthropy and greater prudence, who governed Bavaria twenty-six years. He was succeeded in 1825 by his son Louis, who specially distinguished himself by his zeal for the promotion of the fine arts. Finding himself unequal to the emergency of the times, he abdicated in March 1848, in favour of his son Maximilian II., the present king.

Bavaria, like other German states, has long had its states or parliament, composed of nobility and prelates. Its present form of government is founded partly on long-established usage, partly on a constitutional act of great length, passed in May 1818. The country is there declared an integral part of the Germanic confederation, and the monarchy hereditary, with a legislative body of two houses, the upper and lower. The title of the sovereign is simply king of Bavaria; that of his presumptive heir is crown prince of Bavaria. The executive power is vested altogether in the king, whose person is declared inviolable: the responsibility rests with the ministers, whose functions are nearly the same as those of ministers in England or France; and they have respectively offices for foreign affairs, for the home department, for the treasury, the army, and the administration of justice. The upper house of the Bavarian parliament comprises the princes of the blood-royal, the two arch-

Bavaria ‖ Baxter.

bishops, the barons or heads of families of landed property, the president of the Protestant consistory, and any other members whom the king may nominate, either as hereditary peers or as counsellors for life; but the latter must not exceed a third of the hereditary members. The lower house consists of about 140 deputies, of whom an eighth part must be of the class of nobility, another eighth of the clergy, a fourth part citizens or burghers, and the remaining half landed proprietors. Each of the three universities also names a representative. A general election takes place once in six years, and the number of members bids fair to increase; for the elective law prescribes that there shall be a deputy or member of the lower house for every 7000 families in the kingdom. The king generally convenes the parliament once a year; and by the constitution it is obligatory on him to do so at least once in three years. The direct taxes must be granted anew under the authority of the parliament once in six years.

The adoption of this constitution was accompanied by the abolition of all that remained of personal servitude among the peasantry; for many Bavarians of the lower class were until lately serfs, being paid for their labour not by wages, but by maintenance; and they were consequently very indolent. The political improvements still wanting in Bavaria are a more complete equalization of taxes; publicity in the proceedings of courts of justice; a removal of the restrictions on trade with the neighbouring states; and an amendment of the penal code. The liberty of the press is already complete.

Foreign politics.

No part of Europe, if we except the Netherlands, has been more exposed to invasion than Bavaria, and in none has the painful interest arising from military conflicts been given to a greater variety of places. Two centuries ago, both Bavaria and Franconia were laid waste in the Thirty Years' War between the Catholics and Protestants. It was near Augsburg, on the banks of the Lech, that Gustavus Adolphus obtained, in 1632, a memorable victory over the Austrians and other Catholic allies, commanded by Count Tilly. At Nuremberg the success of the Swedish sovereign was for a time arrested by the talents of Wallenstein; but at Nordlingen, two years after, the death of the king and the injuries of the Protestants were avenged in a dreadful conflict. The French next took part in the war, and carried devastation throughout this part of Germany. In the succeeding age Bavaria was invaded by our countrymen and their allies; and it was at Schellenberg, a strong position near the Danube, that the Duke of Marlborough first worsted the Bavarians, in July 1704, above a month previous to the battle of Blenheim. In the wars of the French revolution both Franconia and Bavaria were repeatedly overrun. It was at Amberg that the Archduke Charles stopped the advance of the French in 1796, and at Wurzburg that he finally defeated them; successes repeated with equal effect three years after, when, in March 1799, he again met their army on Bavarian ground, near the banks of the Lech. The subsequent operations in this country were equally pernicious to it, though very different in their political results. The name of Hohenlinden recals the triumph of Moreau in 1800; that of Ulm the surrender of the Austrian army under Mack, in October 1805. Lastly, it was at Eckmuhl and Ratisbon, in 1809, that Buonaparte obtained over the Austrians victories which compelled them to retreat with heavy loss, and opened to him the gates of Vienna. (J. L—E.)

Bavaria ‖ Baxter.

BAVIUS and MÆVIUS, two despicable poets whose enmity to Virgil and Horace has immortalized their names. *Qui Bavium non odit amet tua carmina, Mævi.* (Virg. *Ecl.* iii. 90. See also Horace, *Epod.* x.)

BAWTRY, a market-town in the parish of Blythe, in the west riding of Yorkshire. It is a small but well-built town, and stands on a gentle eminence, sloping towards the river Idle, which empties itself into the Trent, and by which some trade is carried on. It is 153 miles from London, on the great road to Scotland, and has a good market on Thursday. Pop. in 1851, 1170.

BAXTER, ANDREW, a very ingenious metaphysical writer, the son of a merchant in Old Aberdeen, was born in 1686 or 1687, and educated in King's College there. His principal employment was that of private tutor to young gentlemen; and among his pupils were Lord Gray, Lord Blantyre, and Mr Hay of Drummelzier. About 1724 he married the daughter of a clergyman in Berwickshire. A few years afterwards, he published, in quarto, but without date, *An Inquiry into the Nature of the Human Soul*, wherein its immateriality is evinced from the principles of reason and philosophy. In 1741 he went abroad with Mr Hay, and resided several years at Utrecht, having Lord Blantyre also under his care. From this place he made excursions into Flanders, France, and Germany, his wife and family residing in the mean time chiefly at Berwick-upon-Tweed. He returned to Scotland in 1747, and resided till his death at Whittingham, in the county of East Lothian. He drew up, for the use of his pupils and his son, a piece entitled *Matho, sive Cosmotheoria puerilis, Dialogus, in quo prima elementa de mundi ordine et ornatu proponuntur*, &c. This was afterwards greatly enlarged, and published in English in two volumes 8vo. In 1750 was published an appendix to his *Inquiry into the Nature of the Human Soul*, in which he endeavours to remove some difficulties which had been started against his notions of the *vis inertiæ* of matter, by Maclaurin, in his *Account of Sir Isaac Newton's Philosophical Discoveries*. To this piece Mr Baxter prefixed a dedication to Mr John Wilkes, with whom he had commenced an acquaintance abroad. He died on the 23d April 1750, after suffering for some months under a complication of severe disorders, of which the gout was the chief.

Baxter's learning and abilities are sufficiently manifested in his writings. He was also greatly esteemed for the benevolence and candour of his disposition, and had numerous friends and correspondents of eminence, among whom was Dr Warburton, bishop of Gloucester. He left many manuscripts behind him, and intended, had he lived, to complete his work upon the human soul. A second edition of it was published in two volumes 8vo in 1737, and a third in 1745.

BAXTER, *Richard*, an eminent Nonconformist divine, was born in the village of Rowton in Shropshire, on the 12th November 1615. His father's example fostered the principles of serious piety in his youthful mind. After receiving a competent education he was sent to London, under the patronage of Sir Henry Herbert, master of the revels; but he soon returned into the country to study divinity, and in 1638 received ordination in the Church of England; but as he conscientiously refused to subscribe to the oath of universal obedience to the doctrines of the church, he left the establishment.

When the civil war broke out he sided with the parliament, and after the battle of Naseby acted as chaplain in Colonel Whalley's regiment. Although serving under the parliament he professed himself friendly to the Church of England. In consequence of ill health he retired from his military chaplaincy in 1647. Upon the opening of the Long Parliament he was chosen vicar of Kidderminster. But in the heat of the civil wars he removed from that town to

Baxter. Coventry, and preached to the garrison and inhabitants. When Oliver Cromwell was made Protector, he once preached before him, but he declined complying with his measures, and even once told him in a conference that the people of England deemed the ancient monarchy a blessing.

He came to London just before the deposition of Richard Cromwell, and preached before the parliament the day previous to that on which they voted the return of Charles II. The king, on his restoration, appointed Baxter one of his chaplains in ordinary; and he assisted at the conference in the Savoy as one of the commissioners for settling the fundamentals in religion, and reforming the liturgy. He was offered the bishopric of Hereford, which he refused, desiring no higher preferment than the liberty of continuing minister of Kidderminster. This, however, was denied him, for he was not permitted to preach there above twice or thrice after the Restoration. He accordingly returned to London and preached occasionally in or about the city till the Act of Uniformity passed. In 1662 he married Margaret Charleton, daughter of Francis Charleton, Esq., of the county of Salop. This lady was a woman of great piety, entered thoroughly into her husband's views concerning religion, and cheerfully shared all his sufferings both in and out of prison. During the plague in 1665 Baxter retired into Buckinghamshire; but afterwards returned to Acton, where he staid till the act against conventicles expired, when his audience became so large that he wanted room. After this he was committed to prison; but having procured a *habeas corpus*, he was discharged. After the indulgence in 1672, he returned to London; but in 1682 he was seized for coming within five miles of a corporation. In 1684 he was again seized; and in the reign of James II., in 1685, he was committed prisoner to the King's Bench, and tried before the infamous Judge Jeffreys for his *Paraphrase on the New Testament*, which was called a "scandalous" and "seditious" book against the government. Mr Macaulay (*History of England*, vol. i. p. 487) gives the following graphic sketch of the character and trial of Baxter:—

"About the same time a culprit, who bore very little resemblance to Oates or Dangerfield, appeared on the floor of the court of King's Bench. No eminent chief of a party has ever passed through many years of civil and religious dissension with more innocence than Richard Baxter. He belonged to the mildest and most temperate section of the Puritan body. He was a young man when the civil war broke out. He thought that the right was on the side of the houses; and he had no scruple about acting as chaplain to a regiment in the parliamentary army: but his clear and somewhat sceptical understanding, and his strong sense of justice, preserved him from all excesses. He exerted himself to check the fanatical violence of the soldiery. He condemned the proceedings of the High Court of Justice. In the days of the commonwealth he had the boldness to express, on many occasions, and once even in Cromwell's presence, love and reverence for the ancient institutions of the country. While the royal family was in exile, Baxter's life was chiefly passed at Kidderminster in the assiduous discharge of parochial duties. He heartily concurred in the Restoration, and was sincerely desirous to bring about a union between Episcopalians and Presbyterians. For, with a liberality rare in his time, he considered questions of ecclesiastical polity as of small account when compared with the great principles of Christianity, and had never, even when prelacy was most odious to the ruling powers, joined in the outcry against bishops.

"The attempt to reconcile the contending factions failed. Baxter cast in his lot with his proscribed friends, refused the mitre of Hereford, quitted the parsonage of Kidderminster, and gave himself up almost wholly to study. His theological writings, though too moderate to be pleasing to the bigots of any party, had an immense reputation. Zealous churchmen called him a Roundhead; and many Nonconformists accused him of Erastianism and Arminianism. But the integrity of his heart, the purity of his life, the vigour of his faculties, and the extent of his attainments, were acknowledged by the best and wisest men of every persuasion. His political opinions, in spite of the oppression which he and his brethren had suffered, were moderate. He was friendly to that small party which was hated by both whigs and tories. He could not, he said, join in cursing the Trimmers, when he remembered who it was that had blessed the peacemakers. Baxter.

"In a commentary on the New Testament he had complained, with some bitterness, of the persecution which the dissenters suffered. That men who, for not using the prayer-book, had been driven from their homes, stripped of their property, and locked up in dungeons, should dare to utter a murmur, was then thought a high crime against the state and the church. Roger Lestrange, the champion of the government, and the oracle of the clergy, sounded the note of war in the *Observator*. An information was filed. Baxter begged that he might be allowed some time to prepare for his defence. It was on the day on which Oates was pilloried in Palace Yard that the illustrious chief of the Puritans, oppressed by age and infirmities, came to Westminster Hall to make this request. Jeffreys burst into a storm of rage, 'Not a minute,' he cried, 'to save his life. I can deal with saints as well as with sinners. There stands Oates on one side of the pillory; and if Baxter stood on the other, the two greatest rogues in the kingdom would stand together.'

"When the trial came on at Guildhall, a crowd of those who loved and honoured Baxter filled the court. At his side stood Doctor William Bates, one of the most eminent of the Nonconformist divines. Two whig barristers of great note, Pollexfen and Wallop, appeared for the defendant. Pollexfen had scarce begun his address to the jury, when the chief justice broke forth: 'Pollexfen, I know you well. I will set a mark on you. You are the patron of the faction. This is an old rogue, a schismatical knave, a hypocritical villain. He hates the liturgy. He would have nothing but longwinded cant without book:' and then his lordship turned up his eyes, clasped his hands, and began to sing through his nose, in imitation of what he supposed to be Baxter's style of praying, 'Lord, we are thy people, thy peculiar people, thy dear people.' Pollexfen gently reminded the court that His late Majesty had thought Baxter deserving of a bishopric. 'And what ailed the old blockhead then,' cried Jeffreys, 'that he did not take it?' His fury now rose almost to madness. He called Baxter a dog, and swore that it would be no more than justice to whip such a villain through the whole city. Wallop interposed, but fared no better than his leader. 'You are in all these dirty causes, Mr Wallop,' said the judge. 'Gentlemen of the long robe ought to be ashamed to assist such factious knaves.' The advocate made another attempt to obtain a hearing, but to no purpose. 'If you do not know your duty,' said Jeffreys, 'I will teach it you.' Wallop sat down; and Baxter himself attempted to put in a word. But the chief justice drowned all expostulation in a torrent of ribaldry and invective, mingled with scraps of Hudibras. 'My Lord,' said the old man, 'I have been much blamed by dissenters for speaking respectfully of bishops.' 'Baxter for bishops!' cried the judge, 'that's a merry conceit indeed. I know what you mean by bishops—rascals like yourself, Kidderminster bishops, factious snivelling Presbyterians!' Again Baxter essayed to speak, and again Jeffreys bellowed, 'Richard! Richard! dost thou think we will let thee poison the court? Richard! thou art an old knave. Thou hast written books enough to load a cart, and every book as full of sedition as an egg is full of meat. By the grace of God, I'll look after thee. I see a great many of your brotherhood waiting to know what

Baxter ‖ Bay Salt.

will befall their mighty Don. And there,' he continued, fixing his savage eyes on Bates, 'there is a doctor of the party at your elbow. But, by the grace of God Almighty, I will crush you all.' Baxter held his peace. But one of the junior counsel for the defence made a last effort, and undertook to show that the words of which complaint was made would not bear the construction put on them by the information. With this view he began to read the context. In a moment he was roared down; 'You shan't turn the court into a conventicle.' The noise of weeping was heard from some of those who surrounded Baxter. 'Snivelling calves!' said the judge. Witnesses to character were in attendance, and among them were several clergymen of the Established Church. But the chief justice would hear nothing. 'Does your lordship think,' said Baxter, 'that any jury will convict a man on such a trial as this?' 'I warrant you, Mr Baxter,' said Jeffreys; 'don't trouble yourself about that.' Jeffreys was right. The sheriffs were the tools of the government. The juries, selected by the sheriffs from among the fiercest zealots of the tory party, conferred for a moment, and returned a verdict of Guilty. 'My lord,' said Baxter, as he left the court, 'there was once a chief justice who would have treated me very differently.' He alluded to his learned and virtuous friend Sir Matthew Hale. 'There is not an honest man in England,' answered Jeffreys, 'but looks on thee as a knave.'

"The sentence was, for those times, a lenient one. What passed in conference among the judges cannot be certainly known. It was believed among the Nonconformists, and is highly probable, that the chief justice was overruled by his three brethren. He proposed, it is said, that Baxter should be whipped through London at the cart's tail. The majority thought that an eminent divine, who, a quarter of a century before, had been offered a mitre, and who was now in his seventieth year, would be sufficiently punished for a few sharp words by fine and imprisonment."

Baxter continued in prison two years; but was at last discharged, and had his fine remitted by the king. He died on the 8th of December 1691, and was buried in Christ Church. His works consisted of 112 separate publications, which were collected and published in four volumes folio in 1707.

BAXTER, *William*, nephew and heir to the preceding, was an eminent schoolmaster and critic. He was born at Llanlugan in Montgomeryshire, in the year 1650. At the age of eighteen, when he first went to school, he knew not one letter, nor understood one word of any language but Welsh; but he improved his time so well that he became a person of great and extensive knowledge. The natural bent of his mind led him chiefly to the study of antiquities and philology, in which he composed several books. The first he published was a grammar, in 1679, entitled *De Analogia seu Arte Latinæ Linguæ Commentariolus.* He also published a new and correct edition of Anacreon, with notes; an edition of Horace; a dictionary of British antiquities, in Latin; and several other works. He was a great master of the ancient British and Irish tongues, and particularly skilled in the Latin, Greek, northern, and oriental languages. He died on the 31st May 1723, after being above twenty years master of Mercer's school in London.

BAY (Saxon, *byge*, an angle), an arm of the sea extending into the land. It is smaller than a gulf, and larger than a creek.

BAY, the *Laurus nobilis*, a tree belonging to the natural order *Lauraceæ*. See BOTANY.

BAY *Colour* denotes a sort of reddish-brown, of various shades, approaching to chestnut. Bay horses (to which the term is chiefly applied) are characterized by the black mane and tail.

BAY *Salt* is salt made by the action of the sun and air on sea-water, or on any water containing salt, in contradistinction to that which is manufactured by artificial evaporation.

Bay Window ‖ Bayard.

BAY *Window*, a projecting window rising from the ground or basement, either in the form of a semicircle or otherwise, forming a space similar in shape to a bay: hence its name.

BAYADEER, the Indian term for a dancing girl, supposed to be a corruption of the Portuguese *bailadeira*, a female dancer. See DANCING GIRLS.

BAYAN-KHARA, a range of mountains in Eastern Asia, which the Chinese represent as occupying the centre of the great high plateau of that quarter of the world, about Lat. 36. N. and Long. 100 E. (Ritter's *Asia.*)

BAYARD, PIERRE DU TERRAIL, CHEVALIER DE, one of the most illustrious heroes of the chivalrous age, or rather one of the latest representatives of the ancient chivalry, was descended from an ancient and noble family in Dauphiné, and was born in 1476 at the château of Bayard, near Grenoble. He was esteemed by his contemporaries the model of soldiers and men of honour, and denominated "the knight without fear and without reproach." He accompanied Charles VIII. in his expedition to Italy, and gave remarkable proofs of his valour, especially at the battle of Fuornuovo. He was dangerously wounded at the storming of Brescia, and was nursed in the house of a lady, who on his recovery presented him with two thousand pistoles for the protection he had afforded her family against the soldiers. With knightly courtesy he accepted the gift, and bestowed it on her two daughters for their marriage portions; an action which has been celebrated by many historians. On his return to France he was made lieutenant-general of Dauphiné. He fought by the side of Francis I. in the tremendous battle of Marignano; and that young prince afterwards insisted on being knighted by his hand, after the manner of the ancient knights. During six weeks he defended the town of Mezieres against the army of Charles the Fifth. In 1524, at the retreat of Rebec, the conduct of the rear was committed to the Chevalier Bayard; who, though so much a stranger to the arts of a court that he never rose to the chief command, was always called, in times of real danger, to the posts of greatest difficulty and importance. He put himself at the head of the men-at-arms; and animating them by his presence and example to sustain the shock of the enemy's whole troops, he enabled the rest of his countrymen to make good their retreat. But in this service he received a mortal wound; and being unable to continue longer on horseback, he ordered one of his attendants to place him against a tree, with his face to the enemy; then fixing his eyes on the guard of his sword, which he held up instead of a cross, he addressed his prayers to God, and, in this attitude, which became his character both as a soldier and as a Christian, he calmly awaited the approach of death. Bourbon, who led the foremost of the enemy's troops, found him in this situation, and expressed pity and regret at the sight. "Pity not me," cried the high-spirited chevalier; "I die as a man of honour ought, in the discharge of my duty. They indeed are objects of pity who fight against their king, their country, and their oath." The Marquis de Pescara, coming up soon after, manifested his admiration of Bayard's virtue as well as sorrow for his fate, with the generosity of a gallant enemy; and finding that he could not be removed with safety from the spot, he ordered a tent to be pitched there, and appointed proper persons to attend him. Bayard died, as his ancestors for several generations had done, on the field of battle. His death took place on the 30th of April 1524, at the age of forty-eight. Pescara ordered the body to be embalmed; and the Duke of Savoy commanded it to be received with royal honours in all the cities of his dominions. In Dauphiné, Bayard's native province, the people of all ranks came out in a solemn procession to meet it. The life of Bayard was written by one of his secretaries, and has since appeared under various forms.

Bayazid ‖ Bayeux.

BAYAZID, or BAJAZID, a city of Turkish Armenia, in the pashalic of Erzeroum, situated on a mountain, the summit of which is strongly fortified. It is surrounded by a wall and ramparts; and contains two churches, three mosques, and a monastery, that of Karu Killeesea, which is famous for the beauty of its architecture, as well as for its antiquity and grandeur. This city, which, when visited by Kinneir, had about 30,000 inhabitants, is now in a ruinous and filthy condition. According to the accounts given by Messrs Smith and Dwight, the American missionaries who visited it in 1832, the population must be considerably under 5000. Great numbers of the Armenian inhabitants have emigrated to the Russian territories. It is 50 miles S.S.W. of Erivan, and 140 east of Erzeroum. Long. 43. 26. E. Lat. 39. 24. N.

BAYEN, PIERRE, a celebrated chemist, and member of the Institute of France, was born in 1725, at Chalons-sur-Marne. Showing a great inclination for study, he was sent by his parents to school at Troyes, where he went through a course of classical education with success.

The bent of his disposition was to physical science. He went to Paris in 1749, and became the pupil and friend of an eminent druggist. In this situation he acquired a complete knowlege of the profession; and, before the age of thirty, he was appointed chief apothecary to the French army in Germany, in the Seven Years' War, a situation which he filled with industry, intelligence, and integrity. After the conclusion of peace, he returned to Paris, and was employed for several years by the government in making analyses of the mineral waters of France.

On his return to Paris, he made analyses of different minerals collected chiefly during his residence in the Alpine region of the Pyrenees. Amongst these is the marble of Campan, of which there are two varieties, the red and the green. They are brought from that country to Paris, where they are used with striking effect in ornamental architecture; as may be seen in the columns of the Great Trianon at Versailles, in the interior of the church of St Sulpice, and in other great buildings. These analyses are published in the *Mémoires présentés à l'Académie par divers Savans*, commonly called *Memoires des Savans Etrangers*.

Bayen made most accurate experiments on the oxides of mercury, to show that oxidation arises from the absorption of a portion of the atmospheric air, and that the existence of the phlogiston of Stahl could not be proved. Lavoisier, who was present when the account of these experiments was read, was employed at that time in examining the metallic oxides; and soon after brought the subject into a clearer light, demonstrating the nature of oxygen, and the composition of the atmosphere.

Bayen enjoyed good health till sixty, and died at the age of seventy-six, in the year 1801. He was a man of sound judgment, of strict integrity, and acquainted with several other branches of knowledge besides that which he particularly cultivated. There is a collection of his works, entitled *Opuscules Chimiques*, 1798, 2 vols. 8vo. (W. A. C.)

BAYEUX, the capital of an arrondissement of the same name in the department of Calvados, France. It is situated in a fruitful valley on the river Aure, 17 miles W.N.W. of Caen. The principal building is the cathedral, a majestic edifice of great antiquity, in which is the celebrated tapestry, said to have been the work of Matilda, queen of William the Conqueror, and representing the events connected with the Norman conquest. It is now believed to be an authentic monument of that era; and has been engraved by the Society of English Antiquaries in the 6th volume of *Monumenta Vetusta*. Bayeux is the seat of a bishopric, and has tribunals of primary jurisdiction and commerce, a communal college, and a public library. Its manufactures are linen and cotton goods, hosiery, lace, &c. Pop. (1851) 8835. The arrondissement has 6 cantons, 144 communes, and 79,976 inhabitants

Bayla ‖ Bayle.

BAYLA, or BELA, a town of Beluchistan, capital of the province of Lus, on the north-eastern bank of the river Poorally. About one-third of the town in the western quarter is encompassed by a mud wall. The streets are narrow; but from the elevated situation of the town, and its rocky site, they are always clean, even in the wettest weather. The bazaar is very neat. Bayla is the residence of the chief of Lus, whose government is mild and equitable, and insures complete protection to mercantile dealers. His durbar or hall of audience is a large open apartment of very ordinary structure, and he maintains little or no state. Pop. 5000. Distance north of Khelat, 293 miles. Long. 66. 40. E. Lat. 26. 10. N.

BAYLE, PIERRE, author of the *Historical and Critical Dictionary*, was born on the 18th November 1647, at Carlat, a village in the county of Foix, in France. His father, Jean Bayle, a Calvinist minister, took upon himself the early education of his son, and instructed him in Latin and Greek. The young Bayle was afterwards sent to Puylaurens, where he continued his studies with equal ardour and success. He completed his rhetorical studies in this academy, and went in 1669 to Toulouse, to study philosophy under the Jesuits. There, embarrassed by some objections raised against his religious belief, he abjured Calvinism for Catholicism, which for a short time appeared to him the more rational system: but renewed reflection and more thorough investigation soon brought him back to his former faith. Immediately on his restoration to the reformed church, he went to Geneva, and adopted the principles of Cartesianism in preference to the Peripatetic scholasticism which he had learnt from the Jesuits; and there also he formed lasting friendships with the celebrated professors of theology, Pictet and Leger, and especially with a young man named Basnage, who afterwards distinguished himself as an author and minister of the gospel. In the year 1675, a chair of philosophy was vacant at the Sedan academy. Pressed by Basnage, who had then finished his theological studies in this town, and who had obtained for his friend the help of Jurieu his master, Bayle competed for the place and obtained it. He occupied this post for six years, to the satisfaction of all, and even of Jurieu himself, who, in spite of his envious character, could not withhold from him his esteem. In 1681, five years before the revocation of the edict of Nantes, the Calvinist university of Sedan was broken up, and Bayle went with Jurieu to Rotterdam, where M. de Paets founded for them *l'Ecole illustre*. The public teaching with which Bayle was there intrusted comprehended philosophy and history. His lectures, and particularly his numerous publications, soon attracted general attention; all the savants of Europe corresponded with him, and the learned Queen Christina of Sweden wrote to him with her own hand. But he did not long enjoy this celebrity undisturbed. His colleague Jurieu persecuted him with cruel animosity. He denounced him as an atheist to the consistory, and as a conspirator to the public authorities. His intrigues, after having for a long time proved futile, at length succeeded. In 1693 the magistrates of Rotterdam removed Bayle from his office, and forbade him to give private instructions. His misfortune appears to have affected him but little; he rather congratulated himself at having escaped from the cabals and parties so common in the academies. In spite of the persecutions which disturbed his latter years, he was so happy in the enjoyment of independence, that when, in 1706, the Count of Albemarle asked him as a favour to come and live in his house at the Hague, Bayle refused.

But he was now suffering from the malady which at last proved fatal to him. An affection of the chest, for which he refused to seek any remedies, as he considered it incurable, made rapid progress, which he observed with perfect calmness. His activity was never for a moment inter-

Bayle.

rupted; his labours proceeded as perseveringly as when he was in perfect health, till death overtook him, pen in hand, on the 28th December 1706, in the fifty-ninth year of his age.

The lives of few literary men have been so completely occupied as that of Bayle. From his twentieth year he scarcely allowed himself a moment's repose. To those who were astonished at the rapidity with which his publications succeeded each other, he answers, in the preface to the second volume of his dictionary, "Diversions, parties of pleasure, games, collections, country excursions, visits, and such other recreations as are said by many men of letters to be necessary, have no charms for me; I lose no time. I do not even spend any in domestic cares, or in endeavouring to attain anything whatever, nor in solicitations, nor in any other affairs. In this way an author accomplishes much in few years."

He wrote with extreme facility, and rarely revised his first copy. "I never (says he) make a rough draft of an article; I commence and finish it without stopping." What he chiefly sought in the expressions in which he clothed his thoughts was clearness, and his style is rather lively and flowing, than elegant and chaste.

His erudition was immense, and at once exact and profound. His logic was equal to his learning, for he was one of those rare geniuses with whom retentiveness of memory does not weaken the reasoning powers. Unfortunately these extraordinary talents were often wasted on profitless paradox and bewildering scepticism. The subtility of his reasoning faculties led him to doubt the most universally acknowledged facts. All the important questions which philosophy proposes to solve entangle themselves, according to Bayle, in inextricable difficulties. The proposition that *there is one God* does not, according to him, possess indisputable evidence. Nature is an impenetrable deep. "Man," he says, "is the stumbling-block of the true and the false, and nothing is so difficult for reason alone to penetrate, as what we call a rational animal. What do we know of the nature and destiny of souls? arguments have been equally advanced for their materiality and immateriality, for their mortality and immortality. The principles on which morality rests are still less certain than those which give to the physical sciences their tottering base and their uncertain foundation." He gives a true character of himself when he says (Lettre au P. Taurnemene), "I am only Jupiter, the cloud-compeller; my talent is to form doubts, but they are to me only doubts." His scepticism enveloped every thing. He does not attack openly and directly the dogmas which he impugns; his method is to oppose to the system which supports certain doctrines some other system, ancient or modern, which denies them, and thus to break the contradictory doctrines against each other, leaving the truth buried under their ruins.

The great work of Bayle is the *Dictionnaire Historique et Critique*, which, with much that is of little interest or value, contains a large number of articles remarkable for erudition and critical discernment, and has exercised no inconsiderable influence on the literature and philosophy of Europe. The first edition was published in 1699 in 2 vols. fol. Of the twelve subsequent editions, the best are, that of Des Maizeaux (with life of Bayle), Basle and Amst. 1740, 4 tom. fol.; and that of Beuchot, Paris, 1820, &c., 16 tom. 8vo. The latter is enriched with the critical remarks of various authors. The English translation by Birch and Lockman, Lond. 10 vols. fol. 1734–41, contains considerable additions to the original. The *Œuvres Diverses* of Bayle were published in 1727–31, 4 tom. fol. at the Hague; and his *Lettres Choisies* at Rotterd. 1714, and Amst. 1729, 3 tom. 12mo.

(See Durevert, *Histoire de Bayle*, &c., Amst. 1716; G. F. Schœtterbeck, *Diss. de P. Baylio*, Tubing. 1719, 4to; Feuerbach, *Pierre Bayle*, &c., Ansp. 1838, 8vo; Damiron, in the *Mem. de l'Acad. des Sciences Mor. et Polit.*, tom. xi. p. 319; Tennemann, *Geschichte der Philos.*; St Beuve, in the *Rev. des Deux Mondes*, Dec. 1835.)

Bayly (Bazaar.

BAYLY, Lewis, an English prelate, author of a well-known book entitled *The Practice of Piety*. He was born at Caermarthen in Wales, educated at Oxford, appointed minister of Evesham about 1611, made chaplain to King James, and promoted to the see of Bangor in 1616. He died in 1632.

BAYONET, from the French *baïonette*, and so called, it is said, because this weapon was first made at Bayonne. It is a kind of three-sided dagger-like weapon, which was originally screwed into the muzzle of the gun; and thus it could only be used after the piece was discharged. The bayonet is now made with a hollow iron handle, which embraces the muzzle exteriorly, so that the soldier fires with his bayonet fixed. The original invention as well as the subsequent improvement of this weapon is due to the French, who were also the first to employ it, and, according to Folard, gained important advantages in consequence, before the use of it became general. Its great advantage consists in rendering the musket a pike, and thus providing the soldier with a weapon which he can at all times employ, either to resist an attack of cavalry, or to charge the enemy's infantry. See Guibert, *Essai Général de Tactique*. This weapon was formerly called dagger; and in some old English authors it is written *bagonet*.

BAYONNE, the ancient *Lapurdum*, a first-class fortified city of France, in the department of Lower Pyrenees, and capital of an arrondissement of the same name. It is well built, and agreeably situated at the confluence of the Nive and Adour, about three miles from the sea. A bar at the mouth of the river prevents large vessels from entering except at high water, when at spring tides there is a depth of from 13 to 15 feet, and from 9 to 11 feet at neaps. The citadel is one of the finest works of Vauban, and the cathedral is a small but elegant Gothic structure of the thirteenth century. Bayonne is the seat of a bishopric, and has courts of primary jurisdiction and commerce, an exchange, a mint, theatre, naval and commercial docks, schools of commerce and navigation, &c.; with distilleries, sugar refineries, glass works, &c. Its export trade is considerable, particularly in chocolate, liqueurs, cream of tartar, and hams. The Nive and Adour divide the town into three nearly equal parts, communicating with each other by bridges. The Bayonne, which lies on the left bank of the Nive, contains the old castle; Little Bayonne, where the new castle stands, is situated between the Nive and the Adour; and the suburb Saint Esprit occupies the right bank of the Adour. The last is not comprehended in the commune of Bayonne, but forms a separate commune in the department of Landes. The bayonet derives its name from this place, where it is said to have been invented. Bayonne, though often besieged, has never been taken, and is one of the few places that refused to participate in the massacre of St Bartholomew. Pop. of commune in 1851, 16,299. The arrondissement of the same name contains 8 cantons, 53 communes, and (in 1851) 88,185 inhabitants.

BAZA, a city of Granada, in the Sierra Nevada, with a population of 10,133, a cathedral, and a seminary for the education of priests. It stands in a fruitful valley. Lat. 37. 30. N. Long. 2. 50. W.

BAZAAR, or Bazar, a denomination among the Turks and Persians, given to a kind of exchange, or place where stuffs and other wares are sold. The word *bazaar* is of Persic origin, and literally denotes sale or exchange of goods. Some of the Eastern bazaars are open, like the market-places in Europe, and serve the same purposes, more particularly for the sale of the bulky and less valuable commodities. Others, again, are covered with lofty ceilings, or domes, pierced to

give light; and it is in these that the jewellers, goldsmiths, and other dealers in the richer wares, have their shops. The bazaar or maidan of Ispahan is one of the finest places in Persia, and greatly surpasses all the exchanges in Europe. The bazaar of Tauris was famed for its extent, having several times contained 30,000 men ranged in order of battle; and the bazaar of Ali Pacha at Adrianople is of very large dimensions. At Constantinople there are the old and the new bazaar, which are large square buildings, covered with domes, and sustained by arches and pilasters. The name of bazaar has lately been given to various establishments in London and other cities, where all sorts of goods and wares are exhibited for sale.

BAZAS, an arrondissement in the department of the Gironde, in France, extending over 604 square miles, and comprehending 7 cantons and 68 communes, with a population of 55,112 persons. The chief place is a market-town of the same name, which in 1851 contained 4437 inhabitants, employed in various kinds of manufactures, particularly glass. Long. 0. 12. 25. W. Lat. 44. 25. 55. N.

BAZAT, or BAZA, in *Commerce*, a long, fine-spun cotton, which is brought from Jerusalem, whence it is called *Jerusalem cotton.*

BAZEEGURS, a tribe of Indians, inhabiting different parts of the peninsula of Hindustan. They are recognised by several appellations, as Bazeegurs, Panchperee, Kunjura, or Nuts; they follow a mode of life distinguishing them from the Hindus, among whom they dwell; and abstain from intermixing their families with the Hindus, and from any intercourse by which they can be united. They are dispersed throughout the whole of India, partly in wandering tribes, partly adhering to fixed residences, but the greater proportion lead a nomadic life.

The Bazeegurs are divided into seven castes; but besides those who are united into sets or castes, there are individuals who wander about endeavouring to pick up a precarious livelihood. Although the Bazeegurs are distinguished by their manners and customs from the natives of Hindustan, their features do not certainly discriminate them as a separate race. Some of their women are reputed very beautiful, and are thence sought after in those temporary alliances common in the East. The Bazeegurs, more especially distinguished by that name, are the most civilized of the whole; they are Mahometans in food, apparel, and religion. The Panchperee profess no system of faith in preference, adopting indifferently that of any village, whither their wanderings may guide them. Some traverse the country as Mahometan Fakeers, and live on the ill-directed bounty of devotees; and a particular association among them, of bad repute or abject superstition, has been accused of sacrificing human victims.

The chief occupation of the Bazeegurs seems to consist in feats of address and agility to amuse the public, in which both males and females are equally skilful. The former are extremely athletic, and the women are taught dancing, which, instead of the graceful motions seen in the north, consists principally of a display of lascivious gestures. Most, if not all the men, are jugglers, tumblers, and actors, in which they are very adroit. The people of each sect, or *dramatis personæ*, are hired out by a sirdar or manager of a company, for a definite period, generally one year, after which they are at liberty to join any other party. Both males and females pursue such a systematic course of debauchery, that few live beyond forty, and many do not attain their thirtieth year. From the pursuits of the females being productive to their parents, their marriages are deferred to a later period than is usual in India.

The females who do not attend the juggling exhibitions of the men, or their feats of activity, practise physic and cupping, and perform a kind of tattooing on the skin of the Hindus of their own sex, called *godna*. The men, besides their usual occupations, collect medicinal herbs, which are prepared by their wives as curatives, especially of the complaints of their own sex. In this manner, or by the sale of trinkets, they find employment in the towns, though these occupations afford them but a precarious subsistence. Some tribes also exhibit wild beasts to the vulgar, or offer for sale mats fabricated by themselves. Before the establishment of the British government in Bengal, the Bazeegurs were subject to the arbitrary exactions of a tax-gatherer, whom they greatly dreaded; and the apprehension of the renewal of that officer's powers has proved a considerable impediment to investigating their manners and customs.

The Bazeegurs are supposed to present many features analogous to the gipsies scattered over Europe and Asia, where they subsist as a distinct race from all the other inhabitants of the countries frequented by them. The Bazeegurs, as well as the gipsies, have a chief or king; each has a peculiar language, bearing some reciprocal analogy, and different from that of the people among whom they reside; and this analogy is so decided, that it is difficult to deny that in both cases it has had a common origin. Another resemblance, which has probably been lost in the lapse of time, is supposed to consist in the three-stringed viol introduced into Europe by the jugglers of the thirteenth century, which is exactly similar to the instrument now used in Hindustan. Disjoined, these analogies may not carry conviction of the identity of the European gipsies with the Indian Bazeegurs; but, on combining the whole, it does not seem unlikely, that if Asia be their original country, or if they have found their way from Egypt to India, they may also have emigrated farther at a period of remote antiquity, and reached the boundaries of Europe. (J.G.D.)

BAZGENDGES, the name of a substance used by the Turks and other Eastern nations in scarlet-dyeing.

BAZZANO, a city of Italy, in the papal delegation of Bologna, on the canal of St Giovanni. Pop. 2600.

BDELLIUM, a gum-resin of a dark-reddish colour, and bitter and pungent to the taste. It is used as a perfume, and sometimes in medicine as a weak deobstruent.

BEACHY-HEAD, a promontory on the coast of Sussex, between Hastings and Brighton, where the French defeated the English and Dutch fleet in 1690. It has a lighthouse with a revolving light 285 feet above high-water mark, in Long. 0. 13. E. Lat. 50. 44. N.

BEACON (Saxon *beacen*,) an ancient species of signal, consisting generally of a long pole to which was fastened a pitch-barrel to be fired by night, and to produce smoke by day. These were erected on conspicuous eminences, to give notice of an approaching invasion.

Beacons are also marks and signs erected on the coasts for guiding and preserving vessels at sea by night as well as by day. The erection of beacons, lighthouses, and sea-marks, is a branch of the royal prerogative. The sovereign has the exclusive power, by commission under the great seal, to cause them to be erected in fit and convenient places, as well upon the lands of the subject as upon the demesnes of the crown, which power is usually vested by letters-patent in the office of lord high admiral. By statute 8th Elizabeth, cap. 13, the corporation of the Trinity-house is empowered to set up any beacons or sea-marks wherever they shall think such necessary; and the owner of the land or any other person destroying these, or taking down any steeple, tree, or other known sea-mark, is declared liable to severe penalties.

BEACONAGE, money paid towards the maintenance of a beacon.

BEACONSFIELD, a market-town in the hundred of Burnham, county of Buckingham, 23 miles from London, on the road to Oxford. It consists of four streets crossing each other at right angles. This place is celebrated as the residence of the poet Waller and Edmund Burke; and both are buried here. Market-day Wednesday. Pop. in 1851, 1684.

BEAD, a small globule or ball used in necklaces, and made of different materials, as pearl, steel, garnet, coral, diamond, amber, crystal, pastes, glass. The Romanists make great use of beads in rehearsing their *Ave-Marias* and *Pater-nosters*; and a similar custom obtains among the religious orders throughout the East, as well Mahometan as heathen. A string of such beads is called a rosary.

Glass beads were used by the Spaniards to barter with the natives of South America for gold; and to this day they are a favourite article of traffic with all savage nations. Sir William Beechy made considerable use of them during his visit to Behring's Straits in 1828.

Bead-Proof, a term formerly used by distillers to denote that the spirit manufactured by them was of the legal strength. This was ascertained by immersing in the spirit Wilson's or Lovi's beads, which consisted of hollow balls or beads of glass so graduated that each would only maintain its equilibrium in a fluid of a certain density. The beads being all fitted for certain different densities, were thrown into the fluid to be tested, and the bead which was of the exact density of the fluid remained suspended in the fluid, the others sinking or floating according as the fluid was too dense or too thin for them. These beads are now quite superseded by Sykes's hydrometer. See Hydrodynamics.

Bead-Roll, among Roman Catholics, a list of persons for the rest of whose souls a certain number of prayers is to be repeated, which are counted by telling the beads.

BEADLE (from the Saxon *bydel*, or *bædel*, a messenger), a crier or messenger of a court, who cites persons to appear and answer. He is also called a *summoner* or *apparitor*. *Beadle* is likewise an officer of a university, whose chief business is to walk before the masters with a mace at all public processions. There are, besides, *church beadles*, whose business is to punish petty offenders.

BEAGLE (French, *bigle*), a small sort of hound or hunting dog. Beagles are of different kinds; as the southern beagle, something less and shorter but thicker than the deep-mouthed hound; the fleet northern or cat beagle, smaller and of a finer shape than the southern, and a harder runner. From these two, by crossing the strains, is bred a third sort, considered preferable to either. There is also a smaller sort, scarcely bigger than a lap-dog, which affords an agreeable diversion in hunting the rabbit or even the young hare in dry weather.

BEAK or Beak-head, that external part of a ship before the forecastle which is fastened to the stem and supported by the main-knee. The beak, called by the Greeks ἔμβολος, by the Latins *rostrum*, was an important part in the ancient ships of war, which were hence called *naves rostratæ*. The beak was made of wood, fortified with brass, and fastened to the prow, for the purpose of damaging the enemy's vessels. Its invention is attributed to Pisæus, an Etruscan. The first beaks were made long and high; but afterwards a Corinthian, named Ariston, made them short and strong, and placed so low as to pierce the enemy's vessels under water. By means of these great havoc was made by the Syracusans in the Athenian fleet. See Rostrum.

BEAKED, in *Heraldry*. When the beak and legs of a fowl are of a different tincture from the body, the technical expression is, *beaked and membered of such a tincture*.

BEALE, Mary, distinguished for her skill in painting, was the daughter of Mr Cradock, minister of Walton-upon-Thames, and is said to have learned the rudiments of the art from Sir Peter Lely. She painted in oil, in water-colours, and in crayons, and was greatly employed. Her portraits were executed in the Italian style, which she acquired by copying pictures and drawings from Sir Peter Lely's and the royal collections. She also imitated Vandyk. Her paintings have a good deal of nature, but the colouring is stiff and heavy. Her master, says Walpole, was supposed to have had a tender attachment to her, but as he was reserved in communicating to her all the resources of his pencil, it was probably a gallant rather than a successful one. Mrs Beale died in Pall Mall on the 28th December 1697, aged sixty-five.

BEAM, in weaving, a long thick wooden cylinder, placed lengthwise on the back part of the loom of those who work with a shuttle. That cylinder on which the stuff is rolled as it is weaved is also called the *beam* or *roller*, and is placed on the fore-part of the loom.

Beams of a Ship are the great main cross-timbers which hold the sides of the ship from falling together, and also support the deck and the orlops. The main beam is next the main-mast, and from it they are successively reckoned as first, second, third, and so on. The greatest beam of all is called the *midship beam*. A ship is said to be *on her beam-ends* when she inclines so much to one side that her beams approach to a vertical position.

Beam-Compass, an instrument consisting of a square wooden or brass beam, with sliding sockets that carry steel or pencil points. Beam-compasses are used for describing larger circles than can conveniently be drawn by the common compasses.

BEAMINSTER, or Beminster, a market-town in the parish of Netherbury, and county of Dorset. It is situated in a fruitful district surrounded with orchards, on the banks of the river Birt. It has some manufactures of sailcloth and other flaxen goods, coarse woollens, pottery, and tin, copper, and iron wares. Market-day Thursday. The town is well built, with a handsome church and free grammar-school. Pop. in 1851, 2085.

BEAN, the seed of certain leguminous plants cultivated for food all over the world, and furnished by three genera, *Faba*, *Phaseolus*, and *Dolichos*. The common bean, in all its varieties, as cultivated in this country and on the continents of Europe and America, is the produce of the *Faba vulgaris*. The French bean, kidney bean, or haricot, is the seed of the *Phaseolus vulgaris;* but in India several other species of this genus of plants are raised, and form no small portion of the diet of the inhabitants. From the genus *Dolichos*, again, the natives of India and South America procure beans or pulse, of no small importance as articles of diet, such as the *D. ensiformis*, or sword bean of India, the Lima beans, &c.; and two of the species *D. bulbosus* and *tetragonolobus* yield also tuberose roots, held in much estimation by the natives of India. These now form separate genera in modern botanical arrangements. The common bean is even more nutritious than wheat; containing 84 per cent. of nutritive matter, whereas wheat contains only 74 per cent. The principle use of beans is to feed horses, for which they are admirably adapted, as being far more nourishing than oats. In this country French beans are chiefly, almost exclusively, used in the green state, and the whole pod is eaten as a substitute for green peas. It is a wholesome and nutritious vegetable, and it is to be regretted that we do not follow the Dutch and Germans in preserving it for winter and spring use, when other green vegetables cannot be had. In Holland and Germany the pods of the French bean are preserved in salt by almost every family. The green pods are cut across obliquely, most generally by a machine invented for the purpose, and salted in barrels. In this state they keep the whole winter and spring. When wanted for use they are steeped in fresh water to remove the salt, and broiled or stewed, when they form an agreeable addition to the diet at a time when no other vegetable may be had. For the cultivation, &c., of the common bean, see Agriculture.

The ancients made use of beans in gathering the votes of the people, and for the election of magistrates. A white bean signified "absolution," and a black one "condemnation." Beans had a mysterious use in the *lemuralia* and *parentalia*, where the master of the family, after washing his hands three times, threw black beans over his head nine

Bean-Cod || Beard.

times, still repeating the words, "I redeem myself and family by these beans." Ovid gives a lively description of the whole ceremony. Abstinence from beans was enjoined by Pythagoras, one of whose symbols is κυάμων ἀπέχεσθαι, *abstinere a fabis*. The Egyptian priests held it a crime to look at beans, judging the very sight unclean: and among the Romans the *flamen dialis* was not permitted even to mention the name. The precept of Pythagoras has been variously interpreted. Some understand it to imply forbearing to meddle in trials and verdicts; others, resting on the equivoque of the word κύαμος, which signifies equally a *bean* and a human *testicle*, explain it by abstinence from venery. Clemens Alexandrinus grounds the prohibition against beans on their alleged quality of rendering women barren; and this is confirmed by Theophrastus, who asserts that some other plants have the same property. Cicero suggests another reason for this abstinence, namely, that beans are great enemies to tranquillity of mind. Hence Amphiaraus is said to have abstained from beans, even before Pythagoras, that he might enjoy a clearer divination by dreams.

Bean-Cod, a small fishing vessel, or pilot-boat, common in Portugal. It is extremely sharp forward, having its stem bent above into a great curve inward, plated on the fore-side with iron, and fortified with bolts. It is commonly navigated with a large lateen sail.

Bean-Fly, in *Natural History*, a very beautiful fly, of a pale purple colour, frequently found on bean-flowers. It is produced from the maggot called *mida*.

BEAR. See Mammalia, *Index*.

Bear, in *Astronomy*. See Ursa Major, and Astronomy.

Order of the Bear was a military order in Switzerland, instituted by the Emperor Frederick II. in 1213, by way of acknowledgment for the service the Swiss had done him, and in favour of the abbey of St Gall. To the collar of the order hung a medal, on which was represented a bear raised on an eminence of earth.

Bear or *Bere Island*, on the S.W. coast of Ireland, in Bantry Bay, is about six miles in length and one and a half broad. It lies twelve miles from Bantry, and is of a hilly and rugged aspect.

Bear Lake, *Great*, an extensive sheet of fresh water in the N.W. part of North America; between 65. and 67. N. Lat. and 117. and 123. W. Long. It is of a very irregular shape, and has an estimated area of 14,000 square miles. The Bear Lake River carries its waters into the Mackenzie River. It is upwards of 200 feet above the sea.

BEARD, the hair growing on the chin and adjacent parts of the adult male in the human subject.

Various have been the ceremonies and customs of nations in regard to the beard. The Tartars, from a religious principle, waged a long and bloody war with the Persians, declaring them infidels merely because they would not cut their whiskers after the fashion of Tartary; and we find that a considerable branch of the religion of the ancients consisted in the management of their beards. The Greeks wore their beards till the time of Alexander the Great; but that prince ordered the Macedonians to be shaved, lest the beard should afford a handle to their enemies. According to Varro and Pliny, the Romans did not begin to shave till the year B.C. 300, when P. Ticinius Mænas or Mæna brought barbers from Sicily.

Consecration of the beard was a ceremony among the Roman youth, who, when shaved for the first time, on assuming the *toga virilis*, kept a day of rejoicing, and were particularly careful to put the hair of their beard into a box, of silver or gold, and make an offering of it to some god, particularly to Jupiter Capitolinus, as was done by Nero, according to Suetonius.

The fashion of the beard has varied in different ages and countries; some cultivating one part of it, some another. The Hebrews wear a beard on the chin, but not on the upper lip or cheeks. Moses forbids them to cut off entirely the angle or extremity of their beard; that is, to manage it after the Egyptian fashion, leaving only a little tuft of beard at the extremity of the chin; whereas the Jews to this day suffer a little fillet of hair to grow from the lower end of their ears to their chins, where, as well as on their lower lips, their beards are in a pretty long bunch. The Jews, in time of mourning, neglected to trim their beards or cut off the superfluous growth on the upper lips and cheeks. In time of grief and great affliction they also plucked out the hair of their beards.

Beard.

Anointing the beard with unguents was an ancient practice both among the Jews and Romans, and still continues in use among the Turks. One of the principal ceremonies observed among the latter in serious visits, is to throw sweet-scented water on the beard of the visitant.

The discipline of the church has varied in the matter of beards. Ecclesiastics have sometimes been enjoined to wear them, from a notion of there being too much effeminacy in shaving, and that a long beard was more suitable to the ecclesiastical gravity; and sometimes again they have been forbidden to do so, from an idea that pride lurked beneath a venerable beard. The Greek and Roman churches have long differed on this important subject. Since the time of their separation, the Romanists seem to have given more into the practice of shaving by way of opposition to the Greeks; and have even made some express constitutions *de radendis barbis*. The Greeks, on the contrary, espouse very zealously the cause of long beards, and are extremely scandalized at the beardless images of saints in the Roman churches. By the statutes of some monasteries, it appears that the lay-monks were to let their beards grow, and the priests were enjoined to shave; and that the beards of all who were received into the monasteries were blessed with a great deal of ceremony. There are still extant the prayers used in consecrating the beard to God when an ecclesiastic was shaven.

Le Comte observes that the Chinese affect long beards extravagantly; but nature has balked them by only giving them a scanty growth, which however they cultivate with infinite care. Chrysostom observes that the kings of Persia had their beards woven or matted together with gold thread. The sculptures brought from Nineveh by Layard show the extreme care of their beards by that ancient race; and some of the first kings of France had their beards knotted and buttoned with gold.

Among the Turks, it is more infamous for any one to have his beard cut off, than among us to be publicly whipt or branded with a hot iron. The Arabs make the preservation of their beards a capital point of religion, because Mahomet never cut his. Hence the razor is never drawn over the face of the Sultan; and the Persians, who clip their beards and shave above the jaw, are reputed downright heretics. The slaves who serve in the seraglio have their beards shaven as a sign of their servitude.

The most celebrated ancient writers, and also some of later times, have spoken honourably of the fine beards of antiquity. Homer commemorates the white beard of Nestor, and that of old King Priam. Virgil describes that of Mezentius, which was so thick and long as to cover all his breast; and Chrysippus praises the noble beard of Timotheus, a famous player on the flute. Pliny the younger tells us of the white beard of Euphrates, a Syrian philosopher; and he takes pleasure in relating the respect and awe with which it inspired the people. Plutarch speaks of the long white beard of an old Laconian who on being asked why he let it grow to such length, replied, "It is that having my white beard continually before my eyes, I may do nothing unworthy of its whiteness." Strabo relates that the Indian philosophers called gymnosophists were particularly attentive to have their beards of sufficient length to "captivate"

Beard. the veneration of the people;—Diodorus gives a very circumstantial history of the beards of the Indians;—Juvenal does not forget that of Antilochus the son of Nestor;—Fenelon, in describing a priest of Apollo in all his magnificence, tells us that he had a white beard down to his girdle;—and Persius, convinced that a beard was the symbol of wisdom, thought he could not bestow a greater encomium on Socrates than by calling him the bearded master, *Magistrum barbatum.*

Whilst the Gauls were under the sway of their native sovereigns, none but the nobles and Christian priests were permitted to wear long beards. But the Franks, having made themselves masters of Gaul, assumed the same authority as the Romans; the bondmen were expressly commanded to shave their chins; and this law continued in force until the entire abolition of servitude in France. So, likewise, in the time of the first race of kings, a long beard was the sign of nobility and freedom; and the kings, as being the highest nobles in their kingdom, were emulous to display the largest beards. Eginhard, secretary to Charlemagne, speaking of the last kings of the first race, says they came to the assemblies in the field of Mars in a carriage drawn by oxen, and sat on the throne with their hair dishevelled, and a very long beard, *crine profuso, barba submissa, solio residerent, ut speciem dominantis effingerent.*

To touch any one's beard, or cut off a bit of it, was, among the early French, the most sacred pledge of protection and confidence. For a long time all letters that came from the sovereign had, for greater sanction, three hairs of his beard in the seal; and there is still in being a charter of 1121 which concludes with the following words: *Quod ut ratum et stabile perseveret in posterum, præsenti scripto sigilli mei robur apposui cum tribus pilis barbæ meæ.*

Several great men received or adopted the surname of *Bearded.* The Emperor Constantine IV. is distinguished by the epithet of *Pogoniates;*—in the time of the Crusades, we find there was a *Geoffrey the Bearded;*—Baldwin IV., Earl of Flanders, was surnamed *Handsome-Beard;*—and, in the illustrious house of Montmorenci there was a famous *Bouchard* who took a pride in the surname of *Bearded,* and was always the declared enemy of the monks, doubtless because they were shavelings.

In the tenth century, we find that King Robert of France, the rival of Charles the Simple, was not more famous for his exploits than for his long white beard. In order that it might be more conspicuous to the soldiers when he was in the field, he used to let it hang down outside his cuirass; and this venerable sight encouraged the troops in battle, and served to rally them when defeated. A celebrated painter in Germany, called John Mayo, had so large a beard that he was nicknamed *John the Bearded.* He wore it fastened to his girdle; and though he was a very tall man, it hung upon the ground when he stood upright. John would sometimes untie it in the presence of the Emperor Charles V., who took great pleasure in seeing the wind make it fly against the faces of the lords of his court. In England, the chancellor Sir Thomas More, one of the greatest men of his time, was able, when on the fatal scaffold, to procure respect for his beard, and saved it by a pleasantry. When he had laid his head on the block, he drew his beard aside, observing, "My beard has not been guilty of treason; it would be an injustice to punish it."

Every one has admired on medallions and in portraits the beard of the renowned Henry IV. of France, "which gave to the countenance of that prince a majestic dignity, and which ought to serve as a model for that of every great king, as the beard of his illustrious minister should for that of every statesman." But there is little dependence on the stability of the things of this world. By an event equally fatal and unforeseen, the beard, which had arrived at its highest degree of glory, all of a sudden lost its favour, and was at length entirely proscribed. The unexpected death of Henry the Great, and the youth of his successor, were the sole causes of this revolution. Louis XIII. mounted the throne of his glorious ancestors without a beard. Every one concluded immediately that the courtiers, seeing their young king with a smooth chin, would look upon their own as too rough; and the conjecture proved correct. They presently reduced their beards to whiskers, and a small tuft of hair under the nether lip. But the people at first refused to follow this dangerous example. The Duke of Sully also persisted in clinging to his beard. This man, great as a general and a minister, was likewise so in his retirement, and had the courage to keep his long beard, nay, to appear with it at the court of Louis XIII., when called thither to give his advice in an affair of importance. The young smooth-shaven courtiers laughed outright at the grave look and old fashioned appearance of the venerable minister; on which the latter, probably jealous of the honour of his beard, observed to the king, "Sir, when your father, of glorious memory, did me the honour to consult me on his great and important affairs, the first thing he did was to send away all the buffoons and stage-dancers of his court." Beard.

The Czar Peter had the boldness to impose a tax on the produce of his subjects' chins. He ordered that the noblemen and gentlemen, tradesmen and artisans, should pay a hundred rubles for the privilege of retaining their beards, and that the lower class of people should pay a copec for the same liberty; and he established clerks at the gates of the different towns to collect these duties. Such a new and singular impost troubled the vast empire of Muscovy, and both religion and manners were thought in imminent danger. But Peter was inflexible, and shaving began in good earnest; the Russians very generally coming to the conclusion that it was better to cut off their beards than to give serious offence to a man who had the power of cutting off their heads.

Example, more powerful than authority, produced in Spain what the Czar Peter had not accomplished in Russia without great difficulty. Philip V. ascended the throne with a shaven chin. The courtiers imitated the prince, and the people in turn imitated the courtiers. This revolution however, although brought about gradually, and without violence, caused much lamentation and murmuring; the gravity of the Spaniards lost by the change, and they said, *Desde que no hay barba, no hay mas alma;* "since we have lost our beards, we have lost our souls." In fact, among those European nations which have been most curious in beards and whiskers, we must distinguish Spain. This grave romantic people has always regarded the beard as an ornament which ought to be peculiarly prized, and indeed has often made the loss of honour consist in that of their whiskers. Nor have the Portuguese, whose national character is much the same, been behind them in this respect. In the reign of Catherine queen of Portugal, the brave John de Castro had taken the castle of Diu in India. Victorious, but in want of everything, he found himself obliged to ask the inhabitants of Goa to lend him a thousand pistoles for the maintenance of his fleet; and as a security for that sum he sent them one of his whiskers, telling them,—"All the gold in the world cannot equal the value of this natural ornament of my valour; and I deposit it in your hands as a security for the money." The whole town was penetrated with his heroism, and every one interested himself about this invaluable whisker: even the women were desirous to give marks of their zeal for so brave a man; several sold their bracelets to increase the sum asked for; and the inhabitants of Goa sent him immediately both the money and his whisker.

In Louis XIII.'s reign, whiskers (moustaches) attained the highest degree of favour, at the expense of the expiring

Bearing. beards. In those days of gallantry, not yet empoisoned by wit, they became the favourite occupation of lovers. A fine black mustachio, elegantly turned up, was a very powerful recommendation to the favour of the fair sex. They were still in fashion in the beginning of Louis XIV.'s reign; and this king, with all the great men of his time, took a pride in wearing them. They were consequently the ornament of Turenne, Condé, Colbert, Corneille, Molière, &c. It was then no uncommon thing for a favourite lover to have his moustaches turned up, combed, and dressed by his mistress; and hence a man of fashion took care to be always provided with every little necessary article, especially whisker-wax. It was highly flattering to a lady to have it in her power to praise the beauty of her lover's moustaches, which, far from being disagreeable, gave his person an air of vivacity; and several even thought them an incitement to love. But the levity of the French caused several changes both in their form and name; there were *Spanish, Turkish, guard-dagger* whiskers, nay, even *royal* ones, which were the last worn; the smallness of these proclaiming their approaching fall.

Kissing the BEARD. The Turkish wives kiss their husbands' beards, and children their fathers', as often as they come to salute them. The men kiss one another's beards reciprocally on both sides when they salute in the streets, or return from a journey.

Bearded Women. Of these there have been several remarkable instances. In the cabinet of curiosities of Stuttgard in Germany, there is the portrait of a woman called Bartel Grætje, whose chin is covered with a very large beard. Her portrait was painted in 1587, at which time she was only twenty-five years of age. It is said that the Duke of Saxony had the portrait taken of a poor Swiss woman, remarkable for her long bushy beard; and those who attended the carnival at Venice in 1726 saw a female dancer astonish the spectators not more by her talents than by her chin covered with a black bushy beard. Charles XII. had in his army a female grenadier, who had both the beard and courage of a man. She was taken prisoner at the battle of Pultowa, and carried to Petersburg, where she was presented to the Czar in 1724; her beard measured a yard and a half. A woman was once seen at Paris who had not only a bushy beard on her face, but her body likewise covered all over with hair. Amongst a number of examples of this nature, that of Margaret, the Governess of the Netherlands, is very remarkable. She had a very long stiff beard, on which she prided herself; and being persuaded that it contributed to give her an air of majesty, she took care not to lose a single hair of it. The Lombard women, it is said, when they went to war, made themselves beards with the hair of their heads, which they ingeniously arranged on their cheeks, in order that the enemy might take them for men.

Beard of a Comet, the rays which the comet emits towards that part of the heavens to which its proper motion seems to direct it, is distinguished from the tail, which denotes the rays emitted towards that part from which its motion appears to carry it.

BEARING, in *Navigation*, an arch of the horizon intercepted between the nearest meridian and any distant object, either discovered by the eye and referred to a point on the compass, or resulting from the spherical proportion; as, in the first case, "at four P.M. Cape Spado, in the isle of Candia, bore S. by W. by the compass." In the second, the longitudes and latitudes of any two places being given, and consequently the difference of latitude and longitude between them, the bearing of one from the other is discovered by the following analogy: As the meridional difference of latitude is to the difference of longitude, so is the radius to the tangent of the bearing.

BEARING is also the situation of any distant object estimated from some part of the ship according to her position. An object so discovered must be either ahead, astern, abreast, on the bow, or on the quarter. If the ship sails with a side wind, it alters in some measure the names of such bearings, since a distant object on the beam is then said to be to leeward or to windward; on the lee-quarter or bow, and on the weather-quarter or bow. Bearings ‖ Beatitude.

BEARINGS, in *Heraldry*, a term used to express a coat of arms.

BEAST, a general appellation given to all four-footed animals, fit either for food, labour, or sport.

BEAT, in the Manége. A horse is said *to beat the dust* when at each stroke or motion he does not take in ground or way enough with his fore-legs.

Beat of Drum, in the military art, is a succession of strokes, varied in different ways, for particular purposes; as, an alarm of sudden danger; a notice to repair immediately to arms or quarters; or an order to obey a movement either in advance or retreat. To *beat the tattoo*, is to give notice for retiring to quarters by a very rapid succession of strokes on the drum.

BEAT, *St*, a town of France, in the department of Upper Garonne, at the confluence of the Garonne and the Pique. It stands in a narrow ravine, which renders it gloomy. The houses are chiefly built of marble. Pop. 1400.

BEATERS. See GOLD-BEATERS.

BEATIFICATION, an act by which the pope declares a person beatified or blessed after his death. It is the first step towards canonization, or raising any one to the honour and dignity of a saint. The corpse and relics of the future saint are exposed to the veneration of all good Christians; his images are crowned with rays, and a particular office is set apart for him, but his body and relics are not carried in procession. Indulgences and remissions of sins are likewise granted on the day of his beatification.

BEATING THE WIND, was a practice in use in the ancient method of trial by combat. If one of the combatants did not appear in the field at the time appointed, the other was to make so many flourishes with his weapon, by which he was entitled to all the advantages of a conqueror.

Beating Time, in *Music*, a method of measuring and marking the time for performers in concert, by a motion of the hand or foot up and down successively and in equal times. The Romans had an officer called *portisculus* in each galley, whose business it was to beat time to the rowers by a pole or mallet, or by his voice alone. The ancients marked the rhythm in their musical compositions; but to make it more observable in practice, they beat the measure or time, and this in different manners. The most usual method consisted in a motion of the foot, which was raised from and struck alternately against the ground. This was commonly the province of the master of the music, called μεσόχορος and κορυφαῖος, because placed in the middle of the choir of musicians, and in an elevated situation, in order to be more easily seen and heard by the whole company. These beaters of measure were also called by the Greeks ποδοψόφοι, because of the noise of their feet; the Latins denominated them *pedarii, podarii*, and *pedicularii*. To make the beats or strokes more audible, their feet were generally shod with a sort of sandals made of wood or iron, called by the Grecks κρούπεζια, κρούπαλα, κρούπετα, and by the Latins *pedicula, scabella*, or *scabilla*, because resembling little stools or foot-stools. The ancients also beat time or measure with shells, as oyster shells, and bones of animals, which they struck against one another, in the manner of the modern castanets and similar instruments. Other noisy instruments, as drums, cymbals, and citterns, were also used for the same purpose.

BEATING, in *Navigation*, the operation of making progress at sea against the wind, by steering in a zigzag course.

BEATITUDE imports the supreme good, or the highest

Beaton || Beattie.

degree of happiness human nature is susceptible of; in other words, the most perfect state of a rational being, wherein the soul has attained to the utmost excellency and dignity it is capable of. In this sense it is equivalent to what we call "blessedness," or "sovereign felicity," the Greeks εὐδαιμονία, and the Latins *summum bonum*, *beatitudo*, and *beatitas*. Beatitude, in a theological sense, denotes the beatific vision, or the fruition of God in a future life to all eternity. This term is also used in speaking of the opening theses of Christ's sermon on the mount.

BEATON, DAVID (CARDINAL BEATON), archbishop of St Andrews, an eminent Scottish statesman and ecclesiastic, born in 1494. He was made a cardinal by Pope Paul III. in December 1538; and having been employed by James V. in negotiating his marriage at the court of France, he was there consecrated bishop of Mirepoix. Soon after his instalment as archbishop of St Andrews, he promoted a furious persecution of the reformers in Scotland; but the king's death put a stop for a time to his arbitrary proceedings. He was excluded from the management of public affairs, and thrown into confinement; but he soon raised so strong a party that, upon the coronation of the young Queen Mary, he was admitted of the council, made chancellor, and procured a legatine commission from the court of Rome. He now began to renew his persecution of heretics; and, amongst others, the famous Protestant preacher George Wishart suffered death at the stake in front of the cardinal's residence at St Andrews. It is alleged that Wishart, in the midst of the flames, foretold that Beaton would die a violent death; a prediction which probably proved the cause of its own fulfilment, as the persecutor was assassinated in his chamber, May 29, 1547. See SCOTLAND.

BEATTIE, JAMES, LL.D., a distinguished moralist and poet, was born on the 25th of October 1735, at Laurencekirk, then an obscure hamlet, in the county of Kincardine in Scotland; near which place his father rented a small farm. He received his early education at the common school of the parish, of which it is recorded that Ruddiman had been teacher about forty years before. His acquirements are said to have been interrupted at this time by want of books; a difficulty which has excited commiseration in more instances than that of Beattie, but which is so little able to control natural genius that it seems almost an incitement to its exertions; as "all impediments in fancy's course are motives to more fancy." He first became acquainted with English versification through Ogilby's translation of Virgil.

By his father's death he had been thrown, while yet of tender age, on the care of his elder brother, David Beattie; who, observing his natural endowments, afforded him, notwithstanding his own limited means, every aid in his power towards a liberal education, and in the year 1749 placed him at Marischal College, Aberdeen, where he soon afterwards obtained a bursary or exhibition. Here he had the advantage of pursuing his studies under Dr Thomas Blackwell, author of the *Life of Homer*, Dr Gerard, and other eminent men. In addition to his academical course, he began at this time to instruct himself in the Italian language, and appears to have had a strong predilection for Metastasio.

In 1753 he was appointed schoolmaster of Fordoun, a small village at the foot of the Grampian Mountains, where he likewise performed the duty of precentor or parish clerk, usually attached to that office in Scotland. Here he indulged the propensities of the youthful poet, and frequently wandered during a whole night in the fields, "chewing the cud of sweet and bitter fancy;" and it was from a height in this neighbourhood that his eye first caught a glimpse of the ocean. From the scenery of this secluded spot he appears to have derived, as might be expected, many of those images which he afterwards transferred into his poetical compositions; and certainly no exertion of the inventive powers can furnish representations equal to these immediate copies from nature. Such is that picture in the small poem which he calls *Retirement*

Beattie.

> "Thy shades, thy silence, now be mine,
> Thy charms my only theme;
> My haunt the hollow cliff whose pine
> Waves o'er the gloomy stream;
> Whence the scared owl on pinions gray
> Breaks from the rustling boughs,
> *And down the lone vale sails away*
> *To more profound repose.*"

Such also, among many others in the *Minstrel*, are those beautiful pictures contained in the 20th and 21st stanzas of the first canto.

In this secluded place Beattie was discovered and noticed by Mr Garden, afterwards Lord Gardenstown, then sheriff of the county, and by Lord Monboddo. In 1757 he became a candidate for the situation of usher in the grammar-school of Aberdeen. He was at this time foiled in the competition; but next year, on the occasion of a new vacancy, he was requested to accept the office. Lastly, he was removed, in 1760, to the professorship of Moral Philosophy and Logic in the Marischal College. Here he passed the remainder of his life, occupied in the zealous discharge of his professional duties, and in literary pursuits. Here, too, he possessed all the advantages of a congenial society in the company of Dr George Campbell, Dr Reid, Dr Gerard, and other celebrated men who then adorned the university of Aberdeen.

His first publication was a small collection entitled *Original Poems and Translations*, which was printed in 1760 or 1761. Of many of the pieces contained in this little volume he was afterwards ashamed, and not only omitted them in the subsequent selections which he published, but endeavoured, as far as possible, to obliterate all traces and recollection of them. Of these lesser pieces, *The Hermit* is best known; which, though it cannot be considered as a finished composition, is full of pathos and beauty. In *The Battle of the Pigmies and Cranes*, translated from the Latin of Addison, he has displayed a greater command of terse and happy expression than in most of his original pieces.

Beattie was married, in 1767, to Miss Mary Dun, daughter of Dr James Dun, rector of the grammar-school of Aberdeen. This connection, at first every way auspicious for his happiness, proved in the sequel a source of the deepest distress; for in the course of a few years Mrs Beattie, whose mother had laboured under a similar malady, showed unequivocal symptoms of mental disorder, which terminated in a state of confirmed insanity.

In the year 1770 Beattie published his *Essay on the Nature and Immutability of Truth in opposition to Sophistry and Scepticism*. His design was "to prove the universality and immutability of moral sentiment;" and his motives for the undertaking are sufficiently evident from the title which he has prefixed to the book. He appears to have been particularly encouraged to the prosecution of this task by the opinions of Dr John Gregory and Dr Blacklock. A general outline of the work, which appeared in most of the journals previously to its publication, was prepared by the latter. His original intention, as expressed by himself in one of his letters, was, "first, to have considered the permanency of truth in general;" and, secondly, to have applied the principles which he should have established "to the illustration of certain truths of morality and religion, to which the reasonings of Helvetius, of Mr Hume in his *Essays*, and of some other modern philosophers, seemed unfavourable." Of this plan the former part only was completed. It is well known that, in the execution of it, the author did not spare the opinions of those whom he considered the enemies of religious and moral truth, and particularly treated the

Beattie. writings of Hume without reserve or qualification. The friends of the latter took up arms in return, representing the *Essay* as a piece of personal and unprovoked hostility; and, some time after, the opinions which it contained were canvassed in a more public manner, and with much severity, in an *Examination* by Dr Priestley. These attacks or retaliations were met by Beattie with the same firmness which he had displayed in the original publication of his sentiments; nor would he ever consent to abate either the plainness or spirit with which he had expressed them.

In proportion to the censure which this publication called forth from a certain number of persons, was its favourable reception with a different class. It was the means of gaining for its author the unsolicited good offices of George Lord Lyttleton, Dr Johnson, Hurd bishop of Worcester, Percy bishop of Dromore, and many others. From the great success of the work, a second edition of it was called for in 1771. Beattie visited London in the same year, and again in 1773. On the last of these occasions he received some flattering marks of public notice and distinction. He had the honour of being admitted to a private and long interview with His Majesty; received from the university of Oxford an honorary degree of doctor of laws at the same time with Sir Joshua Reynolds; and was afterwards requested by the latter to sit for his portrait. The reputation of his *Essay*, and still more, perhaps, the motives and general character of the author, likewise procured for him about this time a yearly pension of L.200 from the crown.

In the course of the same year, 1773, he published the first part of his *Minstrel, or the Progress of Genius;* to which he added a second part in 1774. His object, as described by himself, was "to trace the progress of a poetical genius, born in a rude age, from the first dawning of fancy and reason till that period at which he may be supposed capable of appearing in the world as a minstrel; that is, as an itinerant poet and musician; a character which, according to the notion of our forefathers, was not only respectable but sacred." It appears from his letters that he little anticipated the favourable reception which this poem obtained from the public; a doubt which was probably founded on the want of incident and variety of character in the composition. Its merit, however, was quickly acknowledged; and by it the author's reputation as a poet and a man of genius was raised to its height.

On occasion of a vacancy which occurred soon after in the chair of natural and experimental philosophy at Edinburgh, it was proposed that Dr Beattie should become a candidate; to which step he was strongly urged by some of his friends, particularly Lord Hales; and about the same period he received various offers of preferment in the English church. These plans of promotion, however, he successively declined, considering the situation which he held as best adapted to his abilities, and affording him the greatest opportunities of usefulness. His reluctance to accept a chair in the university of Edinburgh arose partly, indeed, from the remaining effect of those heats which controversial metaphysics had produced. "I am so great a lover of peace," he says in a letter to one of his friends on this occasion, "and so willing to think well of my neighbours, that I do not wish to be connected with one person who dislikes me."

Between the years 1780 and 1793 he published his *Elements of Moral Science*, and various other works, moral and critical, which are well known, and deservedly popular. He enjoyed the acquaintance and friendship of many distinguished characters in different classes of society. Among his literary correspondents in England were Bishop Porteous, Mrs Montagu, Scott the poet of Amwell, and Gray. He was intrusted by the latter, in 1768, with superintending Beattie. an edition of his poems, printed by Foulis.

During the latter period of his life Dr Beattie experienced a new train of domestic calamities, which, added to the unfortunate situation of Mrs Beattie, gradually undermined his health and impaired his intellectual powers. The first and severest of these trials was the loss of his eldest son, James Hay Beattie, who died in 1790; in whose society he had found one of his greatest enjoyments, and who had already been associated with him in the professorship of moral philosophy, at the early age of nineteen.[1] Some years after, his only remaining son, Montagu Beattie, likewise died, after a short illness. This event he intimated to one of his friends, by a letter written on the same day, in the terms of calm and unaffected resignation. But his mind had been violently shaken even before this blow; and when he looked on the dead body of his son for the last time, he gave way to the scene, and exclaimed, "Now I have done with this world." Its first effect was the loss of memory respecting his deceased son. Yet it was found that, by the mention of what the latter had suffered during his sickness, his recollection could usually be recalled. He continued to discharge his duty as professor; but, notwithstanding some returns of a more vigorous intellect and fancy, he did not from this time resume his studies, and seldom answered the letters which he received. He was attacked with palsy in 1799, and afterwards sustained repeated shocks, the last in 1802. He lingered till the 18th of August 1803, when he expired at the age of sixty-eight. A particular account of his life and writings, by Sir William Forbes of Pitsligo, who had long been his friend and confidant, was published in 1806, in which are to be found some interesting selections from his private correspondence.

The character of Dr Beattie is delineated in his writings, of which the most prominent features are purity of sentiment, and warm attachment to the principles of religion and morality. His dispositions were gentle and modest, and he possessed great tenderness of heart. He was laborious in his literary pursuits, yet fond at all times of conversation and society. Towards the latter period of his life he was subject to an irritability of nerves, by which his temper was sensibly affected; and though, to appearance, his bodily frame was robust, he had impaired his strength by excessive study. He possessed considerable talents both for music and drawing.

His abilities as a writer may be said to have already undergone that ultimate test which is to be found in public opinion; and it has ranked him high as a moralist, a critic, and a poet. His *Essay on Truth* became a very popular book, particularly in England, and has gone through many editions. It must be confessed that this work is not without considerable faults as a philosophical composition. Its leading doctrine has been thus stated by himself: "As we know nothing of the eternal relations of things, *that* to us is and must be *truth* which we feel that we must believe; and *that* to us is falsehood which we feel that we must disbelieve. I have shown that all genuine reasoning does ultimately terminate in certain principles, which it is impossible to disbelieve, and as impossible to prove; that, therefore, the ultimate standard of truth to us is common sense, or that instinctive conviction into which all true reasoning does resolve itself." What constitutes the chief defect of the *Essay* is a want of that strictness and precision which a discussion of the metaphysical parts of the subject necessarily requires. His *Elements of Moral Science*, and his different critical and philological treatises, are compositions of a very pleasing character; and it was chiefly by them that his reputation was established in other countries. Some of his books were early translated into the Dutch and other languages. A French

[1] An interesting account of his life and character, by Dr Beattie, with a small collection of his compositions in prose and verse, was published in the year 1800.

Beaucaire ‖ Beauharnois.

translation of his *Essays on Poetry and Music* was printed at Paris in 1798. But it is chiefly as the author of the *Minstrel* that Beattie is known, and will continue to be admired. This poem, or rather poetical fragment, for the design was not completed, stands fully confirmed in the public favour. A single stanza may suffice to show the author's exquisite appreciation of the beauties of nature:—

"O, how canst thou renounce the boundless store
Of charms which Nature to her votary yields!
The warbling woodland, the resounding shore,
The pomp of groves, and garniture of fields;
All that the genial ray of morning gilds,
And all that echoes to the song of even,
All that the mountain's sheltering bosom shields,
And all the dread magnificence of heaven;—
O, how canst thou renounce, and hope to be forgiven!"

It has been objected to the second part of this poem that it contains too much philosophy. But, though the instruction conveyed in it be frequently addressed to the understanding, it is never abstruse, and the lessons are those of a poet not less than of a moralist. Like the *Castle of Indolence*, it is in scope and design a didactic piece. Both commence in the highest strain of descriptive and pathetic poetry; and the subsequent depression of tone in both is a necessary result of this lofty preparation. But the criticism is more just when applied to the work of Thomson than to the *Minstrel*.

The following is a list of Dr Beattie's writings: *Poems*, first published in 1760; *Essay on Truth*, 1771; *Minstrel*, 1771, 1774; *Essays*, viz., On Poetry and Music—On Laughter and Ludicrous Composition—On Classical Learning, 1776; *Dissertations*, viz., On Memory and Imagination—On Dreaming—On the Theory of Language—On Fable and Romance—On the Attachments of Kindred—and Illustrations of Sublimity, 1783; Evidences of Christianity, 1706; and Elements of Moral Science, 1790, 1793. He likewise published, in 1790, an edition of Mr Addison's papers in the *Tatler*, *Spectator*, *Guardian*, and *Freeholder*, and of his *Treatise on the Christian Religion*, with his *Life of Tickell*, and some original Notes, Edinburgh 4 vols. 8vo. (J. G—D.)

BEAUCAIRE, the ancient *Ugernum*, a town of France, department of Gard, and arrondissement of Nismes. Lat. 43. 48. 32. N. Long. 4. 38. 50. E. It is situated on the right bank of the Rhone, opposite Tarascon, with which it is connected by a magnificent suspension-bridge of four arches, and 1456 feet in length. The town is generally well built, but has no public buildings worthy of notice, and the streets are narrow and crooked. Its ancient castle is now in ruins. It gives name to the canal which communicates with the sea, and also connects it with the canal of Languedoc, forming part of the line of communication between the Rhone and the Garonne. It is also connected with Nismes and Alais by a railway opened in 1839. The manufactures are few and unimportant. The town derives its celebrity from the annual fair held here from the 1st to the 28th of July, and to which merchants come from all parts of Europe, and even from Persia and Armenia. An extensive meadow on the banks of the Rhone is set apart for the fair, which exhibits almost every kind of article, whether of convenience or luxury. Though now less frequented than formerly, it is said that still as many as 100,000 persons attend. Pop. of town in 1846, 8536.

BEAUFORT, Cardinal, son of John of Gaunt. See England.

Beaufort, a town of France, department of Maine and Loire, with a castle, sixteen miles E. of Angiers. Pop. 3000.

BEAUHARNOIS, Eugene, step-son of Napoleon, who treated him and his sister as children of his own. He was born in 1780, and in 1806 married the Princess Augusta Amelia of Bavaria. He was viceroy of the kingdom of Italy from 1805 to 1814. He accompanied Buonaparte in his Italian campaigns, and in Egypt; was with him in the disastrous Russian campaign of 1812–13; and after Napoleon and Murat left the army, the chief command devolved on Eugene, who had shown skill and courage during the retreat. He appears to have been an amiable and judicious man. After the overthrow of Napoleon in 1814, he withdrew to Munich, and died there in 1824, at the age of forty-five.

Beaulieu ‖ Beaumarchais.

BEAULIEU, Sébastien de Pontault de, a celebrated French engineer and field-marshal under Louis XIV. He published plans of all the military expeditions of his master, with military disquisitions annexed. He died in 1674.

BEAULY, a village of Scotland, county of Inverness, situated on the north side of the river Beauly, where it flows into the Moray Firth. On this river there is a fine cascade called the Falls of Kilmorack. Beauly has the remains of a Cistercian abbey, founded in the year 1230. The port is accessible to vessels of ninety tons burden. The trade carried on is inconsiderable. Distance west of Inverness, ten miles. Long. 4. 21. W. Lat. 57. 29. N.

BEAUMARCHAIS, Pierre Augustin Caron de, appears to have been one of those persons who, from restlessness of disposition and singularity of character, obtain, in their own age, more celebrity than they are entitled to from their merit or talents. He was born at Paris in 1732, and was the son of a clockmaker, who brought him up to his own trade. From his earliest youth, however, he discovered an inclination for literature, together with a remarkable talent for music. His proficiency in this art procured him an introduction to the French court, where he was employed to teach the princesses, daughters of Louis XV., to play on the guitar. At their concerts, which he attended, he became acquainted with the banker Duverney, by whom he was instructed in business, and placed in a situation which was likely to lead to fortune. Beaumarchais first attracted public attention by his drama of *Eugénie*, which was published in 1767; but he was chiefly indebted for the notoriety he obtained to the various law-suits in which he became involved after the death of his patron Duverney. The chief advantage which he acquired from these various processes was the astonishing interest and admiration which were universally excited in France by the *Factums* or *Memoires* which he wrote in his defence; in which the most logical and convincing argument is diversified with the bitterest sarcasm, the keenest raillery, and the relation of incidents as strange and amusing as any which are met with in romance. These able and lively productions, however, procured him many enemies, as they discovered him to be a man of a most resentful and calumnious disposition. Though occupied with these processes and various literary pursuits, Beaumarchais did not neglect the improvement of his fortune. He engaged in various speculations, of which the most profitable was his project of supplying the Americans with arms and ammunition during the war with this country. Having thus gained a considerable fortune, he built a magnificent villa in the Faubourg St Antoine, which he embellished with much taste and at great expense. He afterwards lost some part of the money he had acquired by an expensive and ill-executed edition of the works of Voltaire; and neither the early support which he gave to the principles of the French revolution, nor his importation of fire-arms for the use of the French forces, was sufficient to preserve his property from confiscation, or his person from proscription. The sufferings and dangers which he experienced during this period have been detailed by him in a work entitled *Mes Six Époques*, which is written with considerable force and interest. After he had endured every species of accusation and persecution, and had passed some time as an exile from his native country, he returned to France when the storms of the revolution had subsided into a more settled tyranny; and having recovered po[illegible]ion

Beaumaris || Beaumont and Fletcher.

of his villa in the Faubourg St Antoine, he remained there till his death, which happened suddenly in the year 1799.

Besides his *Mémoires*, Beaumarchais is the author of various dramatic productions, which made a great noise, and gained him considerable reputation in Paris at the time they appeared. His works were published at Paris in 1809, in 8 vols. 8vo; and in 1827, in 6 vols. 8vo. (W. H–Z–T.)

BEAUMARIS, a borough and market-town of Anglesey, North Wales. It is situated on the bay of Beaumaris, at the northern entrance of the Menai Straits, in Lat. 53. 16. N. Long. 4. 5. W. The town consists of several neat streets, and at the extremity of the principal one stands the castle. This fortress was built by Edward I. about 1295. It covers a great extent of ground, but its imposing effect is somewhat lessened by its low position, which was so designed that the fosse might communicate with the sea, so that vessels might unload beneath its walls. The chapel dedicated to the Virgin is a spacious structure containing several fine monuments. A free school was founded here in 1603. The principal buildings are the town-hall, county-hall, prison, custom-house, assembly-room, and national school. Beaumaris has no manufactures, but is much frequented as a bathing-place. The corporation consists of a mayor, four aldermen, and nine councillors. It unites with Holyhead, Amlwch, and Llangefni, in returning a member to parliament. Market-day Saturday. The bay affords good anchorage, having seven fathoms of water at the lowest ebb. Pop. in 1851, 2599.

BEAUMONT, Sir George Howland, the seventh baronet of a family in Leicestershire, was a distinguished amateur of the fine arts, and an excellent landscape painter. He was a munificent contributor to the National Gallery, and to that of Dulwich. He was born in 1753, and died in 1827.

Beaumont, *Sir John*, the elder brother of Francis Beaumont the famous dramatic poet, was born in the year 1582, and in 1626 had the dignity of baronet conferred upon him by Charles I. In his youth he applied himself to poetry with tolerable success, and wrote *The Crown of Thorns*, a poem, in eight books; a miscellany, entitled *Bosworth Field;* Translations from the Latin poets; and several poems on religious and political subjects. He died in 1628. His poetic genius was celebrated by Ben Jonson, Michael Drayton, and others.

Beaumont and Fletcher, two celebrated English dramatic writers, who flourished in the reign of James I., and were so closely connected, both as authors and as friends, that it has been judged not improper to give them under one article.

Francis Beaumont was descended from an ancient family at Grace-Dieu, in Leicestershire, where he was born about the year 1585 or 1586, in the reign of Queen Elizabeth. His grandfather, John Beaumont, was Master of the Rolls, and his father, Francis Beaumont, one of the judges of the Common Pleas. He was educated at Cambridge, and afterwards admitted of the Inner Temple. It does not, however, appear that he made any great proficiency in the law, a study which may be presumed to have been too dry and unentertaining for a man of his fertile and sprightly genius. Indeed we should scarcely be surprised to find that he had given no application to any study but poetry, nor attended on any court but that of the Muses: our attention might rather fix itself on the opposite extreme, and fill us with admiration of the extreme assiduity of his genius and rapidity of pen, when we consider the voluminousness of his works, and the brief space allowed him for their composition; works, the execution of which might well have occupied a long life. For although, out of fifty-three plays which are collected together as the joint labours of these brother-authors, Beaumont was concerned in much the greater part, yet he did not live to complete his thirtieth year. He died in the beginning of March 1616, on the ninth day of which he was interred in the entrance of St Benedict's Chapel, in Westminster Abbey. There is no inscription on his tomb; but there are two epitaphs to his memory, one by his elder brother Sir John Beaumont, and the other by Bishop Corbet. He left a daughter, Frances Beaumont, who died in Leicestershire some time after the year 1700. She had in her possession several poems of her father's composition; but these were lost at sea in a voyage from Ireland, where she had lived for some time in the Duke of Ormond's family.

Beaumont and Fletcher.

John Fletcher was not more meanly descended than his poetical associate; his father, the Rev. Dr Fletcher, having first been made bishop of Bristol by Queen Elizabeth, and afterwards by the same princess, in the year 1593, translated to the rich see of London. The poet was born in 1576; and, like his friend, was educated at Cambridge, where he made great proficiency in his studies, and was accounted a very good scholar. A natural vivacity of wit, for which he was remarkable, soon rendered him a devotee of the Muses; and his close attention to their service, and fortunate connection with a genius equal to his own, soon raised him to one of the highest places in the temple of poetical fame. As he was born near ten years before Beaumont, so also he survived him by an equal period; the plague, which broke out in the year 1625, having carried him off in the forty-ninth year of his age.

During the joint lives of these two great poets, it appears that they wrote nothing separately, excepting one little piece each, which seemed of too trivial a nature for either to require assistance in, namely, *The Faithful Shepherd*, a pastoral, by Fletcher; and *The Masque of Gray's Inn Gentlemen*, by Beaumont. Yet what share each had in the writing or designing of the pieces composed by them jointly, there is no possibility of determining. It is however generally allowed that Fletcher's peculiar talent was wit, and Beaumont's, though much the younger man, judgment. Nay, so extraordinary was the latter property in Beaumont, that it is recorded of Ben Jonson, who seems to have been by no means wanting in a good opinion of his own abilities, that he constantly, during the lifetime of Beaumont, submitted his own writings to his censure, and, as is thought, availed himself of his judgment at least in the correction, if not even in the contrivance of all his plots. It is probable, therefore, that Beaumont's share of the work generally consisted in forming the plots and contriving the conduct of the fable, as well as writing the more serious and pathetic parts, and lopping off the redundant branches of Fletcher's wit, whose luxuriance, it is said, stood frequently in need of castigation. Fletcher, again, whose conversation with the fashionable world (to which indeed both of them from their birth and station in life had been ever accustomed), added to the volatile and lively turn he possessed, rendered him perfectly master of dialogue and polite language, probably executed the designs formed by the other, and raised the superstructure of those lively and spirited scenes of which Beaumont had only laid the foundation. In this he was so successful, that although his wit and raillery were extremely keen and poignant, yet they were at the same time so perfectly polished, that they used rather to please than disgust the very persons on whom they seemed to reflect. Yet that Fletcher was not entirely excluded from a share in the conduct of the drama, may be gathered from a story related by Winstanley, that the two bards having concerted the rough draught of a tragedy over a bottle of wine at a tavern, Fletcher said he would undertake to "kill the king;" which words being caught by the waiter, who had not overheard the context of their conversation, he lodged an information of treason against them. But on their explanation that it only meant the compassing the death of a theatrical monarch, and their loyalty being moreover unquestioned, the affair ended in a jest.

Beaune || Beauty.

The works of Beaumont and Fletcher, *par nobile fratrum*, possess great and enduring merit; and some of their dramas deservedly stand on the list of the stock pieces of the theatre. The plots are ingenious, interesting, and well managed; the characters are strongly marked; and the dialogue is sprightly and natural; yet there is in the latter a coarseness which is not suitable to the politeness of the present age, and a fondness for repartee, which frequently runs into obscenity, and which we may suppose to have been the vice of the time, since even Shakspeare himself is not entirely free from it. But as these authors have more of that kind of wit than the "Swan of Avon," it is not to be wondered if, in the licentious reign of Charles II., their works were preferred to his. Now, however, the tables are entirely turned; and while Shakspeare's immortal works form our constant and daily study, those of Beaumont and Fletcher are only occasionally dipped into. Some of their plays were printed in quarto during the lives of the authors; and in the year 1645 there was published in folio a collection of such of their plays as had not been printed before, amounting to between thirty and forty. This collection was published after the shutting up of the theatres, by Shirley, and dedicated to the Earl of Pembroke by ten of the most famous actors. In 1679 there was an edition of all their plays published in folio; and another appeared in 1711 by Mr Tonson, in seven volumes 8vo. The finest edition is that of Weber, in 14 vols. 8vo. Another edition, by Mr Dyce, in 11 vols. 8vo, is worthy of mention.

BEAUNE, an arrondissement of the department of Côte d'Or, in France, extending over 769 square miles, and comprehending 10 cantons and 201 communes. Population (1851) 124,206. The chief city, of the same name, is situated on the river Buozcoise, twenty-three miles S.S.W. of Dijon on the Paris and Lyons railway, in a district highly productive of the best Burgundy wine. Pop. (1851) 10,800.

Beaupréau || Beauty.

BEAUPRÉAU, an arrondissement in the department of the Maine and Loire, in France, extending over 629 square miles, and containing 7 cantons and 75 communes. Pop. 121,375. The chief town, of the same name, is on the river Evre, 27 miles S.W. of Angers. Pop. (1851) 3448.

BEAUSOBRE, Isaac de, a learned Protestant writer, of French origin, was born at Niort in 1659. He was forced into Holland to avoid the execution of a sentence which condemned him to make the *amende honorable* for having broken the royal signet, which was put upon the door of a church of the reformers to prevent the public profession of their religion. He went to Berlin in 1694, and was made chaplain to the king of Prussia, and counsellor of the royal consistory. He died in 1738, aged seventy-nine, after having published several works, among which may be mentioned, 1. Défense de la Doctrine des Réformés. 2. A Translation of the New Testament, with Notes, jointly with M. Lenfant; much esteemed among Protestants. 3. Dissertation sur les Adamites de Bohème; a curious work. 4. Histoire Critique de Manichée et du Manichéisme, 2 tom. 4to. This is a very learned and valuable work; discussing, as Gibbon observes, "many deep questions of Pagan and Christian theology, and forming a rich treasury of facts and opinions." 5. Several dissertations in the Bibliothèque Britannique. Beausobre had strong sense with profound erudition, and was one of the best writers of his time; and he preached as he wrote, with spirit and ability.

BEAUTY,

That property in objects by which they are recommended to the power or faculty of taste—the reverse of ugliness—the primary or more general object of love or admiration.

Necessary imperfection of the definition.

These, we confess, are rather explanations of the word than definitions of the thing it signifies; and can be of no value, even as explanations of the word, except only to those who understand, without explanation, all the other words they contain. For, if the curious inquirer should proceed to ask, "And what is the faculty or power of taste?" we do not see what other answer we could give, than that it was that of which beauty was the object, or by which we were enabled to discover and to relish what was beautiful. It is material, however, to observe, that if it could be made out, as some have alleged, that our perception of beauty was a simple sensation, like our perception of colour; and that taste was an original and distinct sense, like that of seeing or hearing; this would be truly the only definition that could be given, either of the sense or of its object; and all that we could do in investigating the nature of the latter, would be to digest and enumerate the circumstances under which it was found to present itself to its appropriate organ. All that we can say of colour, if we consider it very strictly, is, that it is that property in objects by which they are recommended to the faculty of sight; and the faculty of sight can scarcely be defined in any other way than as that by which we are enabled to discover the existence of colour. When we attempt to proceed farther, and say that green is the colour of grass, and red of roses or blood, it is plain that we do not in any respect explain the nature of those colours, but only *give instances* of their occurrence; and that one who had never seen them could learn nothing whatever from these pretended definitions. Complex ideas, on the other hand, and compound emotions, may be always defined, and explained to a certain extent, by enumerating the parts of which they are made up, or resolving them into the elements of which they are composed; and we may thus acquire not only a substantial knowledge of their nature, but a practical power in their regulation or production.

State of the question.

It becomes of importance, therefore, in the very outset of this inquiry, to consider whether our sense of beauty be really a simple sensation, like some of those we have enumerated, or a compound or derivative feeling, the sources or elements of which may be investigated and ascertained. If it be the former, we have then only to refer it to the peculiar sense or faculty of which it is the object, and to determine, by repeated observation, under what circumstances it occurs; but, if it be the latter, we have to proceed, by a joint process of observation and reflection, to ascertain what are the primary feelings to which it may be referred, and by what peculiar modification of them it is produced and distinguished. We are not quite prepared as yet to exhaust the whole of this important discussion, to which we shall be obliged to return in the sequel of our inquiry; but it is necessary, in order to explain and to set forth, in their natural order, the difficulties with which the subject is surrounded, to state here, in a very few words, one or two of the most obvious, and, as we think, decisive objections against the notion of beauty being a simple sensation, or the object of a separate and peculiar faculty.

The first, and perhaps the most considerable, is the want of agreement as to the presence and existence of beauty in particular objects, among men whose organization is perfect, and who are plainly possessed of the faculty, whatever it may be, by which beauty is discerned. Now,

First reason against the notion of beauty being a peculiar quality, and the object of a distinct sense or faculty.

no such thing happens, we imagine, or can be conceived to happen, in the case of any other simple sensation, or the exercise of any other distinct faculty. Where one man sees light, all men who have eyes see light also. All men allow grass to be green, and sugar to be sweet, and ice to be cold; and the unavoidable inference from any apparent disagreement in such matters necessarily is, that the party is insane, or entirely destitute of the sense or organ concerned in the perception. With regard to beauty, however, it is obvious at first sight that the case is quite different. One man sees it perpetually, where to another it is quite invisible, or even where its reverse seems to be conspicuous. Nor is this owing to the insensibility of either of the parties; for the same contrariety exists where both are keenly alive to the influences of the beauty they respectively discern. A Chinese or African lover would probably see nothing at all attractive in a belle of London or Paris; and, undoubtedly, an *elegans formarum spectator* from either of these cities would discover nothing but deformity in the Venus of the Hottentots. A little distance in time produces the same effects as distance in place: the gardens, the furniture, the dress, which appeared beautiful in the eyes of our grandfathers, are odious and ridiculous in ours. Nay, the difference of rank, education, or employments, gives rise to the same diversity of sensation. The little shopkeeper sees a beauty in his roadside box, and in the staring tile roof, wooden lions, and clipped boxwood, which strike horror into the soul of the student of the picturesque; whilst *he* is transported in surveying the fragments of ancient sculpture, which are nothing but ugly masses of mouldering stone in the judgment of the admirer of neatness. It is needless, however, to multiply instances, since the fact admits of no contradiction. But how can we believe that beauty is the object of a peculiar sense or faculty, when persons undoubtedly possessed of the faculty, and even in an eminent degree, can discover nothing of it in objects where it is distinctly felt and perceived by others with the same use of the faculty? This one consideration, we confess, appears to us conclusive against the supposition of beauty being a real property of objects, addressing itself to the power of taste as a separate sense or faculty, and seems to point irresistibly to the conclusion, that our sense of it is the result of other more elementary feelings, into which it may be analyzed or resolved.

Second reason.

A second objection, however, if possible of still greater force, is suggested by considering the prodigious and almost infinite variety of things to which this property of beauty is ascribed, and the impossibility of imagining any one inherent quality which can belong to them all, and yet at the same time possess so much unity as to be the peculiar object of a separate sense or faculty. All simple qualities that are perceived in any one object are immediately recognised to be *the same* when they are again perceived in another; and the objects in which they are thus perceived are at once felt so far to resemble each other, and to partake of the same nature. Thus snow is seen to be white, and chalk is seen to be white; but this is no sooner seen than the two substances, however unlike in other respects, are felt at once to have this quality in common, and to resemble each other in all that relates to the quality of colour and the sense of seeing. Now, is this felt, or could it even be intelligibly asserted, with regard to the quality of beauty? Take even a limited and specific sort of beauty,—for instance the beauty of form. The form of a fine tree is beautiful,—and the form of a fine woman,—and the form of a column, and a vase, and a chandelier. Yet how can it be said that the form of a woman has any thing in common with that of a tree or a temple? or to which of the senses by which forms are distinguished, does it appear they have any resemblance or affinity?

The matter, however, becomes still more inextricable when we recollect that beauty does not belong merely to forms or colours, but to sounds, and perhaps to the objects of other senses; nay, that in all languages and in all nations, it is not supposed to reside exclusively in material objects, but to belong also to sentiments and ideas, and intellectual and moral existences. Not only is a tree beautiful, as well as a palace or a waterfall; but a poem is beautiful, and a theorem in mathematics, and a contrivance in mechanics. But if things intellectual and totally segregated from matter may thus possess beauty, how can it possibly be a quality of material objects? Or what sense or faculty can that be, whose proper office it is to intimate to us the existence of some property which is common to a flower and a demonstration, a valley and an eloquent discourse?

Agreeableness of the objects of beauty not their common quality.

The only answer which occurs to this is plainly enough a bad one; but the statement of it, and of its inefficiency, will serve better, perhaps, than any thing else to develope the actual difficulties of the subject, and the true state of the question with regard to them. It may be said, then, in answer to the questions we have suggested above, that all these objects, however various and dissimilar, agree at least in being agreeable; and that this *agreeableness*, which is the only quality they possess in common, may probably be the beauty which is ascribed to them all. Now, to those who are accustomed to such discussions, it would be quite enough to reply, that though the agreeableness of such objects depends plainly enough upon their beauty, it by no means follows, but quite the contrary, that their beauty depends upon their agreeableness; the latter being the more comprehensive or generic term, under which beauty must rank as one of the species. Its nature, therefore, is no more explained, nor is less absurdity substantially committed, by saying that things are beautiful because they are agreeable, than if we were to give the same explanation of the sweetness of sugar; for no one, we suppose, will dispute, that though it be very true that sugar is agreeable because it is sweet, it would be manifestly preposterous to say that it was sweet because it was agreeable. For the benefit, however, of those who wish or require to be more regularly initiated in these mysteries, we beg leave to add a few observations.

In the first place, then, it seems evident that agreeableness in general cannot be the same with beauty, because there are very many things in the highest degree agreeable that can in no sense be called beautiful. Moderate heat, and savoury food, and rest, and exercise, are agreeable to the body; but none of these can be called beautiful: and, among objects of a higher class, the love and esteem of others, and fame, and a good conscience, and health, and riches, and wisdom, are all eminently agreeable; but not at all beautiful, according to any intelligible use of the word. It is plainly quite absurd, therefore, to say that beauty consists in agreeableness, without specifying in consequence of what it is agreeable; or to hold that any thing whatever is taught as to its nature, by merely classing it among our pleasurable emotions.

In the second place, however, we may remark, that among all the objects that are agreeable, whether they are also beautiful or not, scarcely any two are agreeable on account of the same qualities, or even suggest their agreeableness to the same faculty or organ. Most certainly there is no resemblance or affinity whatever between the qualities which make a peach agreeable to the palate, and a beautiful statue to the eye; which soothe us in an easy chair by the fire, or delight us in a philosophical discovery.

Beauty. The truth is, that agreeableness is not properly a quality of any object whatsoever, but the effect or result of certain qualities, the nature of which we can generally define pretty exactly, or of which we know at least with certainty that they manifest themselves respectively to some one particular sense or faculty, and to no other; and consequently it would be just as obviously ridiculous to suppose a faculty or organ, whose office it was to perceive agreeableness, as to suppose that agreeableness was a distinct quality that could thus be perceived.

The class of agreeable objects, thanks to the bounty of Providence, is exceedingly large. Certain things are agreeable to the palate, and others to the smell and to the touch. Some, again, are agreeable to our faculty of imagination, to our understanding, or to our moral feelings; and none of all these we call beautiful. But there are others which we do call beautiful; and those we say are agreeable to our faculty of taste: yet when we come to ask what is the faculty of taste, and what are the qualities which recommend them to that faculty, we find ourselves just where we were at the beginning of the discussion, and embarrassed with all the difficulties arising from the prodigious diversity of objects which seem to possess these qualities.

We know pretty well what is the faculty of seeing or hearing; or, at least, we know that what is agreeable to one of those faculties, has no effect whatever on the other. We know that bright colours afford no delight to the ear, nor sweet tones to the eye; and are therefore perfectly assured that the qualities which make the visible objects agreeable, cannot be the same with those which give pleasure to the ear. But it is by the eye and by the ear that all material beauty is perceived; and yet the beauty which discloses itself to these two separate senses, and plainly depends upon qualities which have no sort of affinity, is supposed to be one distinct quality, and to be perceived by a peculiar sense or faculty! The perplexity becomes still greater when we think of the beauty of poems or theorems, and endeavour to imagine what qualities they can possess in common with the agreeable modifications of light or of sound.

In what the difficulty of the subject truly consists. It is in these considerations undoubtedly that the difficulty of the subject consists. The faculty of taste, plainly, is not a faculty, like any of the external senses, the range of whose objects is limited and precise, as well as the qualities by which they are gratified or offended; and beauty, accordingly, is discovered in an infinite variety of objects, among which it seems at first sight impossible to discover any other bond of connection. Yet boundless as their diversity may appear, it is plain that they *must* resemble each other in *something*, and in something more definite and definable than in merely being agreeable; since they are all classed together, in every tongue and nation, under the common appellation of beautiful, and are felt indeed to produce emotions in the mind that have some sort of kindred or affinity. The words *beauty* and *beautiful*, in short, must mean something, and are universally felt to mean something, much more definite than agreeableness or gratification in general; and while it is confessedly by no means easy to describe or define what that something is, the force and clearness of our perception of it is demonstrated by the readiness with which we determine, in any particular instance, whether the object of a given pleasurable emotion is or is not properly described as beauty.

What we have already said, we confess, appears to us conclusive against the idea of this beauty being any fixed or inherent property of the objects to which it is ascribed, or itself the object of any separate and independent faculty; and we will no longer conceal from the reader what we take to be the true solution of the difficulty. In our opinion, then, our sense of beauty depends entirely on our previous experience of simpler pleasures or emotions, and consists in the *suggestion* of agreeable or interesting sensations with which we had formerly been familiar by the direct and intelligible agency of our common sensibilities; and that vast variety of objects, to which we give the common name of beautiful, become entitled to that appellation, merely because they all possess the power of recalling or reflecting those sensations of which they have been the accompaniments, or with which they have been associated in our imagination by any other more casual bond of connection. According to this view of the matter, therefore, beauty is not an inherent property or quality of objects at all, but the result of the accidental relations in which they may stand to our experience of pleasures or emotions,—and does not depend upon any particular configuration of parts, proportions, or colours, in external things, nor upon the unity, coherence, or simplicity of intellectual creations, but merely upon the associations which, in the case of every individual, may enable these inherent, and otherwise indifferent qualities, to suggest or recall to the mind emotions of a pleasurable or interesting description. It follows, therefore, that no object is beautiful in itself, or could appear so, antecedently to our experience of direct pleasures or emotions; and that, as an infinite variety of objects may thus reflect interesting ideas, so all of them may acquire the title of beautiful, although utterly diverse and disparate in their nature, and possessing nothing in common but this accidental power of reminding us of other emotions.

Beauty. Solution proposed.

This theory, which we believe is now very generally adopted, though under many needless qualifications, shall be further developed and illustrated in the sequel. But at present we shall only remark, that it serves at least to solve the great problem involved in the discussion, by rendering it easily conceivable how objects which have no inherent resemblance, nor indeed any one quality in common, should yet be united in one common relation, and consequently acquire one common epithet,—just as all the things that belonged to a beloved individual may serve to remind us of him, and thus to awake a kindred class of emotions, though just as unlike each other as any of the objects that are classed under the general name of beautiful. His poetry, for instance, or his slippers,—his acts of bounty, or his saddle-horse,—may lead to the same chain of interesting remembrances, and thus agree in possessing a power of excitement, for the sources of which we should look in vain through all the variety of their physical or metaphysical qualities.

By the help of the same consideration, we get rid of all the mystery of a peculiar sense or faculty, imagined for the express purpose of perceiving beauty; and discover that the power of taste is nothing more than the habit of tracing those associations, by which almost all objects may be connected with interesting emotions. It is easy to understand, that the recollection of any scene of delight or emotion must produce a certain agreeable sensation, and that the objects which introduce these recollections should not appear altogether indifferent to us: nor is it, perhaps, very difficult to imagine, that recollections thus strikingly suggested by some real and present existence should present themselves under a different aspect, and move the mind somewhat differently from those which arise spontaneously in the ordinary course of our reflections, and do not thus grow out of a direct and peculiar impression.

The whole of this doctrine, however, we shall endeavour by and by to establish upon more direct evidence; but having now explained, in a general way, both the

difficulties of the subject, and our suggestion as to their true solution, it is proper that we should take a short review of the more considerable theories that have been proposed for the elucidation of this curious question; which is one of the most delicate, as well as the most popular, in the science of metaphysics,—was one of the earliest which exercised the speculative ingenuity of philosophers,—and has at last, we think, been more successfully treated than any other of a similar description.

View of the theories proposed on the subject.

In most of these speculations we shall find rather imperfect truth than fundamental error,—or, at all events, such errors only as arise naturally from that peculiar difficulty which we have already endeavoured to explain, as consisting in the prodigious multitude and diversity of the objects in which the common quality of beauty was to be accounted for. Those who have not been sufficiently aware of the difficulty have generally dogmatized from a small number of instances, and have rather given examples of the occurrence of beauty in some few classes of objects, than afforded any light as to that upon which it essentially depended in all; whilst those who felt its full force have very often found no other resource than to represent beauty as consisting in properties so extremely vague and general (such, for example, as the power of exciting ideas of relation), as almost to elude our comprehension, and, at the same time, of so abstract and metaphysical a description, as not to be very intelligibly stated as the radicals of a strong, familiar, and pleasurable emotion. This last observation leads us to make one other remark upon the general character of these theories; and this is, that some of them seem necessarily to imply the existence of a peculiar sense or faculty for the perception of beauty, as they resolve it into properties that are not in any way interesting or agreeable to any of our known faculties. Such are all those which make it consist in proportion,—or in variety, combined with regularity,—or in waving lines,—or in unity,—or in the perception of relations,—without explaining, or attempting to explain, how any of these things should affect us with any delight or emotion. Others, again, do not require the supposition of any such separate faculty; because in them the sense of beauty is considered as arising from other more simple and familiar emotions, which are in themselves and beyond all dispute agreeable. Such are those which teach that beauty depends on the perception of utility, or of design, or of fitness, or in tracing associations between its objects and the common joys or emotions of our nature. Which of these two classes of speculation (to one or other of which, we believe, all theories of beauty may be reduced) is the most philosophical in itself, we imagine can admit of no question; and we hope, in the sequel, to leave it as little doubtful, which is to be considered as most consistent with the fact. In the meantime, we must give a short account of some of the theories themselves.

Speculations of Plato.

The most ancient of which it seems necessary to take any notice, is that which may be traced in the Dialogues of Plato,—though we are very far from pretending that it is possible to give any intelligible or consistent account of its tenor It should never be forgotten, however, that it is to this subtile and ingenious spirit that we owe the suggestion that it is *Mind* alone that is beautiful; and that, in perceiving beauty, it only contemplates the shadow of its own affections;—a doctrine which, however mystically unfolded in his writings, or however combined with extravagant or absurd speculations, unquestionably carries in it the germ of all the truth that has since been revealed on the subject. By far the largest dissertation, however, that this great philosopher has left upon the nature of beauty, is to be found in the dialogue entitled *The Greater Hippias*, which is entirely devoted to that inquiry. We do not learn a great deal of the author's own opinion, indeed, from this performance; for it is one of the dialogues which have been termed *anatreptic* or confuting,—in which nothing is concluded in the affirmative, but a series of sophistical suggestions or hypotheses are successively exposed. The plan of it is to lead on Hippias, a shallow and confident sophist, to make a variety of dogmatical assertions as to the nature of beauty, and then to make him retract and abandon them upon the statement of some obvious objections. Socrates and he agree at first in the notable proposition, " that beauty is that by which all beautiful things are beautiful;" and then, after a great number of suggestions, by far too childish and absurd to be worthy of any notice, such as, that the beautiful may peradventure be gold, or a fine woman, or a handsome mare, they at last get to some suppositions, which show that almost all the theories that have since been propounded on this interesting subject, had occurred thus early to the active and original mind of this keen and curious inquirer. Thus Socrates first suggests that beauty may consist in the fitness or suitableness of any object to the place it occupies; and afterwards more generally and directly, that it may consist in utility; a notion which is ultimately rejected, however, upon the subtile consideration that the useful is that which produces good, and that the producer and the product being necessarily different, it would follow, upon that supposition, that beauty could not be good, nor good beautiful. Finally, he suggests, that beauty may be the mere organic delight of the eye or the ear,—to which, after stating very slightly the objection, that it would be impossible to account upon this ground for the beauty of poetry or eloquence, he proceeds to rear up a more refined and elaborate refutation, upon such grounds as these: If beauty be the proper name of that which is naturally agreeable to the sight and hearing, it is plain that the objects to which it is ascribed must possess some common and distinguishable property besides that of being agreeable, in consequence of which they are separated and set apart from objects that are agreeable to our *other* senses and faculties, and, at the same time, classed together under the common appellation of beautiful. Now we are not only quite unable to discover what this property is, but it is manifest that objects which make themselves known to the ear *can* have no property as such in common with objects that make themselves known to the eye; it being impossible that an object which is beautiful by its colour, can be beautiful from the same quality with another which is beautiful by its sound. From all which it is inferred, that, as beauty is admitted to be something real, it cannot be merely what is agreeable to the organs of sight or hearing.

There is no practical wisdom, we admit, in those fine-drawn speculations; nor any of that spirit of patient observation by which alone any sound view of such objects can ever be attained. There are also many marks of that singular incapacity to distinguish between what is absolutely puerile and silly, and what is plausible, at least, and ingenious, which may be reckoned among the characteristics of " the divine philosopher," and in some degree of all the philosophers of antiquity: but they show clearly enough the subtile and abstract character of Greek speculation, and prove at how early a period, and to how great an extent, the inherent difficulties of the subject were felt, and produced their appropriate effects.

There are some hints on these subjects in the works of Xenophon, and some scattered observations in those of Cicero, who was the first, we believe, to observe that the sense of beauty is peculiar to man; but nothing else, we believe, in classical antiquity which requires to be analyzed or explained. It appears that St Augustin composed a

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large treatise on beauty, and it is to be lamented that the speculations of that acute and ardent genius on such a subject have been lost. We discover, from incidental notices in other parts of his writings, that he conceived the beauty of all objects to depend on their unity, or on the perception of the principle or design which fixed the relations of their various parts, and presented them to the intellect or imagination as one harmonious whole. It would not be fair to deal very strictly with a theory with which we are so imperfectly acquainted: but it may be observed, that, while the author is so far in the right as to make beauty consist in a relation to mind, and not in any physical quality, he has taken far too narrow and circumscribed a view of the matter, and one which seems almost exclusively applicable to works of human art; it being plain enough, we think, that a beautiful landscape, or a beautiful horse, has no more unity, and no more traces of design, than one which is not beautiful.

Doctrine of St Augustin.

We do not pretend to know what the schoolmen taught upon this subject during the dark ages, but the discussion does not seem to have been resumed for long after the revival of letters. The followers of Leibnitz were pleased to maintain that beauty consisted in perfection; but what constituted perfection they did not attempt to define. M. Crouzas wrote a long essay to show that beauty depended on these five elements, variety, unity, regularity, order, and proportion; and the Père André, a still longer one to prove, that, admitting these to be the true foundations of beauty, it was still most important to consider, that the beauty which results from them is either essential, or natural, or artificial, and that it may be greater or less, according as the characteristics of each of these classes are combined or set in opposition.

Opinions of Crouzas and André;

of Lord Shaftesbury;

Among ourselves we are not aware of any considerable publication on the subject till the appearance of Lord Shaftesbury's *Characteristics*, in which a sort of rapturous Platonic doctrine is delivered as to the existence of a primitive and supreme good and beauty, and of a certain internal sense, by which both beauty and moral merit were distinguished. Addison published several ingenious papers in *The Spectator* on the pleasures of the imagination, and was the first, we believe, who referred them to the specific sources of beauty, sublimity, and novelty. He did not enter much, however, into the metaphysical discussion of the nature of beauty itself; and the first philosophical treatise of note that appeared on the subject may be said to have been the *Inquiry* of Dr Hutcheson, first published, we believe, in 1725.

of Addison.

Dr Hutcheson's doctrine.

In this work the notion of a peculiar internal sense, by which we are made sensible of the existence of beauty, is very boldly promulgated, and maintained by many ingenious arguments. Yet nothing, we conceive, can be more extravagant than such a proposition; and nothing but the radical faults of the other parts of the hypothesis could possibly have driven the learned author to its adoption. Even after the existence of this sixth sense was assumed, he felt that it was still necessary that he should explain what were the qualities by which it was gratified, and these, he was pleased to allege, were nothing but the combinations of variety with uniformity; all objects, as he has himself expressed it, which are equally uniform being beautiful in proportion to their variety, and all objects equally various being beautiful in proportion to their uniformity. Now, not to insist upon the obvious and radical objection that this is not true in fact, as to flowers, landscapes, or indeed of any thing but architecture, if it be true of that, it could not fail to strike the ingenious author that these qualities of uniformity and variety were not of themselves agreeable to any of our known senses or faculties, except when considered as symbols of utility or design, and therefore could not intelligibly account for the very lively emotions which we often experience from the perception of beauty, where the notion of design or utility was not at all suggested. He was constrained, therefore, either to abandon this view of the nature of beauty altogether, or to imagine a new sense or faculty, whose characteristic and description it should be to receive delight from the combinations of uniformity and variety, without any consideration of their being significant of things agreeable to our faculties; and this being accomplished by the mere force of the assumption and the definition, there was no room for further dispute or difficulty in the matter.

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Some of Hutcheson's followers, such as Gerard and others, who were a little startled at the notion of a separate faculty, and yet wished to retain the doctrine of beauty depending on variety and uniformity, endeavoured, accordingly, to show that these qualities were *naturally* agreeable to the mind, and were recommended by considerations arising from its most familiar properties. Uniformity or simplicity, it is said, renders our conception of objects easy, and saves the mind from all fatigue and distraction in the consideration of them; whilst variety, if circumscribed and limited by an ultimate uniformity, gives it a pleasing exercise and excitement, and keeps its energies in a state of pleasurable activity. Now this appears to us to be mere trifling. The varied and lively emotions which we receive from the perception of beauty obviously have no sort of resemblance to the pleasure of moderate intellectual exertion; nor can any thing be conceived more utterly dissimilar than the gratification we have in gazing on the form of a lovely woman, and the satisfaction we receive from working an easy problem in arithmetic or geometry. If a triangle is more beautiful than a regular polygon, as those authors maintain, merely because its figure is more easily comprehended, the number *four* should be more beautiful than the number three hundred and twenty-seven, and the form of a gibbet far more agreeable than that of a branching oak. The radical error, in short, consists in fixing upon properties that are not interesting in themselves, and can never be conceived, therefore, to excite any emotion, as the fountain-spring of all our emotions of beauty; and it is an absurdity that must infallibly lead to others,—whether these take the shape of a violent attempt to disguise the truly indifferent nature of the properties so selected, or of the bolder expedient of creating a peculiar faculty, whose office it is to find them interesting.

Attempts to resolve beauty into uniformity and variety.

The next remarkable theory was that proposed by Edmund Burke, in his *Treatise of the Sublime and Beautiful*. But of this, in spite of the great name of the author, we cannot persuade ourselves that it is necessary to say much. His explanation is founded upon a species of materialism,—not much to have been expected from the general character of his genius, or the strain of his other speculations,—for it resolves entirely into this, that all objects appear beautiful which have the power of producing a peculiar relaxation of our nerves and fibres, and thus inducing a certain degree of bodily langour and sinking. Of all the suppositions that have been at any time hazarded to explain the phenomena of beauty, this, we think, is the most unfortunate, and the most weakly supported. There is no philosophy in the doctrine; and the fundamental assumption is in every way contradicted by the most familiar experience. There is no relaxation of the fibres in the perception of beauty, and there is no pleasure in the relaxation of the fibres. If there were, it would follow that a warm bath would be by far the most beautiful thing in the world, and that the brilliant lights and bracing airs of a fine autumn morning would be the very reverse

Theory of Burke.

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of beautiful. Accordingly, though the treatise alluded to will always be valuable on account of the many fine and just remarks it contains, we are not aware that there is any accurate inquirer into the subject (with the exception, perhaps, of Mr Price, in whose hands, however, the doctrine assumes a new character), by whom the fundamental principle of the theory has not been explicitly abandoned.

Theory of Diderot.

A yet more extravagant doctrine was soon afterwards inculcated, and in a tone of great authority, in a long article from the brilliant pen of Diderot, in the French *Encyclopédie*, and one which exemplifies, in a very striking manner, the nature of the difficulties with which the discussion is embarrassed. This ingenious person, perceiving at once that the beauty which we ascribe to a particular class of objects could not be referred to any peculiar and inherent quality in the objects themselves, but depended upon their power of exciting certain sentiments in our minds,—and being, at the same time, at a loss to discover what common power could belong to so vast a variety of objects as pass under the general appellation of beautiful, or by what tie all the various emotions which are excited by the perception of beauty could be united,—was at last driven, by his sense of the necessity of keeping his definition sufficiently wide and comprehensive, to hazard the strange assertion, that all objects were beautiful which excite in us the idea of *relation;* that our sense of beauty consisted in tracing out the relations which the object possessing it might have to other objects; and that its beauty was in proportion to the number and clearness of the relations thus suggested and perceived. It is scarcely necessary, we presume, to expose by any arguments the manifest fallacy, or rather the palpable absurdity, of such a theory as this. In the first place, we conceive it to be obvious, that all objects whatever have an infinite, and consequently an equal number of relations, and are equally likely to suggest them to those to whom they are presented: at all events, it is certain that ugly and disagreeable objects have just as many relations as those that are agreeable, and ought, therefore, to be just as beautiful, if the sense of beauty consists in the perception of relations. In the next place, it seems to be sufficiently certain, from the experience and common feelings of all men, that the perception of relations among objects is not in itself accompanied by any pleasure whatever, and in particular has no conceivable resemblance to the emotion we receive from the perception of beauty. When we perceive one ugly old woman sitting exactly opposite to two other ugly old women, and observe at the same moment that the first is as big as the other two taken together, we humbly conceive that this clear perception of the relations in which these three graces stand to each other cannot well be mistaken for a sense of beauty, and that it does not in the least abate or interfere with our sense of their ugliness. Finally, we may observe, that the sense of beauty results instantaneously from the perception of the object; whereas the discovery of its relations to other objects must necessarily be a work of time and reflection, in the course of which the beauty of the object, so far from being created or brought into notice, must, in fact, be lost sight of and forgotten.

Theory of Father Buffier and Sir Joshua Reynolds.

Another more plausible and ingenious theory was suggested by the Père Buffier, and afterwards adopted and illustrated with great talent in the *Discourses* of Sir Joshua Reynolds. According to this doctrine, beauty consists, as Aristotle held virtue to do, in mediocrity, or conformity to that which was most usual. Thus a beautiful nose, to make use of Dr Smith's very apt illustration of this doctrine, is one that is neither very long nor very short, very straight nor very much bent, but of an ordinary form and proportion compared with all the extremes. It is the form, in short, which nature seems to have aimed at in all cases, though she has more frequently deviated from it than hit it; but deviating from it in all directions, all her deviations come nearer to it than they ever do to each other. Thus the most beautiful in every species of creatures bears the greatest resemblance to the whole species, while monsters are so denominated because they bear the least; and thus the beautiful, though in one sense the rarest, as the exact medium is but seldom hit, is invariably the most common, because it is the central point from which all the deviations are the least remote. This view of the matter is adopted by Sir Joshua in its full extent, and is even carried so far by this great artist, that he does not scruple to conclude, "That if we were more used to deformity than beauty, deformity would then lose the idea that is now annexed to it, and take that of beauty;—just as we approve and admire fashions in dress, for no other reason than that we are used to them."

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Now, not to dwell upon the very startling conclusion to which these principles must lead, viz. that things are beautiful in proportion as they are ordinary, and that it is merely their familiarity which constitutes their beauty, we would observe, in the first place, that the whole theory seems to have been suggested by a consideration of animal forms, or perhaps of the human figure exclusively. In these forms, it is quite true that great and monstrous deviations from the usual proportions are extremely disagreeable. But this, we have no doubt, arises entirely from some idea of pain or disaster attached to their existence, or from their obvious unfitness for the functions they have to perform. In vegetable forms, accordingly, these irregularities excite no such disgust; it being, in fact, the great object of culture, in almost all the more beautiful kinds, to produce what may be called monstrosities. And, in mineral substances, where the idea of suffering is still more completely excluded, it is notorious that, so far from the more ordinary configurations being thought the most beautiful, this epithet is scarcely ever employed but to denote some rare and unusual combination of veins, colours, or dimensions. As to landscapes, again, and almost all the works of art, without exception, the theory is plainly altogether incapable of application. In what sense, for example, can it be said that the beauty of natural scenery consists in mediocrity; or that these landscapes are the most beautiful that are the most common? or what meaning can we attach to the proposition, that the most beautiful building, or picture, or poem, is that which bears the nearest resemblance to all the individuals of its class, and is, upon the whole, the most ordinary and common?

To a doctrine which is liable to these obvious and radical objections, it is not perhaps necessary to make any other; but we must remark further, *first*, That it necessarily supposes that our sense of beauty is, in all cases, preceded by such a large comparison between various individuals of the same species, as may enable us to ascertain that average or mean form in which beauty is supposed to consist, and, consequently, that we could never discover any object to be beautiful antecedently to such a comparison; and, *secondly*, That, even if we were to allow that this theory afforded some explanation of the superior beauty of any one object compared with others of the same class, it plainly furnishes no explanation whatever of the superior beauty of one class of objects compared with another. We may believe, if we please, that one peacock is handsomer than another because it approaches more nearly to the average or mean form of peacocks in general; but this reason will avail us nothing whatever in ex-

plaining why any peacock is handsomer than any pelican or penguin. We may say, without manifest absurdity, that the most beautiful pig is that which has least of the extreme qualities that sometimes occur in the tribe; but it would be palpably absurd to give this reason, or any thing like it, for the superior beauty of the tribe of antelopes or spaniels.

The notion, in short, seems to have been hastily adopted by the ingenious persons who have maintained it, partly upon the narrow ground of the disgust produced by monsters in the animal creation, which has been already sufficiently explained,—and partly in consequence of the fallacy which lurks in the vague and general proposition of those things being beautiful which are neither *too* big nor *too* little, *too* massive nor *too* slender, &c.; from which it was concluded that beauty must consist in mediocrity:—not considering that the particle *too* merely denotes those degrees which are exclusive of beauty, without in any way fixing what those degrees are. For the plain meaning of these phrases is, that the rejected objects are too massive or too slender *to be beautiful;* and, therefore, to say that an object is beautiful which is neither too big nor too little, &c. is really saying nothing more than that beautiful objects are such as are not in any degree ugly or disagreeable. The illustration as to the effects of use or custom in the article of dress is singularly inaccurate and delusive; the fact being, that we never admire the dress which we are most accustomed to see,—which is that of the common people,—but the dress of the few who are distinguished by rank or opulence; and that we require no more custom or habit to make us admire this dress, whatever it may be, than is necessary to associate it in our thoughts with the wealth and dignity of those who wear it.

Opinions of Dr Gerard, Dr Blair, &c.

We need say nothing in this place of the opinions expressed on the subject of beauty by Dr Gerard, Dr Blair, and a whole herd of rhetoricians, because none of them pretend to have any new or original notions with regard to it, and, in general, have been at no pains to reconcile or render consistent the various accounts of the matter which they have contented themselves with assembling and laying before their readers altogether, as affording among them the best explanation that could be offered of the question. Thus they do not scruple to say, that the sense of beauty is sometimes produced by the mere organic affection of the senses of sight or hearing; at other times by a perception of a kind of regular variety; and in other instances by the association of interesting conceptions;—thus abandoning altogether any attempt to answer the radical question, how the feeling of beauty should be excited by such opposite causes,—and confounding together, without any attempt at discrimination, those theories which imply the existence of a separate sense or faculty, and those which resolve our sense of beauty into other more simple or familiar emotions.

Later and more important speculations.

More recently, however, we have had three publications on the subject, of a far higher character,—we mean Mr Alison's *Essays on the Nature and Principles of Taste,* Mr Payne Knight's *Analytical Inquiry* into the same objects, and Mr Dugald Stewart's Dissertations on the Beautiful, and on Taste, in his volume of *Philosophical Essays.* All these works possess an infinite deal of merit, and have among them disclosed almost all the truth that is to be known on the subject; though, as it seems to us, with some little admixture of error, from which it will not, however, be difficult to separate it.

Mr Alison maintains, that all beauty, or at least that all the beauty of material objects, depends on the associations that may have connected them with the ordinary affections or emotions of our nature; and in this, which is the fundamental point of his theory, we conceive him to be no less clearly right, than he is convincing and judicious in the copious and beautiful illustration by which he has sought to establish its truth. When he proceeds, however, to assert that our sense of beauty consists not merely in the suggestion of ideas of emotion, but in the contemplation of *a connected series* of such ideas, and indicates a state of mind in which the faculties, half active and half passive, are given up to a sort of reverie or musing, in which they may wander, though among kindred impressions, far enough from the immediate object of perception, we will confess that he not only seems to us to advance a very questionable proposition, but very essentially to endanger the evidence, as well as the consistency, of his general doctrine. We are far from denying, that, in minds of sensibility and of reflecting habits, the contemplation of beautiful objects will be apt, especially in moments of leisure, and when the mind is vacant, to give rise to such trains of thought, and to such protracted meditations; but we cannot possibly admit that their existence is necessary to the perception of beauty, or that it is in this state of mind exclusively that the sense of beauty exists. The perception of beauty, on the contrary, we hold to be, in most cases, quite instantaneous, and altogether as immediate as the perception of the external qualities of the object to which it is ascribed. Indeed, it seems only necessary to recollect, that it is to a present material object that we actually ascribe and refer this beauty, and that the only thing to be explained is, how this object comes to appear beautiful. In the long train of interesting meditations, however, to which Mr Alison refers,—in the delightful reveries in which he would make the sense of beauty consist,—it is obvious that we must soon lose sight of the external object which gave the first impulse to our thoughts; and though we may *afterwards* reflect upon it, with increased interest and gratitude, as the parent of so many charming images, it is impossible, we conceive, that the perception of *its* beauty can ever depend upon a long series of various and shifting emotions.

It likewise occurs to us to observe, that if every thing were beautiful which was the occasion of a train of ideas of emotion, it is not easy to see why objects that are called ugly should not be entitled to that appellation. If they are sufficiently ugly not to be viewed with indifference, they too will give rise to ideas of emotion; and those ideas are just as likely to run into trains and series as those of a more agreeable description. Nay, as contrast itself is one of the principles of association, it is not at all unlikely that, in the train of impressive ideas which the sight of ugly objects may excite, a transition may be ultimately made to such as are connected with pleasure; and, therefore, if the perception of the beauty of the object which first suggested them depended upon its having produced a series of ideas of emotion, or even of agreeable emotions, there seems to be no good reason for doubting that ugly objects may thus be as beautiful as any other, and that beauty and ugliness may be one and the same thing. Such is the danger, as it appears to us, of deserting the object itself, or going beyond its immediate effect and impression, in order to discover the sources of its beauty. Our view of the matter is safer, we think, and far more simple. We conceive the object to be associated, either in our past experience, or by some universal analogy, with pleasures or emotions that upon the whole are pleasant; and that these associated pleasures are instantaneously suggested, as soon as the object is presented, and by the first glimpse of its physical properties, with which, indeed, they are consubstantiated and confounded in our sensations.

Knight's theory.

The work of Mr Knight is more lively, various, and discursive, than Mr Alison's, but not so systematic or conclu-

Beauty.

sive. It is the cleverer book of the two, but not the most philosophical discussion of the subject. He agrees with Mr Alison in holding the most important, and, indeed, the only considerable part of beauty, to depend upon association; and has illustrated this opinion with a great variety of just and original observation. But he maintains, and maintains stoutly, that there is a beauty independent of association—prior to it, and more original and fundamental—the primitive and natural beauty of colours and sounds. Now this we look upon to be a heresy, and a heresy inconsistent with the very first principles of catholic philosophy. We shall not stop at present to give our reasons for this opinion, which we shall illustrate at large before we bring this article to a close; but we beg leave merely to suggest at present, that if our sense of beauty be confessedly in most cases the mere image or reflection of pleasures or emotions that have been associated with objects in themselves indifferent, it cannot fail to appear strange that it should also on some few occasions be a mere organic or sensual gratification of the particular organs. Language, it is believed, affords no other example of so whimsical a combination of different objects under one appellation, or of the confounding of a direct physical sensation with the suggestion of a social or sympathetic moral feeling. We would observe also, that while Mr Knight stickles so violently for this alloy of the senses in the constitution of beauty, he admits unequivocally, that sublimity is, in every instance and in all cases, the effect of association alone. Yet sublimity and beauty, in any just or large sense, and with a view to the philosophy of either, are manifestly one and the same; nor is it conceivable to us, that, if sublimity be *always* the result of an association with ideas of power or danger, beauty can possibly be, in any case, the result of a mere pleasurable impulse on the nerves of the eye or the ear. We shall return, however, to this discussion hereafter. Of Mr Knight we have only further to observe, that we think he is not less heretical in maintaining that we have no pleasure in sympathizing with distress or suffering, but only with mental energy; and that, in contemplating the sublime, we are moved only with a sense of power and grandeur, and never with any feeling of terror or awe. These errors, however, are less intimately connected with the subject of our present discussion.

Stewart's Essay.

With Mr Stewart we have less occasion for quarrel; chiefly, perhaps, because he has made fewer positive assertions, and entered less into the matter of controversy. His Essay on the Beautiful is rather philological than metaphysical. The object of it is to show by what gradual and successive extensions of meaning the word, though at first appropriated to denote the pleasing effect of *colours* alone, might naturally come to signify all the other pleasing things to which it is now applied. In this investigation he makes many admirable remarks, and touches, with the hand of a master, upon many of the disputable parts of the question; but he evades the particular point at issue between us and Mr Knight, by stating that it is quite immaterial to his purpose whether the beauty of colours be supposed to depend on their organic effect on the eye, or on some association between them and other agreeable emotions; it being enough for his purpose that this was probably the first sort of beauty that was observed, and that to which the name was at first exclusively applied. It is evident to us, however, that he leans to the opinion of Mr Knight, as to this beauty being truly sensual or organic. In observing, too, that beauty is not now the name of any one thing or quality, but of very many different qualities, and that it is applied to them all merely because they are often united in the same objects, or perceived at the same time and *by the same organs*, it appears to us that he carries his philology a little too far, and disregards other principles of reasoning of far higher authority. To give the name of beauty, for example, to every thing that interests or pleases us through the channel of sight, including in this category the mere impulse of light that is pleasant to the organ, and the presentment of objects whose whole charm consists in awakening the memory of social emotions, seems to us to be confounding things together that must always be separate in our feelings, and giving a far greater importance to the mere identity of the organ of perception than is warranted either by the ordinary language or ordinary experience of men. Upon the same principle, we should give this name of beautiful, and no other, to all acts of kindness or magnanimity, and, indeed, to every interesting occurrence which took place in our sight, or came to our knowledge by means of the eye: nay, as the ear is also allowed to be a channel for impressions of beauty, the same name should be given to any interesting or pleasant thing that we hear; and good news read to us from the gazette should be denominated beautiful, just as much as a fine composition of music. These things, however, are never called beautiful, and are felt, indeed, to afford a gratification of quite a different nature. It is no doubt true, as Mr Stewart has observed, that beauty is not one thing, but many, and does not produce one uniform emotion, but an infinite variety of emotions. But this, we conceive, is not merely because many pleasant things may be intimated to us by the same sense, but because the things that are called beautiful may be associated with an infinite variety of agreeable emotions, of the specific character of which their beauty will consequently partake. Nor does it follow, from the fact of this great variety, that there can be no other principle of union among these agreeable emotions than that of a *name*, extended to them all upon the very slight ground of their coming through the same organ; since, upon our theory, and indeed upon Mr Stewart's, in a vast majority of instances, there is the remarkable circumstance of their being all *suggested* by association with some present sensation, and all modified and compounded to our feelings by an actual and direct perception.

Beauty. Questionable doctrine.

It is unnecessary, however, to pursue these criticisms, or, indeed, this hasty review of the speculation of other writers, any further. The few observations we have already made will enable the intelligent reader both to understand in a general way what has been already done on the subject, and in some degree prepare him to appreciate the merits of that theory, substantially the same with Mr Alison's, which we shall now proceed to illustrate somewhat more in detail.

Further illustration of the theory of associations.

The basis of it is, that the beauty which we impute to outward objects is nothing more than the reflection of our own inward emotions, and is made up entirely of certain little portions of love, pity, and affection, which have been connected with these objects, and still adhere as it were to them, and move us anew whenever they are presented to our observation. Before proceeding to bring any proof of the truth of this proposition, there are two things which it may be proper to explain a little more distinctly; *first*,[1] What are the primary affections, by the suggestion of which we think the sense of beauty is pro-

[1] A considerable part of the sequel of this article has already appeared in a critique (by the same author) upon Mr Alison's *Essay*, in the *Edinburgh Review* for May 1811.

Beauty. duced? and, *secondly*, What is the nature of the connection by which we suppose that the objects we call beautiful are enabled to suggest these affections?

What affections may be the basis of beauty

With regard to the first of these points, it fortunately is not necessary either to enter into any tedious details, or to have recourse to any nice distinctions. All sensations that are not absolutely indifferent, and are, at the same time, either agreeable when experienced by ourselves, or attractive when contemplated in others, may form the foundation of the emotions of sublimity or beauty. The love of sensation seems to be the ruling appetite of human nature; and many sensations, in which the painful seems to bear no little share, are consequently sought for with avidity, and recollected with interest, even in our own persons. In the persons of others, emotions still more painful are contemplated with eagerness and delight; and therefore we must not be surprised to find, that many of the pleasing sensations of beauty or sublimity resolve themselves ultimately into recollections of feelings that may appear to have a very opposite character. The sum of the whole is, that every feeling which it is agreeable to experience, to recall, or to witness, may become the source of beauty in external objects, when it is so connected with them as that their appearance reminds us of that feeling. Now, in real life, and from daily experience and observation, we know that it is agreeable, in the first place, to recollect our own pleasurable sensations, or to be enabled to form a lively conception of the pleasures of other men, or even of sentient beings of any description. We know, likewise, from the same sure authority, that there is a certain delight in the remembrance of our past, or the conception of our future emotions, even though attended with great pain, provided they be not forced too rudely on the mind, and be softened by the accompaniment of any milder feeling. And, finally, we know, in the same manner, that the spectacle or conception of the emotions of others, even when in a high degree painful, is extremely interesting and attractive, and draws us away, not only from the consideration of indifferent objects, but even from the pursuit of light or frivolous enjoyments. All these are plain and familiar facts, of the existence of which, however they may be explained, no one can entertain the slightest doubt, and into which, therefore, we shall have made no inconsiderable progress, if we can resolve the more mysterious fact, of the emotions we receive from the contemplation of sublimity or beauty.

Our proposition then is, that these emotions are not original emotions, nor produced directly by any qualities in the objects which excite them; but are reflections or images of the more radical and familiar emotions to which we have already alluded, and are occasioned, not by any inherent virtue in the objects before us, but by the accidents, if we may so express ourselves, by which these may have been enabled to suggest or recall to us our own past sensations or sympathies. We might almost venture, indeed, to lay it down as an axiom, that, except in the plain and palpable case of bodily pain or pleasure, we can never be *interested* in any thing but the fortunes of sentient beings; and that every thing partaking of the nature of mental emotion must have for its object the feelings, past, present, or possible, of something capable of sensation. Independently, therefore, of all evidence, and without the help of any explanation, we should have been apt to conclude that the emotions of beauty and sublimity must have for their objects the sufferings or enjoyments of sentient beings; and to reject as intrinsically absurd and incredible the supposition, that material objects, which obviously do neither hurt nor delight the body, should yet excite, by their mere physical qualities, the very powerful emotions which are sometimes excited by the spectacle of beauty. Beauty.

Nature of the associations by which objects appear beautiful.

Of the feelings, by their connection with which external objects become beautiful, we do not think it necessary to speak more minutely; and therefore it only remains, under this preliminary view of the subject, to explain the nature of that connection by which we conceive this effect to be produced. Here, also, there is but little need for minuteness, or fulness of enumeration. Almost every tie by which two objects can be bound together in the imagination, in such a manner as that the presentment of the one shall recall the memory of the other, or, in other words, almost every possible relation which can subsist between such objects, may serve to connect the things we call sublime or beautiful, with feelings that are interesting or delightful. It may be useful, however, to class these bonds of association between mind and matter in a rude and general way.

It appears to us, then, that objects are sublime or beautiful, *first*, When they are the natural signs and perpetual concomitants of pleasurable sensations, or, at any rate, of some lively feeling or emotion in ourselves or in some other sentient beings; or, *secondly*, When they are the arbitrary or accidental concomitants of such feelings; or, *thirdly*, When they bear some analogy or fanciful resemblance to things with which these emotions are necessarily connected. In endeavouring to illustrate the nature of these several relations, we shall be led to lay before our readers some proofs that appear to us satisfactory of the truth of the general theory.

First class of associations.

The most obvious and the strongest association that can be established between inward feelings and external objects is, where the object is necessarily and universally connected with the feeling by the law of nature, so that it is always presented to the senses when the feeling is impressed upon the mind,—as the sight or the sound of laughter, with the feeling of gaiety,—of weeping, with distress,—of the sound of thunder, with ideas of danger and power. Let us dwell for a moment on the last instance. —Nothing, perhaps, in the whole range, is more strikingly and universally sublime than the sound we have just mentioned; yet it seems obvious that the sense of sublimity is produced, not by any quality that is perceived by the ear, but altogether by the impression of power and of danger that is necessarily made upon the mind whenever that sound is heard. That it is not produced by any peculiarity in the sound itself, is certain, from the mistakes that are frequently made with regard to it. The noise of a cart rattling over the stones is often mistaken for thunder; and as long as the mistake lasts, this very vulgar and insignificant noise is actually felt to be prodigiously sublime. It is so felt, however, it is perfectly plain, merely because it is then associated with ideas of prodigious power and undefined danger; and the sublimity is destroyed the moment the association is dissolved, though the sound itself, and its effect on the organ, continue exactly the same. This, therefore, is an instance in which sublimity is distinctly proved to consist, not in any physical quality of the object to which it is ascribed, but in its necessary connection with that vast and uncontrolled Power which is the natural object of awe and veneration.

Other examples.

We may now take an example a little less plain and elementary. The most beautiful object in nature, perhaps, is the countenance of a young and beautiful woman;—and we are apt at first to imagine, that, independently of all associations, the forms and colours which it displays are in themselves lovely and engaging, and would appear charming to all beholders, with whatever other qualities or impressions they might happen to be connected. A very little reflection, however, will probably be sufficient

Beauty. to convince us of the fallacy of this impression, and to satisfy us, that what we admire is not a combination of forms and colours, which could never excite any mental emotion, but a collection of signs and tokens of certain mental feelings and affections, which are universally recognised as the proper objects of love and sympathy. Laying aside the emotions arising from difference of sex, and supposing female beauty to be contemplated by the pure and unenvying eye of a female, it seems quite obvious that, amongst its ingredients, we should trace the signs of two different sets of qualities, that are neither of them the object of sight, but of a higher faculty;—in the first place, of youth and health; and, in the second place, of innocence, gaiety, sensibility, intelligence, delicacy or vivacity. Now, without enlarging upon the natural effect of these suggestions, we shall just suppose that the appearances, which must be admitted at all events to be actually significant of the qualities we have enumerated, had been by the law of nature attached to the very opposite qualities; —that the smooth forehead, the firm cheek, and the full lip, which are now so distinctly expressive to us of the gay and vigorous periods of youth,—and the clear and blooming complexion, which indicates health and activity,—had been in fact the forms and colours by which old age and sickness were characterized; and that, instead of being found united to those sources and seasons of enjoyment, they had been the badges by which nature pointed out that state of suffering and decay which is now signified to us by the livid and emaciated face of sickness, or the wrinkled front, the quivering lip, and hollow cheek of age: if this were the familiar law of our nature, can it be doubted that we should look upon these appearances, not with rapture, but with aversion,—and consider it as absolutely ludicrous or disgusting to speak of the beauty of what was interpreted by every one as the lamented sign of pain and decrepitude? Mr Knight himself, though a firm believer in the intrinsic beauty of colours, is so much of this opinion, that he thinks it entirely owing to those associations that we prefer the tame smoothness and comparatively poor colours of a youthful face, to the richly fretted and variegated countenance of a pimpled drunkard.

Such, we conceive, would be the inevitable effect of dissolving the subsisting connection between the animating ideas of hope and enjoyment, and those visible appearances which are now significant of these emotions, and derive their whole beauty from this signification. But the effect would be still stronger if we could suppose the *moral* expression of these appearances to be reversed in the same manner. If the smile which now enchants us as the expression of innocence and affection, were the sign attached by nature to guilt and malignity,—if the blush which expresses delicacy, and the glance that speaks intelligence, vivacity, and softness, had always been found united with brutal passion or idiot moodiness,—is it not certain that the whole of their beauty would be extinguished, and that our emotions from the sight of them would be exactly the reverse of what they now are?

Beauty of inanimate objects. That the beauty of a living and sentient creature should depend, in a great degree, upon the qualities peculiar to such a creature, rather than upon the mere physical attributes which it may possess in common with the inert matter around it, cannot indeed appear a very improbable supposition to any one. But it may be more difficult for some persons to understand how the beauty of mere dead matter should be derived from the feelings and sympathies of sentient beings. It is absolutely necessary, therefore, that we should give an instance or two of this derivation.

Beauty of landscapes. It is easy enough to understand how the sight of a picture or statue should affect us nearly in the same way as the sight of the original; nor is it much more difficult to conceive, how the sight of a cottage should give us something of the same feeling as the sight of a peasant's family, and the aspect of a town raise many of the same ideas as the appearance of a multitude of persons. We may begin, therefore, with an example a little more complicated. Take, for instance, the case of a common English landscape—green meadows, with fat cattle—canals or navigable rivers—well-fenced, well-cultivated fields—neat, clean, scattered cottages—humble antique church, with church-yard elms, and crossing hedge-rows—all seen under bright skies, and in good weather: there is much beauty, as every one will acknowledge, in such a scene. But in what does the beauty consist? Not certainly in the mere mixture of colours and forms; for colours more pleasing, and lines more graceful (according to any theory of grace that may be preferred), might be spread upon a board, or a painter's pallet, without engaging the eye to a second glance, or raising the least emotion in the mind; but in the picture of human happiness that is presented to our imaginations and affections,—in the visible and unequivocal signs of comfort, and cheerful and peaceful enjoyment,—and of that secure and successful industry that insures its continuance,—and of the piety by which it is exalted,—and of the simplicity by which it is contrasted with the guilt and the fever of a city life,—in the images of health and temperance and plenty which it exhibits to every eye,—and in the glimpses which it affords to warmer imaginations, of those primitive or fabulous times, when man was uncorrupted by luxury and ambition, and of those humble retreats in which we still delight to imagine that love and philosophy may find an unpolluted asylum. At all events, however, it is human feeling that excites our sympathy, and forms the object of our emotions. It is man, and man alone, that we see in the beauties of the earth which he inhabits;—or, if a more sensitive and extended sympathy connect us with the lower families of animated nature, and make us rejoice with the lambs that bleat on the uplands, or the cattle that ruminate in the valley, or even with the living plants that drink the bright sun and the balmy air beside them, it is still the idea of enjoyment—of feelings that animate the existence of sentient beings—that calls forth all our emotions, and is the parent of all the beauty with which we proceed to invest the inanimate creation around us.

Instead of this quiet and tame *English* landscape, let us now take a Welsh or a Highland scene, and see whether its beauties will admit of being explained on the same principle. Here we shall have lofty mountains, and rocky and lonely recesses,—tufted woods hung over precipices,—lakes intersected with castled promontories,—ample solitudes of unploughed and untrodden valleys,—nameless and gigantic ruins,—and mountain echoes repeating the scream of the eagle and the roar of the cataract. This, too, is beautiful; and, to those who can interpret the language it speaks, far more beautiful than the prosperous scene with which we have contrasted it. Yet, lonely as it is, it is to the recollection of man and of human feelings that its beauty also is owing. The mere forms and colours that compose its visible appearance, are no more capable of exciting any emotion in the mind, than the forms and colours of a Turkey carpet. It is sympathy with the present or the past, or the imaginary *inhabitants* of such a region, that alone gives it either interest or beauty; and the delight of those who behold it will always be found to be in exact proportion to the force of their imaginations, and the warmth of their social affections. The leading impressions here are those of romantic seclusion and primeval simplicity; lovers sequestered in these blissful solitudes, "from towns and toils remote;" and rustic poets and philosophers communing with nature, at a distance from the

Beauty. low pursuits and selfish malignity of ordinary mortals;—then there is the sublime impression of the Mighty Power which piled the massive cliffs upon one another, and rent the mountains asunder, and scattered their giant fragments at their base,—and all the images connected with the monuments of ancient magnificence and extinguished hostility—the feuds, and the combats, and the triumphs of its wild and primitive inhabitants, contrasted with the stillness and desolation of the scenes where they lie interred,—and the romantic ideas attached to their ancient traditions and the peculiarities of their present life,—their wild and enthusiastic poetry,—their gloomy superstitions,—their attachment to their chiefs,—the dangers, and the hardships, and enjoyments of their lonely huntings and fishings,—their pastoral shielings on the mountains in summer,—and the tales and the sports that amuse the little groups that are frozen into their vast and trackless valleys in the winter. Add to all this the traces of vast and obscure antiquity that are impressed on the language and the habits of the people, and on the cliffs, and caves, and gulfy torrents of the land,—and the solemn and touching reflection perpetually recurring, of the weakness and insignificance of perishable man, whose generations thus pass away into oblivion with all their toils and ambition, while nature holds on her unvarying course, and pours out her streams, and renews her forests, with undecaying activity, regardless of the fate of her proud and perishable sovereign.

Beauty of spring. We have said enough, we believe, to let our readers understand what we mean by external objects being the natural signs or concomitants of human sympathies or emotions. Yet we cannot refrain from adding one other illustration, and asking on what other principle we can account for the beauty of spring? Winter has shades as deep, and colours as brilliant, and the great forms of nature are substantially the same through all the revolutions of the year. We shall seek in vain, therefore, in the accidents of mere organic matter, for the sources of that "vernal delight and joy" which subject all finer spirits to an annual intoxication, and strike home the sense of beauty even to hearts that seem proof against it under all other aspects. And it is not among the dead, but among the living, that this beauty originates. It is the renovation of life and of joy to all animated beings that constitutes this great jubilee of nature,—the young of animals bursting into existence,—the simple and universal pleasures which are diffused by the mere temperature of the air and the profusion of sustenance,—the pairing of birds,—the cheerful resumption of rustic toils,—the great alleviation of all the miseries of poverty and sickness,—our sympathy with the young life, and the promise and the hazards of the vegetable creation,—the solemn yet cheering impression of the constancy of nature to her great periods of renovation,—and the hopes that dart spontaneously forward into the new circle of exertions and enjoyments that is opened up by her hand and her example. Such are some of the conceptions that are forced upon us by the appearances of returning spring, and that seem to account for the emotions of delight with which these appearances are hailed by every mind endowed with any degree of sensibility, somewhat better than the brightness of the colours, or the agreeableness of the smells, that are then presented to our senses.

Beauty of childhood. They are kindred conceptions that constitute all the beauty of childhood. The forms and colours that are peculiar to that age are not necessarily or absolutely beautiful in themselves; for, in a grown person, the same forms and colours would be either ludicrous or disgusting. It is their indestructible connection with the engaging ideas of innocence,—of careless gaiety,—of unsuspecting confidence, made still more tender and attractive by the recollection of helplessness, and blameless and happy ignorance,—of the anxious affection that watches over all their ways,—and of the hopes and fears that seek to pierce futurity, for those who have neither fears nor cares nor anxieties for themselves. Beauty.

These few illustrations will probably be sufficient to give our readers a general conception of the character and the grounds of that theory of beauty which, we think, affords the only true or consistent account of its nature. They are all examples, it will be observed, of the *first* and most important connection which we think may be established between external objects and the sentiments or emotions of the mind, or cases, in which the visible phenomena are the natural and universal accompaniments of the emotion, and are consequently capable of reviving that emotion, in some degree, in the breast of every beholder.

Second class of associations. If the tenor of those illustrations has been such as to make any impression in favour of the general theory, we conceive that it must be very greatly confirmed by the slightest consideration of the *second* class of cases, or those in which the external object is not the natural and necessary, but only the occasional or accidental, concomitant of the emotion which it recalls. In the former instances some conception of beauty seems to be inseparable from the appearance of the objects; and being impressed, in some degree, upon all persons to whom they are presented, there is evidently room for insinuating that it is an independent and intrinsic quality of their nature, and does not arise from association with any thing else. In the instances, however, to which we are now to allude, this perception of beauty is not universal, but entirely dependent upon the opportunities which each individual has had to associate ideas of emotion with the object to which it is ascribed; the same thing appearing beautiful to those who have been exposed to the influence of such associations, and indifferent to those who have not. Such instances, therefore, really afford an *experimentum crucis* as to the truth of the theory in question; nor is it easy to conceive any more complete evidence, both that there is no such thing as absolute or intrinsic beauty, and that it depends altogether on those associations with which it is thus found to come and to disappear.

Diversity of *national* tastes. The accidental or arbitrary relations that may thus be established between natural sympathies or emotions, and external objects, may be either such as occur to whole classes of men, or are confined to particular individuals. Among the former, those that apply to different nations or races of men, are the most important and remarkable; and constitute the basis of those peculiarities by which national tastes are distinguished. Take, again, for example, the instance of female beauty, and think what different and inconsistent standards would be fixed for it in the different regions of the world; in Africa, in Asia, and in Europe; in Tartary and in Greece; in Lapland, Patagonia, and Circassia. If there were any thing absolutely or intrinsically beautiful in any of the forms thus distinguished, it is inconceivable that men should differ so outrageously in their conceptions of it. If beauty were a real and independent quality, it seems impossible that it should be distinctly and clearly felt by one set of persons, where another set, altogether as sensitive, could see nothing but its opposite; and if it were actually and inseparably attached to certain forms, colours, or proportions, it must appear utterly inexplicable that it should be felt and perceived in the most opposite forms and proportions in objects of the same description. On the other hand, if all beauty consist in reminding us of certain natural sympathies and objects of emotion, with which they have been habitually connected, it is easy to perceive how

Beauty. the most different forms should be felt to be equally beautiful. If female beauty, for instance, consist in the visible signs and expressions of youth and health, and of gentleness, vivacity, and kindness; then it will necessarily happen, that the forms, and colours, and proportions which nature may have connected with these qualities, in the different climates or regions of the world, will all appear equally beautiful to those who have been accustomed to recognise them as the signs of such qualities; while they will be respectively indifferent to those who have not learned to interpret them in this sense, and displeasing to those whom experience has led to consider them as the signs of opposite qualities. The case is the same, though perhaps to a smaller degree, as to the peculiarity of national taste in other particulars. The style of dress and architecture in every nation, if not adopted from mere want of skill, or penury of materials, always appears beautiful to the natives, and somewhat monstrous and absurd to foreigners; and the general character and aspect of their landscape, in like manner, if not associated with substantial evils and inconveniences, always appears more beautiful and enchanting than the scenery of any other region. The fact is still more striking, perhaps, in the case of music; in the effects of those national airs, with which even the most uncultivated imaginations have connected so many interesting recollections; and in the delight with which all persons of sensibility catch the strains of their native melodies in strange or in distant lands. It is owing chiefly to the same sort of arbitrary and national association, that white is thought a gay colour in Europe, where it is used at weddings,—and a dismal colour in China, where it is used for mourning; that we think yew-trees gloomy, because they are planted in churchyards,—and large masses of powdered horse hair majestic, because we see them on the heads of judges and bishops.

Effect of education on taste. Next to those curious instances of arbitrary or limited associations that are exemplified in the diversities of national taste, are those that are produced by the differences of instruction or education. If external objects were sublime or beautiful in themselves, it is plain that they would appear equally so to those who were acquainted with their origin, and to those to whom it was unknown. Yet it is not easy, perhaps, to calculate the degree to which our notions of beauty and sublimity are now influenced over all Europe by the study of classical literature; or the number of impressions of this sort which the well-educated consequently receive, from objects that are utterly indifferent to uninstructed persons of the same natural sensibility. Upon this subject we gladly avail ourselves of the beautiful expressions of Mr Alison.

"The delight which most men of education receive from the consideration of antiquity, and the beauty that they discover in every object which is connected with ancient times, is in a great measure to be ascribed to the same cause. The antiquarian, in his cabinet, surrounded by the relics of former ages, seems to himself to be removed to periods that are long since past, and indulges in the imagination of living in a world which, by a very natural kind of prejudice, we are always willing to believe was both wiser and better than the present. All that is venerable or laudable in the history of these times presents itself to his memory. The gallantry, the heroism, the patriotism of antiquity, rise again before his view, softened by the obscurity in which they are involved, and rendered more seducing to the imagination by that obscurity itself, which, while it mingles a sentiment of regret amid his pursuits, serves at the same time to stimulate his fancy to fill up, by its own creation, those long intervals of time of which history has preserved no record. The relics he contemplates seem to approach him still nearer to the ages of his regard. The dress, the furniture, the arms of the times. are so many assistances to his imagination, in guiding or directing its exercise; and, offering him a thousand sources of imagery, provide him with an almost inexhaustible field in which his memory and his fancy may expatiate. There are few men who have not felt somewhat, at least, of the delight of such an employment. There is no man in the least acquainted with the history of antiquity, who does not love to let his imagination loose on the prospect of its remains, and to whom they are not in some measure sacred, from the innumerable images which they bring. Even the peasant, whose knowledge of former times extends but to a few generations, has yet in his village some monument of the deeds or virtues of his forefathers, and cherishes with a fond veneration the memorial of those good old times to which his imagination returns with delight, and of which he loves to recount the simple tales that tradition has brought him. Beauty

"And what is it that constitutes that emotion of sublime delight which every man of common sensibility feels upon the first prospect of Rome? It is not the scene of destruction which is before him. It is not the Tiber, diminished in his imagination to a paltry stream, flowing amid the ruins of that magnificence which it once adorned. It is not the triumph of superstition over the wreck of human greatness, and its monuments erected upon the very spot where the first honours of humanity have been gained. It is ancient Rome which fills his imagination. It is the country of Cæsar, and Cicero, and Virgil, which is before him. It is the mistress of the world which he sees, and who seems to him to rise again from her tomb, to give laws to the universe. All that the labours of his youth or the studies of his maturer age have acquired with regard to the history of this great people, opens at once before his imagination, and presents him with a field of high and solemn imagery, which can never be exhausted. Take from him these associations—conceal from him that it is Rome that he sees, and how different would be his emotion!"

The influences of the same studies may be traced, indeed, through almost all our impressions of beauty; and especially in the feelings which we receive from the contemplation of rural scenery, where the images and recollections which have been associated with such objects, in the enchanting strains of the poets, are perpetually recalled by their appearance, and give an interest and a beauty to the prospect, of which the uninstructed cannot have the slightest perception. Upon this subject, also, Mr Alison has expressed himself with his usual warmth and elegance. After observing that, in childhood, the beauties of nature have scarcely any existence for those who have as yet but little general sympathy with mankind, he proceeds to state that they are usually first recommended to notice by the poets, to whom we are introduced in the course of education; and who, in a manner, create them for us, by the associations which they enable us to form with their visible appearance.

"How different from this period become the sentiments with which the scenery of nature is contemplated by those who have any imagination! The beautiful forms of ancient mythology with which the fancy of poets peopled every element, are now ready to appear to their minds upon the prospect of every scene. The descriptions of ancient authors, so long admired, and so deserving of admiration, occur to them at every moment, and, with them, all those enthusiastic ideas of ancient genius and glory which the study of so many years of youth so naturally leads them to form. Or, if the study of modern poetry has succeeded to that of the ancient, a thousand

other beautiful associations are acquired, which, instead of destroying, serve easily to unite with the former, and to afford a new source of delight. The awful forms of Gothic superstition, the wild and romantic imagery which the turbulence of the middle ages, the crusades, and the institution of chivalry, have spread over every country of Europe, arise to the imagination in every scene; accompanied with all those pleasing recollections of prowess, and adventure, and courteous manners, which distinguished those memorable times. With such images in their minds, it is not common nature that appears to surround them. It is nature embellished and made sacred by the memory of Theocritus and Virgil, and Milton and Tasso; their genius appears still to linger among the scenes which inspired it, and to irradiate every object where it dwells; and the creation of their fancy seems the fit inhabitants of that nature which their descriptions have clothed with beauty."

Other effects.

It is needless, for the purpose of mere illustration, to pursue this subject of arbitrary or accidental association through all the divisions of which it is susceptible; and, indeed, the task would be endless, since there is scarcely any class in society which could not be shown to have peculiar associations of interest and emotion with objects which are not so connected in the minds of any other class. The young and the old—the rich and the poor—the artist and the man of science—the inhabitant of the city and the inhabitant of the country—the man of business and the man of pleasure—the domestic and the dissipated—nay, even the followers of almost every different study or profession,—have perceptions of beauty, because they have associations with external objects, that are peculiar to themselves, and have no existence for any other persons. But, though the detail of such instances could not fail to show, in the clearest and most convincing manner, how directly the notion of beauty is derived from some more radical and familiar emotion, and how many and various are the channels by which such emotions are transmitted, enough, perhaps, has been already said to put our readers in possession of the principles and general bearings of an argument which we must not think of exhausting.

The effect of fashion.

Before entirely leaving this branch of the subject, however, let us pause for a moment on the familiar but very striking and decisive instance of our varying and contradictory judgments as to the beauty of the successive fashions of dress that have existed within our own remembrance. All persons who still continue to find amusement in society, and are not old enough to enjoy only the recollections of their youth, think the prevailing fashions becoming and graceful, and the fashions of twenty or twenty-five years old intolerably ugly and ridiculous. The younger they are, and the more they mix in society, this impression is the stronger; and the fact is worth noticing, because there is really no one thing as to which persons judging merely from their feelings, and therefore less likely to be misled by any systems or theories, are so very positive and decided, as that established fashions are beautiful in themselves; and that exploded fashions are intrinsically and beyond all question preposterous and ugly. We have never yet met a young lady or gentleman, who spoke from their hearts, and without reserve, who had the least doubt on the subject, or could conceive how any person could be so stupid, as not to see the intrinsic elegance of the reigning mode, or not to be struck with the ludicrous awkwardness of the habits in which their mothers were disguised. Yet there can be no doubt, that if these ingenious critics had been born with the same natural sensibility to beauty, but twenty years earlier, they would have joined in admiring what they now laugh at, as certainly as those who succeed them twenty years hereafter will laugh at them. It is plain, then, and we think scarcely disputed out of the circles to which we have alluded, that there is, in the general case, no intrinsic beauty or deformity in any of those fashions; and that the forms, and colours, and materials, that are, we may say, universally and very strongly felt to be beautiful while they are in fashion, are sure to lose all their beauty as soon as the fashion has passed away. Now the forms, and colours, and combinations, remain exactly as they were; and, therefore, it seems perfectly obvious that the source of their successive beauty and ugliness must be sought in something extrinsic, and can only be found in the associations which once recommended and ultimately degraded them in our estimation. While they were in fashion, they were the forms and colours which distinguished the rich and the noble,—the eminent, the envied, the observed in society. They were the forms and the colours in which all that was beautiful, and admired, and exalted, were habitually arrayed. They were associated, therefore, with ideas of opulence, and elegance, and gaiety, and all that is captivating and bewitching in manners, fortune, and situation,—and derived the whole of their beauty from those associations. By and by, however, they were deserted by the beautiful, the rich, and the elegant, and descended to the vulgar and dependent, or were only seen in combination with the antiquated airs of faded beauties or obsolete beaux. They thus came to be associated with ideas of vulgarity and derision, and with the images of old and decayed persons, whom it is difficult for their juniors to believe ever to have been young or attractive;—and the associations being thus reversed, in which all their beauty consisted, the beauty itself naturally disappears.

The operation of the same causes is distinctly visible in all the other apparent irregularities of our judgments as to this description of beauty. Old people have in general but little toleration for the obsolete fashions of their later or middle years, but will generally stickle for the intrinsic elegance of those which were prevalent in the bright days of their early youth,—as being still associated in their recollections with the beauty with which they were first enchanted, and the gay spirits with which they were then inspired. In the same way, while we laugh at the fashions of which fine ladies and gentlemen were proud in the days of our childhood, because they are now associated only with images of decrepitude and decay, we look with some feelings of veneration on the habits of more remote generations, the individuals of which are only known to us as historical persons; and with unmingled respect and admiration on those still more ancient habiliments which remind us either of the heroism of the feudal chivalry, or the virtue and nobleness of classical antiquity. The iron mail of the Gothic knight, or the clumsy shield and naked arms of the Roman warrior, strike us as majestic and graceful, merely because they are associated with nothing but tales of romantic daring or patriotic prowess; while the full-bottomed periwigs that were added to the soldier's equipment in the days of Louis XIV. and King William, and no doubt had a noble effect in the eyes of that generation, now appear to us equally ridiculous and unbecoming, merely because such appendages are no longer to be seen but upon the heads of sober and sedentary lawyers, or in the pictures of antiquated esquires.

Associations peculiar to individuals.

We cannot afford, however, to enlarge any further upon these considerations, and are inclined indeed to think, that what has been already said on the subject of associations, which, though not universal, are common to whole classes of persons, will make it unnecessary to enlarge on those that are peculiar to each individual. It is almost

Beauty. enough, indeed, to transcribe the following short passage from Mr Alison.

"There is no man who has not some interesting associations with particular scenes, or airs, or books, and who does not feel their beauty or sublimity enhanced to him by such connections. The view of the house where one was born, of the school where one was educated, and where the gay years of infancy were passed, is indifferent to no man. They recall so many images of past happiness and past affections, they are connected with so many strong or valued emotions, and lead altogether to so long a train of feelings and recollections, that there is hardly any scene which one ever beholds with so much rapture. There are songs, also, that we have heard in our infancy, which, when brought to our remembrance in after years, raise emotions for which we cannot well account; and which, though perhaps very indifferent in themselves, still continue, from this association, and from the variety of conceptions which they kindle in our minds, to be our favourites through life. The scenes which have been distinguished by the residence of any person whose memory we admire produce a similar effect. *Movemur enim, nescio quo pacto, locis ipsis, in quibus eorum, quos diligimus aut admiramur, adsunt vestigia.* The scenes themselves may be little beautiful; but the delight with which we recollect the traces of their lives blends itself insensibly with the emotions which the scenery excites; and the admiration which these recollections afford seems to give a kind of sanctity to the place where they dwelt, and converts every thing into beauty which appears to have been connected with them."

There are similar impressions,—as to the sort of scenery to which we have long been accustomed,—as to the style of personal beauty by which we were first enchanted,—and even as to the dialect, or the form of versification, which we first began to admire,—that bestow a secret and adventitious charm upon all these objects, and enable us to discover in them a beauty which is invisible, because it is non-existent to every other eye.

Third class of associations.

In all the cases we have hitherto considered, the external object is supposed to have acquired its beauty by being actually connected with the causes of our natural emotions, either as a sign of their existence, or as being locally present to their ordinary occasions. There is a relation, however, of another kind, to which it is necessary to attend, both to elucidate the general grounds of the theory, and to explain several appearances that might otherwise expose it to objections. This is the relation which external objects may bear to our internal feelings, and the power they may consequently acquire of suggesting them, in consequence of a sort of resemblance or analogy which they seem to have to their natural and appropriate objects. The language of poetry is founded in a great degree upon this analogy; and all language, indeed, is full of it, and attests, by its structure, both the extent to which it is spontaneously pursued, and the effects that are produced by its suggestion. We take a familiar instance from the elegant writer to whom we have already referred.

"What, for instance, is the impression we feel from the scenery of spring? The soft and gentle green with which the earth is spread, the feeble texture of the plants and flowers, and the remains of winter yet lingering among the woods and hills,—all conspire to infuse into our minds somewhat of that fearful tenderness with which infancy is usually beheld. With such a sentiment, how innumerable are the ideas which present themselves to our imagination!—ideas, it is apparent, by no means confined to the scene before our eyes, or to the possible desolation which may yet await its infant beauty, but which almost involuntarily extend themselves to analogies with the life of man, and bring before us all those images of hope or fear which, according to our peculiar situations, have the dominion of our hearts. The beauty of autumn is accompanied with a similar exercise of thought: the leaves begin then to drop from the trees; the flowers and shrubs with which the fields were adorned in the summer months decay; the woods and groves are silent; the sun himself seems gradually to withdraw his light, or to become enfeebled in his power. Who is there who at this season does not feel his mind impressed with a sentiment of melancholy? or who is able to resist that current of thought which, from such appearances of decay, so naturally leads him to the solemn imagination of that inevitable fate which is to bring on alike the decay of life, of empire, and of nature itself?" Beauty.

Further illustrations.

A thousand such analogies, indeed, are suggested to us by the most familiar aspects of nature. The morning and the evening present the same ready picture of youth and of closing life as the various vicissitudes of the year. The withering of flowers images out to us the languor of beauty or the sickness of childhood. The loud roar of troubled waters seems to bear some resemblance to the voice of lamentation or violence; and the softer murmur of brighter streams, to be expressive of cheerfulness and innocence. The purity and transparency of water or of air, indeed, is itself felt to be expressive of mental purity and gaiety; and their darkness or turbulence, of mental gloom and dejection. The genial warmth of autumn suggests to us the feeling of mild benevolence;—the sunny gleams and fitful showers of early spring remind us of the waywardness of infancy;—flowers waving on their slender stems impress us with the notion of flexibility and lightness of temper. All fine and delicate forms are typical of delicacy and gentleness of character; and almost all forms bounded by waving or flowing lines suggest ideas of ease, pliability, and elegance. Rapid and impetuous motion seems to be emblematical of violence and passion;—slow and steady motion, of deliberation, dignity, and resolution;—fluttering motion, of inconstancy or terror;—and waving motion, according as it is slow or swift, of sadness or playfulness. A lofty tower or a massive building gives us the idea of firmness and elevation of character;—a rock battered by the waves, of fortitude in adversity. Stillness and calmness in the water or the air seem to shadow out tenderness, indolence, and placidity;—moonlight we call pensive and gentle;—and the unclouded sun gives us an impression of exulting vigour, and domineering ambition and glory.

Existence of certain analogies proved by the structure of language.

It is not difficult, with the assistance which language affords us, to trace the origin of all these and a thousand other associations. In many instances, the qualities which thus suggest mental emotions do actually resemble their constant concomitants in human nature, as is obviously the case with the forms and motions which are sublime or beautiful; and, in some, their effects and relations bear so obvious an analogy to those of human conduct or feeling, as to force itself upon the notice of the most careless beholder. But, whatever may have been their original, the very structure of language attests the vast extent to which they have been carried, and the nature of the suggestions to which they are indebted for their interest or beauty. If we speak familiarly of the sparkling of wit, and the darkness of melancholy, can it be at all difficult to conceive that bright light may be agreeable, because it reminds us of gaiety, and darkness oppressive, because it is felt to be emblematical of sorrow? It is very remarkable, indeed, that, whilst almost all the words by which the affections of the mind are expressed seem to have been borrowed originally from the qualities of matter, the

Beauty. epithets by which we learn afterwards to distinguish such material objects as are felt to be sublime or beautiful, are all of them epithets that had been previously appropriated to express some quality or emotion of mind. Colours are said to be gay or grave—motions to be lively, or deliberate, or capricious—forms to be delicate or modest—sounds to be animated or mournful—prospects to be cheerful or melancholy—rocks to be bold—waters to be tranquil—and a thousand other phrases of the same import; all indicating most unequivocally the sources from which our interest in matter is derived, and proving that it is necessary in all cases to confer mind and feeling upon it, before it can be conceived as either sublime or beautiful. The great charm, indeed, and the great secret of poetical diction, consists in thus lending life and emotion to all the objects it embraces; and the enchanting beauty which we sometimes recognise in descriptions of very ordinary phenomena, will be found to arise from the force of imagination, by which the poet has connected with human emotions a variety of objects, to which common minds could not discover their relation. What the poet does for his readers, however, by his original similes and metaphors in these higher cases, even the dullest of these readers do in some degree every day for themselves; and the beauty which is perceived, when natural objects are unexpectedly vivified by the glowing fancy of the former, is precisely of the same kind that is felt when the closeness of the analogy enables them to force human feelings upon the recollection of all mankind. As the poet sees more of beauty in nature than ordinary mortals, just because he perceives more of these analogies and relations to social emotion, in which all beauty consists; so, other men see more or less of this beauty, exactly as they happen to possess that fancy, or those habits, which enable them readily to trace out these relations.

From all these sources of evidence, then, we think it is pretty well made out, that the beauty or sublimity of external objects is nothing but the reflection of emotions excited by the feelings or condition of sentient beings, and is produced altogether by certain little portions, as it were, of love, joy, pity, veneration, or terror, that adhere to those objects which are present on occasion of such emotions. Nor, after what we have already said, does it seem to be necessary to reply to more than one of the objections to which we are aware that this theory is liable.

Objections answered. If beauty be nothing more than a reflection of love, pity, or veneration, how comes it, it may be asked, to be distinguished from these sentiments? They are never confounded with each other either in our feelings or our language. Why, then, should they all be confounded under the common name of beauty? and why should beauty, in all cases, affect us in a way so different from the love or compassion of which it is said to be merely the reflection?

Now, to these questions we are somewhat tempted to answer, after the manner of Scotchmen, by asking, in our turn, whether it be really true that beauty always affects us in one and the same manner, and always in a different manner from the simple and elementary affections which it is its office to recall to us? In very many cases it appears to us that the sensations which we receive from objects that are felt to be beautiful, and that in the highest degree, do not differ at all from the direct movements of tenderness or pity towards sentient beings. If the epithet of beauty be correctly (as it is universally) applied to many of the most admired and enchanting passages in poetry, which consist entirely in the expression of affecting sentiments, the question would be speedily decided; and it is a fact, at all events, too remarkable to be omitted, that some of the most powerful and delightful emotions that are uniformly classed under this name, arise altogether from the direct influence of these pathetic emotions, without the intervention of any material imagery. We do not wish, however, to dwell upon an argument which certainly is not applicable to all parts of the question; and, admitting that, on many occasions, the feelings which we experience from beauty are sensibly different from the primary emotions in which we think they originate, we shall endeavour, in a very few words, to give an explanation of this difference, which seems to be perfectly consistent with the theory we have undertaken to illustrate. Beauty.

Explanations. In the first place, it should make some difference on the primary affections to which we have alluded, that, in the cases alluded to, they are *reflected* from material objects, and not directly excited by their natural causes. The light of the moon has a very different complexion from that of the sun, though it is in substance the sun's light; and glimpses of interesting, or even of familiar objects, caught unexpectedly from a mirror placed at a distance from these objects, will affect us, like sudden allusions in poetry, very differently from the natural perception of those objects in their ordinary relations. In the next place, the emotion, when suggested in the shape of beauty, comes upon us, for the most part, disencumbered of all those accompaniments which frequently give it a peculiar and less satisfactory character, when it arises from direct intercourse with its living objects. The compassion, for example, that is suggested by beauty of a gentle and winning description, is not attended with any of that disgust and uneasiness which frequently accompany the spectacle of real distress, nor with that importunate suggestion of the duty of relieving it from which it is almost inseparable. Nor does the temporary delight which we receive from beauty of a gay and animating character, call upon us for any such expenditure of spirits, or active demonstrations of sympathy, as are sometimes demanded by the turbulence of real joy. In the third place, the emotion of beauty being partly founded upon illusion, is far more transitory in its own nature, and is both more apt to fluctuate and vary in its character, and more capable of being dismissed at pleasure, than any of the primary affections, whose shadow and representative it is. In the fourth place, the perception of beauty implies a certain exercise of the imagination that is not required in the case of direct emotion, and is sufficient of itself both to give a new character to every emotion that is suggested by the intervention of such an exercise, and to account for our classing all the various emotions that are so suggested under the same denomination of beauty. When we are injured we feel indignation,—when we are wounded we feel pain,—when we see suffering we feel compassion,—and when we witness any splendid act of heroism or generosity we feel admiration, without any effort of the imagination, or the intervention of any picture or vision in the mind. But when we feel indignation, or pity, or admiration, in consequence of seeing some piece of inanimate matter that merely suggests or recalls to us the ordinary causes or proper objects of these emotions, it is evident that our fancy is kindled by a sudden flash of recollection; and that the effect is produced by means of a certain poetical creation that is instantly conjured up in the mind. It is this active and heated state of the imagination, and this divided and busy occupation of the mind, that constitute the great peculiarity of the emotions we experience from the perception of beauty.

Finally, and this is perhaps the most important consideration of the whole, it should be recollected, that, along with the shadow or suggestion of associated emotions, there is always present a real and direct perception, which not only gives a force and liveliness to all the images which it suggests, but seems to impart to them some share of its

Beauty. own reality. That there is an illusion of this kind in the case, is sufficiently demonstrated by the fact, that we invariably ascribe the interest which we think has been proved to arise wholly from these associations, to the object itself, as one of its actual and inherent qualities, and consider *its* beauty as no less a property belonging to it than any of its physical attributes. The associated interest, therefore, is beyond all doubt confounded with the present perception of the object itself; and a livelier and more instant impression is accordingly made upon the mind, than if the interesting conceptions had been merely excited in the memory by the usual operation of reflection or voluntary meditation. Something analogous to this is familiarly known to occur in other cases. When we merely think of an absent friend, our emotions are incomparably less lively than when the recollection of him is suddenly suggested by the unexpected sight of his picture, of the house where he dwelt, or the spot on which we last parted from him; and all these objects seem for the moment to wear the colours of our own associated affections. When Captain Cook's companions found, in the remotest corner of the habitable globe, a broken spoon with the word *London* stamped upon it, and burst into tears at the sight, they proved how differently we are moved by emotions thus connected with the real presence of an actual perception, and by the mere recollection of the objects on which those emotions depend. Every one of them had probably thought of London every day since he left it, and many of them might have been talking of it with tranquillity but a little before this more effectual appeal was made to their sensibility.

If we add to all this, that there is necessarily something of vagueness and variableness in the emotions most generally excited by the perception of beauty, and that the mind wanders with the eye over the different objects which may supply these emotions with a degree of unsteadiness and half voluntary half involuntary fluctuation, we may come to understand how the effect not only should be essentially different from that of the simple presentment of any one interesting conception, but should acquire a peculiarity which entitles it to a different denomination. Most of the associations of which we have been last speaking, as being founded on the analogies or fanciful resemblances that are felt to exist between physical objects and qualities and the interesting affections of mind, are intrinsically of this vague and wavering description; and when we look at a fine landscape, or any other scene of complicated beauty, a great variety of such images are suddenly presented to the fancy, and as suddenly succeeded by others, as the eye ranges over the different features of which it is composed, and feeds upon the charms which it discloses. Now, the direct perception in all such cases not only perpetually accompanies the associated emotions, but is inextricably confounded with them in our feelings, and is even recognised upon reflection as the cause, not merely of their unusual strength, but of the several peculiarities by which we have shown that they are distinguished. It is not wonderful, therefore, either that emotions so circumstanced should not be classed along with similar affections, under circumstances extremely different, or that the perception of present existence, thus mixed up, and indissolubly confounded with interesting conceptions, should between them produce a sensation of so distinct a nature as naturally to be distinguished by a peculiar name, or that the *beauty* which results from this combination should, in ordinary language, be ascribed to the objects themselves, the presence and perception of which is a necessary condition of its existence.

What we have now said is enough, we believe, to give an attentive reader that general conception of the theory before us, which is all that we can hope to give in the limits to which this article is confined. It may be observed, however, that we have spoken only of those sorts of beauty which we think capable of being resolved into some passion, or emotion, or pretty lively sentiment of our nature; and though these are undoubtedly the highest and most decided kinds of beauty, it is certain that there are many things called beautiful which cannot claim so lofty a connection. Beauty.

It is necessary, therefore, to observe, that, though every thing that excites any feeling worthy to be called an *emotion* by its beauty or sublimity, will be found to be related to the natural objects of human passions or affections, there are many things which are pleasing or agreeable enough to be called beautiful in consequence of their relation merely to human convenience and comfort,—many others that please by suggesting ideas of human skill and ingenuity,—and many that obtain the name of beautiful by being associated with human fortune, vanity, or splendour. After what has been already said, it will not be necessary either to exemplify or explain these subordinate phenomena. It is enough merely to suggest that they all please upon the same great principle of sympathy with human feelings, and are explained by the simple and indisputable fact, that we are pleased with the direct contemplation of human comfort, ingenuity, and fortune. All these, indeed, obviously resolve themselves into the great object of sympathy—human enjoyment. Convenience and comfort is but another name for a lower but very indispensable ingredient of that emotion. Skill and ingenuity readily present themselves as means by which enjoyment may be promoted; and high fortune, and opulence, and splendour, pass, at least at a distance, for its certain causes and attendants. The beauty of fitness and adaptation of parts, even in the works of nature, is derived from the same fountain, partly by means of its obvious analogy to works of human skill, and partly by suggestions of that creative power and wisdom to which human destiny is subjected. The feelings, therefore, associated with all these qualities, though scarcely rising to the height of emotion, are obviously in a certain degree pleasing or interesting; and, when several of them happen to be united in one object, may accumulate to a very great degree of beauty. It is needless, we think, to pursue these general propositions through all the details to which they so obviously lead. We shall confine ourselves, therefore, to a very few remarks upon the beauty of architecture,—and chiefly as an illustration of our general position. Associations with ideas of comfort, genius, power, or splendour, are also sources of beauty.

There are few things about which men of *virtù* are more apt to rave, than the merits of the Grecian architecture; and most of those who affect an uncommon purity and delicacy of taste talk of the intrinsic beauty of its proportions as a thing not to be disputed, except by barbarian ignorance and stupidity. Mr Alison, we think, was the first who gave a full and convincing refutation of this mysterious dogma; and, while he admits, in the most ample terms, the beauty of the objects in question, he has shown, we think, in the clearest manner, that it arises entirely from the combination of the following associations:—1*st*, The association of utility, convenience, or fitness for the purposes of the building; 2*dly*, Of security and stability, with a view to the nature of the materials; 3*dly*, Of the skill and power requisite to mould such materials into forms so commodious; 4*thly*, Of magnificence, and splendour, and expense; 5*thly*, Of antiquity; and, 6*thly*, Of Roman and Grecian greatness. His observations are summed up in the following short sentence.

"The proportions," he observes, "of these orders, it is to be remembered, are distinct subjects of beauty, from the ornaments with which they are embellished, from the

Beauty. magnificence with which they are executed, from the purposes of elegance they are intended to serve, or the scenes of grandeur they are destined to adorn. It is in such scenes, however, and with such additions, that we are accustomed to observe them; and, while we feel the effect of all these accidental associations, we are seldom willing to examine what are the causes of the complex emotion we feel, and readily attribute to the nature of the architecture itself the whole pleasure which we enjoy. But, besides these, there are other associations we have with these forms, that still more powerfully serve to command our admiration; for they are the GRECIAN orders,—they derive their origin from those times, and were the ornament of those countries, which are most hallowed in our imaginations; and it is difficult for us to see them, even in their modern copies, without feeling them operate upon our minds as relics of those polished nations where they first arose, and of that greater people by whom they were afterwards borrowed."

This analysis is to us perfectly satisfactory. But, indeed, we cannot conceive any more complete refutation of the notion of an intrinsic and inherent beauty in the proportions of the Grecian architecture, than the fact of the admitted beauty of such very opposite proportions in the Gothic. Opposite as they are, however, the great elements of beauty are the same in this style as in the other,—the impressions of religious awe and of chivalrous recollections, coming here instead of the classical associations which constitute so great a share of the interest of the former. It is well observed by Mr Alison, that the great durability and costliness of the productions of this art have had the effect, in almost all regions of the world, of rendering their fashion permanent, after it had once attained such a degree of perfection as to fulfil its substantial purposes.

"Buildings," he observes, "may last, and are intended to last, for centuries. The life of man is very inadequate to the duration of such productions; and the present period of the world, though old with respect to those arts which are employed upon perishable subjects, is yet young in relation to an art which is employed upon so durable materials as those of architecture. Instead of a few years, therefore, centuries must probably pass before such productions demand to be renewed; and, long before that period is elapsed, the sacredness of antiquity is acquired by the subject itself, and a new motive given for the preservation of similar forms. In every country, accordingly, the same effect has taken place; and the same causes which have thus served to produce among us, for so many years, a uniformity of taste with regard to the style of Grecian architecture, have produced also among the nations of the East, for a much longer course of time, a similar uniformity of taste with regard to their ornamental style of architecture; and have perpetuated among them the same forms which were in use among their forefathers before the Grecian orders were invented."

It is not necessary, we think, to carry these illustrations any farther, as the theory they are intended to explain is now, we believe, universally adopted, though with some limitations, which we see no reason to retain. Those suggested by Mr Alison, we have already endeavoured to dispose of in the few remarks we have made upon his publication; and it only remains to say a word or two more upon Mr Knight's doctrine as to the primitive and independent beauty of colours, upon which we have already hazarded some remarks.

Knight's doctrine as to beauty of colours examined.

Agreeing as he does with Mr Alison, and all modern inquirers, that the whole beauty of objects consists, in the far greater number of instances, in the associations to which we have alluded, he still maintains that some few visible objects affect us with a sense of beauty in consequence of the pleasurable impression they make upon the sense, and that our perception of beauty is, in these instances, a mere organic sensation. Now we have already stated that it would be something quite unexampled in the history either of mind or of language, if certain physical and bodily sensations should thus be confounded with moral and social feelings with which they had no connection, and pass familiarly under one and the same name. Beauty consists confessedly, in almost all cases, in *the suggestion* of moral or social emotions, mixed up and modified by a present sensation or perception; and it is this suggestion, and this identification with a present object, that constitutes its essence, and gives a common character to the whole class of feelings it produces, sufficient to justify their being designated by a common appellation. If the word beauty, in short, must mean something, and if *this* be very clearly what it means in all remarkable instances, it is difficult to conceive that it should occasionally mean something quite different, and denote a mere sensual or physical gratification, unaccompanied by the suggestion of any moral emotion whatever. According to Mr Knight, however, and, indeed, to most other writers, this is the case with regard to the beauty of colours, which depends altogether, they say, upon the delight which the eye naturally takes in their contemplation; this delight being just as primitive and sensual as that which the palate receives from the contact of agreeable flavours.

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Reasons for disputing this doctrine.

It must be admitted, we think, in the first place, that such an allegation is in itself extremely improbable, and contrary to all analogy, and all experience of the structure of language, or of the laws of thought. It is further to be considered, too, that if the pleasures of the senses are ever to be considered as beautiful, those pleasures which are the most lively and important would be the most likely to usurp this denomination, and to take rank with the higher gratifications that result from the perception of beauty. Now, it admits of no dispute, that the mere organic pleasures of the eye are far inferior to those of the palate, the touch, and indeed almost all the other senses,—none of which, however, are in any case confounded with the sense of beauty. In the next place, it should follow, that if what affords organic pleasure to the eye be properly called beautiful, what offends or gives pain to it should be called ugly. Now, excessive or dazzling light is offensive to the eye, but, considered by itself, it is never called ugly, but only painful or disagreeable. The moderate excitement of light, on the other hand, or the soothing of certain bright but temperate colours, when considered in this primary aspect, is scarcely called beautiful, but only agreeable or refreshing. So far as the direct injury or comfort of the organ, in short, is concerned, the language which we use refers merely to physical or bodily sensation, and is not confounded with that which relates to mental emotion; and we really see no ground for supposing that there is any exception to this rule.

It is very remarkable, indeed, that the sense whose organic gratification is here supposed to constitute the feeling of beauty, should be one, in the first place, whose direct organic gratifications are of very little force or intensity; and, in the next place, one whose office it is, almost exclusively, to make us acquainted with the existence and properties of those external objects which are naturally interesting to our inward feelings and affections. This peculiarity makes it extremely probable, that ideas of emotion should be *associated* with the perceptions of this sense, but extremely improbable that its naked and *unassociated* sensations should in any case be classed with

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The only reason that can be assigned, or that actually exists, for this distinction, is, that it has been supposed more difficult to account for the beauty of colours, upon the principles which have accounted for other beauties, or to specify the particular associations by virtue of which they could acquire this quality. Now it appears to us that there is no such difficulty; and that there is no reason whatever for holding that one colour, or combination of colours, is more pleasing than another, except upon the same grounds of association which recommend particular forms, motions, or proportions. It appears to us, that the organic pleasures of the eye are extremely few and insignificant. It is hurt, no doubt, by an excessive glare of light; and it is in some degree gratified, perhaps, by a moderate degree of it. But it is only by the quantity or intensity of the light, we think, that it is so affected. The colour of it, we take it, is, in all cases, absolutely indifferent. But it is the colour only that is called beautiful or otherwise; and these qualities, we think, it very plainly derives from the common fountain of association.

Beauty of colours derived from association alone. In the first place, we would ask, whether there is any colour that is beautiful in all situations? and, in the next place, whether there is any colour that is not beautiful in some situation? With regard to the first, take the colours that are most commonly referred to as being intrinsically beautiful—bright and soft green—clear blue—bright pink, or vermilion. The first is unquestionably beautiful in vernal woods and summer meadows,—and, we humbly conceive, is beautiful because it is the natural sign and concomitant of those scenes and seasons of enjoyment. Blue, again, is beautiful in the vernal sky,—and, as we believe, for the sake of the pleasures of which such skies are prolific; and pink is beautiful on the cheeks of a young woman or the leaves of a rose, for reasons too obvious to be stated. We have associations enough, therefore, to recommend all these colours, in the situations in which they are beautiful; but, strong as these associations are, they are unable to make them universally beautiful.—or beautiful, indeed, in any other situations. Green would not be beautiful in the sky, nor blue on the cheek, nor vermilion on the grass. It may be said, indeed, that, though they are always recognised as beautiful in themselves, their obvious unfitness in such situations counteracts the effect of their beauty, and makes an opposite impression, as of something monstrous and unnatural; and that, accordingly, they are all beautiful in indifferent situations, where there is no such antagonist principle—in furniture, dress, and ornaments. Now the fact, in the first place, is not so;—these bright colours being but seldom and sparingly admitted in ornaments or works of art; and no man, for example, choosing to have a blue house, or a green ceiling, or a pink coat. But, in the second place, if the facts were admitted, we think it obvious that the *general* beauty of these colours would be sufficiently accounted for by the very interesting and powerful associations under which all of them are so frequently presented by the hand of nature. The interest we take in female beauty,—in vernal delights,—in unclouded skies,—is far too lively and too constantly recurring, not to stamp a kindred interest upon the colours that are naturally associated with such objects, and to make us regard with some affection and delight those hues that remind us of them, although we should only meet them upon a fan or a dressing-box, the lining of a curtain or the back of a screen. Finally, we beg leave to observe, that all bright and clear colours are naturally typical of cheerfulness and purity of mind, and are hailed as emblems of moral qualities, to which no one can be indifferent.

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With regard to ugly colours, again, we really are not aware of any to which that epithet can safely be applied. Dull and dingy hues are usually mentioned as in themselves the least pleasing; yet these are the prevailing tints in many beautiful landscapes and many admired pictures. They are also the most common colours that are chosen for dress, for building, for furniture, where the consideration of beauty is the only motive for the choice. In fact, the shaded parts of all coloured objects pass into tints of this description; nor can we at present recollect any one colour which we could specify as in itself disagreeable, without running counter to the feelings and the practice of the great mass of mankind. If the fact, however, were otherwise, and if certain muddy and dull colours were universally allowed to be disagreeable, we should think there could be no difficulty in referring these, too, to natural associations. Darkness, and all that approaches it, is naturally associated with ideas of melancholy, of helplessness, and danger; and the gloomy hues that remind us of it, or seem to draw upon it, must share in the same associations. Lurid skies, too, it should be observed, and turbid waters, and unfruitful swamps, and dreary morasses, are the natural and most common wearers of these dismal liveries. It is from these that we first become acquainted with them; and it is needless, therefore, to say that such objects are necessarily associated with ideas of discomfort, and sadness, and danger; and that the colours that remind us of them can scarcely fail to recall some of the same disagreeable sensations.

Beauty of mixed or combined colours. Enough, however, and more than enough, has been said about the supposed primitive and independent beauty of separate colours. It is chiefly upon the intrinsic beauty of their mixture or combinations that Mr Knight and his adherents have insisted; and it is no doubt quite true, that, among painters and connoisseurs, we hear a great

Beauty. deal about the harmony and composition of tints, and the charms and difficulties of a judicious colouring. In all this, however, we cannot help suspecting that there is no little pedantry and no little jargon; and that these phrases, when used without reference to the practical difficulties of the art, which must go for nothing in the present question, really mean little more than the true and natural appearance of coloured objects, seen through the same tinted or partially obscure medium that commonly constitutes the atmosphere. In nature, we know of no discordant or offensive colouring, except what may be referred to some accident or disaster that spoils the moral or sentimental expression of the scene, and disturbs the associations upon which all its beauty, whether of forms or of hues, seems to us very plainly dependent. We are perfectly aware, that ingenious persons have been disposed to dogmatize and to speculate very confidently upon these subjects; and have had the benefit of seeing various learned treatises upon the natural *gamut* of colours, and the inherent congruity of those that are called complementary, with reference to the prismatic *spectrum*. But we confess we have no faith in any of those fancies; and believe, that, if all these colours were fairly arranged on a plain board, according to the most rigid rules of this supposed harmony, nobody but the author of the theory would perceive the smallest beauty in the exhibition, or be the least offended by reversing their collocation.

We do not mean, however, to dispute that the laws of colouring, insisted on by learned artists, will produce a more pleasing effect *upon trained judges of the art*, than a neglect of these laws; because we have little doubt that these combinations of colour are recommended by certain associations, which render them generally pleasing to persons so trained and educated;—all that we maintain is, that there are no combinations that are originally and universally pleasing or displeasing to the eye, independent of such associations; and it seems to us an irresistible proof of this, that these laws of harmonious colouring are perpetually and deliberately violated by great multitudes of persons, who not only have the perfect use of their sight, but are actually bestowing great pains and expense in providing for its gratification, in the very act of this violation. The Dutch trader, who paints over the outside of his country-house with as many bright colours as are to be found in his tulip-bed, and garnishes his green shutters with blue facings, and his purple roof with lilac ridges, not only sees as well as the studied colourist, who shudders at the exhibition, but actually receives as much pleasure, and as strong an impression of beauty, from the finished *lusthaus*, as the artist does from one of his best pictures. It is impossible, then, that these combinations of colours can be *naturally* or intrinsically offensive to the organ of sight; and their beauty or ugliness *must* depend upon the associations which different individuals may have happened to form with regard to them. We contend, however, for nothing more; and are quite willing to allow that the associations which recommend his staring tawdriness to the burgomaster, are such as could not easily have been formed in the mind of a diligent and extensive observer of nature, and that they would probably be reversed by habits of reflection and study. But the same thing, it is obvious, may be said of the notions of beauty of any other description that prevail among the rude, the inexperienced, and uninstructed; though, in all other instances, we take it for granted that the beauty which *is* perceived depends altogether upon association, and in no degree on its power of giving a pleasurable impulse to the organ to which it addresses itself. If any considerable number of persons, with the perfect use of sight, actually take pleasure in certain combinations of colours, *that* is complete proof that such combinations are not naturally offensive to the organ of sight, and that the pleasure of such persons, exactly like that of those who disagree with them, is derived, not from the sense, but from associations with its perceptions. Beauty.

With regard, again, to the effect of broken masses of light and shadow, it is proper, in the first place, to remember, that by the eye we see *colour only;* and that lights and shadows, as far as the mere organ is concerned, mean nothing but variations of tint. It is very true, no doubt, that we soon learn to refer many of those variations to light and shade, and that they thus become *signs* to us of depth, and distance, and relief. But is not this of itself sufficient to refute the idea of their affording any primitive or organic pleasure? In so far as they are mere variations of tints, they may be imitated by unmeaning daubs of paint on a pallet;—in so far as they are *signs*, it is to the mind that they address themselves, and not to the organ. They are signs, too, it should be recollected, and the only signs we have, by which we can receive any correct knowledge of the existence and condition of all external objects at a distance from us, whether interesting or not interesting. Without the assistance of variety of tint, and of lights and shadows, we could never distinguish one object from another, except by the touch. These appearances, therefore, are the perpetual vehicles of almost all our interesting perceptions; and are consequently associated with all the emotions we receive from visible objects. It is pleasant to see *many* things in one prospect, because some of them are probably agreeable; and it is pleasant to know the relations of those things, because the qualities or associations, by means of which they interest us, depend generally upon that knowledge. The mixture of colours and shades, however, is necessary to this enjoyment, and consequently is a sign of it, and a source of associated interest or beauty. Effects of light and shadow.

Mr Knight, however, goes much farther than this; and maintains, that the beauty which is so distinctly felt in many pictures of objects in themselves disagreeable, is to be ascribed entirely to the effect of the brilliant and harmonious tints, and the masses of light and shadow, that may be employed in the representation. The filthy and tattered rags of a beggar, he observes, and the putrefying contents of a dunghill, may form beautiful objects in a picture; because, considered as mere objects of sight, they may often present beautiful effects of colouring and shadow; and these are preserved or heightened in the imitation, disjoined from all their offensive accompaniments. Now, if the tints and shades were the exclusive sources of our gratification, and if this gratification was diminished, instead of being heightened, by the suggestion which, however transiently, *must* still intrude itself, that they appeared in an imitation of disgusting objects, it must certainly follow, that the pleasure and the beauty would be much enhanced if there was *no imitation of any thing whatever*, and if the canvass merely presented the tints and shades, unaccompanied with the representation, of any particular object. It is perfectly obvious, however, that it would be absurd to call such a collection of coloured spots a beautiful picture; and that a man would be laughed at who should hang up such a piece of stained canvass among the works of the great artists. Again, if it were really possible for any one but a student of art to confine the attention to the mere colouring and shadowing of any picture, there is nothing so disgusting but what might form the subject of a beautiful imitation. A piece of putrid veal, or a cancerous ulcer, or the rags that are taken from it, may display the most brilliant tints and the finest distribution of light and shadow. Does Mr Knight, however, seriously think that either of these experiments would Knight's opinion as to the beauty of certain pictures refuted.

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There is, in the first place, the pleasing association of the skill and power of the artist,—a skill and power which, we know, *may* be employed to produce unmingled delight, whatever may be the character of the particular effort before us. But, in the second place, we do humbly conceive that there are many interesting associations connected with the subjects which have been represented as purely disgusting. The aspect of human wretchedness and decay is not, at all events, an *indifferent* spectacle; and, if presented to us without actual offence to our senses, or any call on our active beneficence, may excite a sympathetic emotion, which is known to be far from undelightful. Many an attractive poem has been written on the miseries of beggars; and why should painting be supposed more fastidious? Besides, it will be observed that the beggars of the painter are generally among the most interesting of that interesting order;—either young and lovely children, whose health, and gaiety, and sweet expression, form an affecting contrast with their squalid garments, and the neglect and misery to which they seem to be destined,—or old and venerable persons, mingling something of the dignity and reverence of age with the broken spirit of their condition, and seeming to reproach mankind for exposing heads so old and white to the pelting of the pitiless storm. While such pictures suggest images so pathetic, it looks almost like a wilful perversity to ascribe their beauty entirely to the mixture of colours which they display, and to the forgetfulness of these images. Even for the dunghill we think it is possible to say something, though we confess we have never happened to see any picture of which that useful compound formed the peculiar subject. There is the display of the painter's art and power here also; and the dunghill is not only useful, but is associated with many pleasing images of rustic toil and occupation, and of the simplicity, and comfort, and innocence of agricultural life. We do not know that a dunghill is at all a disagreeable object to look at, even in plain reality, provided it be so far off as not to annoy us with its odour, or to soil us with its effusions. In a picture, however, we are safe from any of these disasters; and considering that it is usually combined, in such delineations, with other more pleasing and touching remembrancers of humble happiness and contentment, we really do not see that it was at all necessary to impute any mysterious or intrinsic beauty to its complexion, in order to account for the satisfaction with which we can then bear to behold it.

Beauty of sounds all derived from association.

Having said so much with a view to reduce to its just value, as an ingredient of beauty, the mere organical delight which the eye is supposed to derive from colours, we really have not patience to apply the same considerations to the alleged beauty of sounds that are supposed to be insignificant. Beautiful sounds in general, we think, are beautiful from association only,—from their resembling the natural tones of various passions and affections, or from their being originally and most frequently presented to us in scenes or on occasions of natural interest or emotion. With regard, again, to successive or co-existent sounds, we do not, of course, mean to dispute that there are such things as melody and harmony, and that most men are offended or gratified by the violation or observance of those laws upon which they depend. This, however, it should be observed, is a faculty quite *unique*, and unlike any thing else in our constitution; by no means universal, as the sense of beauty is, even in cultivated societies, and apparently withheld from whole communities of quick-eared savages and barbarians. Whether the kind of gratification which results from the mere musical arrangement of sounds would be referred to a sense of beauty, or would pass under that name, if it could be presented entirely detached from any associated emotions, appears to us to be exceedingly doubtful. Even with the benefit of these combinations, we do not find that every arrangement which merely preserves inviolate the rules of composition is considered beautiful; and we do not think that it would be consonant, either to the common feeling or common language of mankind, to bestow this epithet upon pieces that had no other merit. At all events, and whatever may be thought of the proper name of this singular gratification of a musical ear, it seems to be quite certain that all that rises to the dignity of an *emotion* in the pleasure we receive from sounds, is as clearly the gift of association as in the case of visible beauty,—of association with the passionate tones and modulations of the human voice,—with the scenes to which the interesting sounds are native,—with the poetry to which they have been married,—or even with the skill and genius of the artist by whom they have been arranged. Beauty.

Beauty of immaterial objects referable to the same sources.

Hitherto we have spoken of the beauty of external objects only. But the whole difficulty of the theory consists in its application to them. If that be once adjusted, the beauty of immaterial objects can occasion no perplexity. Poems, and other compositions in words, are beautiful in proportion as they are conversant with beautiful objects, or as they suggest to us, in a more direct way, the moral and social emotions on which the beauty of all objects depends. Theorems and demonstrations are beautiful, according as they excite in us emotions of admiration for the genius and intellectual power of their inventors, and images of the magnificent and beneficial ends to which such discoveries may be applied; and mechanical contrivances are beautiful when they remind us of similar talents and ingenuity, and at the same time impress us with a more direct sense of their vast utility to mankind, and of the great additional conveniences with which life is consequently adorned. In all cases, therefore, there is the suggestion of some interesting conception or emotion associated with a present perception, in which it is apparently confounded and embodied; and this, according to the whole of the preceding deduction, is the distinguishing characteristic of beauty.

Consequences of this theory.

Having now explained, as fully as we think necessary, the grounds of that opinion as to the nature of beauty which appears to be most conformable to the truth, we have only to add a word or two as to the necessary consequences of its adoption upon several other controversies of a kindred description.

In the first place, then, we conceive that it establishes the substantial identity of the sublime, the beautiful, and the picturesque, and consequently puts an end to all controversy that is not purely verbal as to the difference of those several qualities. Every material object that interests without actually hurting or gratifying our bodily feelings, must do so, according to this theory, in one and the same manner, that is, by suggesting or recalling some emotion or affection of ourselves or some other sentient being, and presenting, to our imagination at least, some natural object of love, pity, admiration, or awe. The interest of material objects, therefore, is always *the same*, and arises in every case, not from any physical qualities they may possess, but from their association with some idea of emotion. But, though material objects have but one means of exciting emotion, the emotions they do excite are infinite. They are mirrors that may reflect all shades and all colours, and, in point of fact, do seldom

Beauty. reflect the same hues twice. No two interesting objects, perhaps, whether known by the name of beautiful, sublime, or picturesque, ever produced exactly the same emotion in the beholder; and no one object, it is most probable, ever moved any two persons to the very same conceptions. As they may be associated with all the feelings and affections of which the human mind is susceptible, so they may suggest those feelings in all their variety, and, in fact, do daily excite all sorts of emotions, running through every gradation, from extreme gaiety and elevation, to the borders of horror and disgust.

Now, it is certainly true, that all the variety of emotions raised in this way, on the single basis of association, may be classed in a rude way under the denominations of sublime, beautiful, and picturesque, according as they partake of awe, tenderness, or admiration; and we have no other objection to this nomenclature except its extreme imperfection, and the delusions to which we know that it has given occasion. If objects that interest by their association with ideas of power, and danger, and terror, are to be distinguished by the peculiar name of sublime, why should there not be a separate name also for objects that interest by associations of mirth and gaiety,—another for those that please by suggestions of softness and melancholy,—another for such as are connected with impressions of comfort and tranquillity,—and another for those that are related to pity, and admiration, and love, and regret, and all the other distinct emotions and affections of our nature? These are not in reality less distinguishable from each other than from the emotions of awe and veneration that confer the title of sublime on their representatives; and while all the former are confounded under the comprehensive appellation of beauty, this partial attempt at distinction is only apt to mislead us into an erroneous opinion of our accuracy, and to make us believe both that there is a greater conformity among the things that pass under the same name, and a greater difference between those that pass under different names, than is really the case. We have seen already that the radical error of almost all preceding inquirers, has lain in supposing that every thing that passed under the name of beautiful must have some real and inherent quality in common with every thing else that obtained that name. And it is scarcely necessary for us to observe, that it has been almost as general an opinion, that sublimity was not only something radically different from beauty, but actually opposite to it; whereas the fact is, that it is far more nearly related to some sorts of beauty than many sorts of beauty are to each other; and that both are founded exactly upon the same principle of suggesting some past or possible emotion of some sentient being.

Upon this important point we are happy to find our opinions confirmed by the authority of Mr Stewart, who, in his Essay on the Beautiful, already referred to, has observed, not only that there appears to him to be no inconsistency or impropriety in such expressions as the *Sublime Beauties* of nature, or of the sacred Scriptures; but has added, in express terms, that, "to oppose the beautiful to the sublime, or to the picturesque, strikes him as something analogous to a contrast between the beautiful and the comic, the beautiful and the tragic, the beautiful and the pathetic, or the beautiful and the romantic."

The only other advantage which we shall specify as likely to result from the general adoption of the theory we have been endeavouring to illustrate, is, that it seems calculated to put an end to all these perplexing and vexatious questions about the standard of taste, which have given occasion to so much impertinent and so much elaborate discussion. If things are not beautiful in themselves, but only as they serve to suggest interesting conceptions to the mind, then every thing which does in point Beauty. of fact suggest such a conception to any individual, *is beautiful* to that individual; and it is not only quite true that there is no room for disputing about tastes, but that all tastes are equally just and correct, in as far as each individual speaks only of his own emotions. When a man calls a thing beautiful, however, he may indeed mean to make two very different assertions;—he may mean that it gives *him* pleasure, by suggesting to him some interesting emotion; and, in this sense, there can be no doubt that, if he merely speak truth, the thing is beautiful, and that it pleases him precisely in the same way that all other things please those to whom they appear beautiful. But if he mean further to say that the thing possesses some quality which should make it appear beautiful to every other person, and that it is owing to some prejudice or defect in them if it appear otherwise, then he is as unreasonable and absurd as he would think those who should attempt to convince him that he felt no emotion of beauty.

All tastes, then, are equally just and true, in as far as concerns the individual whose taste is in question; and what a man feels distinctly to be beautiful, *is beautiful* to him, whatever other people may think of it. All this follows clearly from the theory now in question: but it does not follow from it that all tastes are equally good or desirable, or that there is any difficulty in describing that which is really the best, and the most to be envied. The only use of the faculty of taste is to afford an innocent delight, and to aid the cultivation of a finer morality; and that man certainly will have the most delight from this faculty who has the most numerous and the most powerful perceptions of beauty. But if beauty consist in the reflection of our affections and sympathies, it is plain that *he* will always see the most beauty whose affections are warmest and most exercised, whose imagination is the most powerful, and who has most accustomed himself to attend to the objects by which he is surrounded. In as far as mere feeling and enjoyment are concerned, therefore, it seems evident that the best taste must be that which belongs to the best affections, the most active fancy, and the most attentive habits of observation. It will follow pretty exactly, too, that all men's perceptions of beauty will be nearly in proportion to the degree of their sensibility and social sympathies; and that those who have no affections towards sentient beings, will be just as insensible to beauty in external objects, as he who cannot hear the sound of his friend's voice must be deaf to its echo.

In so far as the sense of beauty is regarded as a mere source of enjoyment, this seems to be the only distinction that deserves to be attended to; and the only cultivation that taste should ever receive, with a view to the gratification of the individual, should be through the indirect channel of cultivating the affections and powers of observation. If we aspire, however, to be *creators* as well as observers of beauty, and place any part of our happiness in ministering to the gratification of others as artists, or poets, or authors of any sort—then, indeed, a new distinction of tastes, and a far more laborious system of cultivation, will be necessary. A man who pursues only his own delight will be as much charmed with objects that suggest powerful emotions in consequence of personal and accidental associations, as with those that introduce similar emotions by means of associations that are universal and indestructible. To him, all objects of the former class are really as beautiful as those of the latter—and, for his own gratification, the creation of that sort of beauty is just as important an occupation; but if he conceive the ambition of creating beauties for the admiration

of others, he must be cautious to employ only such objects as are the *natural* signs, or the *inseparable* concomitants of emotions, of which the greater part of mankind are susceptible; and his taste will *then* deserve to be called bad and false, if he obtrude upon the public, as beautiful, objects that are not likely to be associated in common minds with any interesting impressions.

For a man himself, then, there is no taste that is either bad or false; and the only difference worthy of being attended to, is that between a great deal and a very little. Some who have cold affections, sluggish imaginations, and no habits of observation, can with difficulty discern beauty in any thing; while others, who are full of kindness and sensibility, and who have been accustomed to attend to all the objects around them, feel it almost in every thing. It is no matter what other people may think of the objects of their admiration; nor ought it to be any concern of theirs that the public would be astonished or offended if they were called upon to join in that admiration. As long as no such call is made, this anticipated discrepancy of feeling need give *them* no uneasiness; and the suspicion of it should produce no contempt in any other person. It is a strange aberration indeed of vanity that makes us despise persons for being happy, for having sources of enjoyment in which we cannot share; and yet this is the true account of the ridicule which is so generally poured upon individuals who seek only to enjoy their peculiar tastes unmolested; for, if there be any truth in the theory we have been expounding, no taste is bad for any other reason than because it is peculiar, as the objects in which it delights must actually serve to suggest to the individual those common emotions and universal affections upon which the sense of beauty is everywhere founded. The misfortune is, however, that we are apt to consider all persons who make known their peculiar relishes, and especially all who create any objects for their gratification, as in some measure dictating to the public, and setting up an idol for general adoration; and hence this intolerant interference with almost all peculiar perceptions of beauty, and the unsparing derision that pursues all deviations from acknowledged standards. This intolerance, we admit, is often provoked by something of a spirit of *proselytism* and arrogance, in those who mistake their own casual associations for natural or universal relations; and the consequence is, that mortified vanity dries up the fountain of their peculiar enjoyment, and disenchants, by a new association of general contempt or ridicule, the scenes that had been consecrated by some innocent but accidental emotion.

As all men must have some peculiar associations, all men must have some peculiar notions of beauty, and, of course, to a certain extent, a taste that the public would be entitled to consider as false or vitiated. For those who make no demands on public admiration, however, it is hard to be obliged to sacrifice this source of enjoyment; and, even for those who labour for applause, the wisest course, perhaps, if it were only practicable, would be to have two tastes,—one to enjoy, and one to work by; one founded upon universal associations, according to which they finished those performances for which they challenged universal praise; and another guided by all casual and individual associations, through which they looked fondly upon nature, and upon the objects of their secret admiration. (F. J.)

BEAUVAIS (the *Cæsaromagus* and *Bellovaci* of antiquity), an arrondissement, department of Oise, in France, containing twelve cantons and 234 communes. Area 756 square miles. Pop. (in 1851) 101,983. The chief city, of the same name, is in a beautiful situation on the river Thérain, 21 miles N.W. of Paris. Pop. 12,508, employed in woollen, flax, cotton, earthenware, and carpet manufactures. The cathedral of Beauvais is one of the largest in France.

BEAVER, or Castor, an amphibious quadruped of the order *Rodentia*, with a thick glossy fur, and horizontally flattened tail, abounding in North America and Siberia, and still found in the north of Europe. It formerly appears to have been known as far south as the Rhone and the Danube; and though with us now extinct, was formerly an inhabitant of Great Britain. The fur of the beaver forms a considerable article of commerce. Among traders the skins are distinguished into three kinds: 1. The fresh beaver, which is obtained in winter, before the animal has shed any of its hair, and consequently that is most esteemed by furriers. 2. The dry or lean beaver, which is captured in summer, when the animal is moulting. 3. The fat beaver, which differs from the fresh only in having acquired additional softness and oiliness from being worn for some time on the persons of the native hunters. This is the kind that is chiefly used in hat-making. The substance called *castor* is found in pouches in the inguinal region of the beaver. It is regarded as a powerful antispasmodic. See Mammalia.

Beaver, that part of a helmet which covers the face.

BECAFICO, or Beccafigo (*Italian*), the fig-pecker, a bird like the nightingale, and much esteemed for its song and for its delicate flavour as food.

BECCAFUMI, Domenico Mecherino, was a painter of the school of Siena, where he was born in 1484, and where his best pictures are. His finest performances are small figures in distemper. He painted less happily in oil; but he is commended both by Vasari and by Lanzi. He died in 1549.

BECCARIA, Cæsar Bonesana, Marquis of, author of the well-known treatise on Crimes and Punishments, was born at Milan in the year 1735. His early studies were carried on in the college of the Jesuits at Parma. He possessed a quick apprehension; but, being naturally taciturn and inclined to reflection, he seldom communicated the progress of his ideas, and was with difficulty prevailed upon to complete his exercises. It is related, as another peculiarity of his disposition, that he never received praise from his teachers without betraying evident marks of pain and humiliation. These unusual indications of a susceptible mind, which, outstripping the course of his instructors, delighted in its own pursuits, and derived little complacency from a sense of its actual attainments, gave him, to common observers, a certain air of slowness, or even of stupidity, and characterized his features and deportment during the whole of his life. Having left college at the age of seventeen, he applied himself, with unremitting diligence, to the study of mathematics and the philosophy of man.

His propensity to the study of jurisprudence and political philosophy was first excited or confirmed by the *Lettre Persannes* of Montesquieu; a production capable, indeed, of alluring a less enthusiastic mind than that of Beccaria. But his industry in the pursuit of knowledge appears to have been chiefly stimulated by the patriotic and honourable desire of diffusing instruction among his countrymen, particularly the inhabitants of Milan, whom he represents, in one of his letters, as abandoned to a state of lamentable and universal ignorance. In the prosecution of these laudable designs, he fortunately possessed the confidence, and was encouraged by the protection, of Count Firmiani, then governor of that part of the Austrian dominions;—an accomplished nobleman, who, with comprehensive views of policy, concurred in every plan for improving the state of the provinces and the condition of their inhabitants.

Beccaria first appeared as an author in the year 1762,

Beccaria. when he published some observations on the Derangement of the Currency in the Milanese States, and a plan for its amendment. Soon after this he established a small literary society at Milan, in concert with some associates of character and sentiment similar to his own; among others, *Alessandro* and *Pietro Verri*, who at that time likewise contributed, by their talents and public spirit, to distinguish the reign of Maria Teresa in Lombardy.[1] Assisted by these friends, and countenanced by Firmiani, he commenced a periodical publication under the name of the *Caffè*; a plan said to have been suggested to them by the celebrity of Addison's *Spectator*, and the general belief of its influence on the opinions and taste of the people of England. Various papers, contributed by the members of this society, on subjects of literature, ethics, and physical science, were published during the years 1764 and 1765.

But by far the most remarkable production to which this society gave rise, and that by which the reputation of Beccaria has been chiefly perpetuated among other nations, was the treatise on Crimes and Punishments (*Dei Delitti e delle Pene*). This essay is said to have been undertaken at the earnest solicitation of Count Alexander Verri, who then discharged the functions of Protector of Prisoners (*Protettore de' Carcerati*) at the court of Milan. It was written at the house of his brother, Peter Verri, where the meetings of the society were held; and in concert with him the author, every evening, revised and corrected what he had written during the day. In this manner the work was completed within two months, and was printed in the course of the year 1764, with the mark of the Lucca press.[2]

In this small but noted work the author appears as the advocate of reason and sound policy no less than of humanity. It was his purpose, by examining the foundation, the objects, and consequently the boundaries, of penal law, to expose the inefficacy as well as injustice of many provisions in the judicial code of his own country, and in those of other European nations, which, derived from remote times, and established under a different order of society, had been perverted and debased during successive ages of barbarism. The authority of positive institutions formed almost the only basis of law, even in countries the furthest advanced in civilization; and that authority was in many of them drawn too servilely from the Roman system. Montesquieu had already thrown many penetrating glances at the foundation and structure of these ancient fabrics; but it was still reserved for others to scrutinize them more closely, and to draw forth, and present to general view, those direct inferences which that examination suggested. In no part were the existing codes more defective and vicious than in the department of the criminal law; and it was to this, accordingly, that Beccaria's attention was exclusively directed. Nor does he offer the work as a general system or theory even of penal law, in which light it would be found every way imperfect, but only as an attempt to analyze parts of a system which he found actually existing. Among the most prominent of those points to which his reasoning is applied, are, the due proportion between crime and punishment, and the violations of that proportion, whether by unnecessary severity of punishments, or the want of a scale and distribution of them suited to the amount and danger of particular offences; the inconsistency of certain rules then established on the subject of legal evidence; secret accusations, fictitious crimes, the use of torture as an instrument for the discovery of truth; imprisonment not authorized by law, or of uncertain duration, and the sale of offices of justice; along with other vices in the constitution of the courts. In treating these various topics, he seldom deduces his argument from remote sources, or pursues it to subtile refinements. That some propositions are advanced in the course of the work which are of a questionable nature, cannot be denied; and there are particular illustrations which have an exclusive reference to certain forms of government then existing in the Italian states. But, in general, the author reasons on few and acknowledged principles, and makes his appeal to the universal feelings of mankind. As one of the most important conclusions which result from his reasoning, or rather as concentrating a number of these conclusions, he closes his book with the following proposition: "In order that a punishment may not be an act of violence of one, or of many, against an individual member of society, it is essential that it should be public, prompt, and necessary, the least possible in the given case, and determined by the law." Beccaria.

His style in this work, with the exception of one or two passages, where he intentionally addresses himself only to the lesser number, is uniformly perspicuous, and, like that of all his other writings, though often eloquent, is unadorned. He employs, in some parts of it, that species of ridicule which, on a similar occasion, had been used with so great effect by Montesquieu. Thus, while treating the subject of torture, he proposes, among others, the following query in the form of a mathematical problem: "The force of the muscles and the sensibility of the nerves of an innocent person being given, it is required to find the degree of pain necessary to make him confess himself guilty of a given crime?" Peculiar traits of the writer's dispositions and train of sentiment are likewise to be found in other passages. Thus having, in a later edition, under that part which relates to fraudulent bankruptcy, modified some sentiments which he had originally expressed, but which, on reflection, appeared to himself too severe, he adds, in a note, "I am ashamed of what I formerly wrote on this subject. I have been accused of irreligion without deserving it; I have been accused of disaffection to the government, and deserved it as little; I was guilty of a real attack upon the rights of humanity, and I have been reproached by nobody."

If many of the views exhibited in this work are now divested of novelty, and if, through the general adoption of them by the most cultivated nations, we are led to forget that they were once hidden or excluded, such is the fate of all improvement as well as of all discovery. Nor does it detract from the true character of this interesting performance, that in some enlightened countries, and in the more propitious climates of political liberty, many of the important doctrines which it inculcated were already recognised in the systems of the law.[3] Beccaria was

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[1] A small publication which appeared about that time, under the title of *Thoughts on Happiness*, was written by the former. His literary pursuits were, soon after, suspended by his appointment to a public situation.

[2] These particulars, communicated in a letter of Count A. Verri to the Abbate Isidoro Bianchi, in 1802, are repeated by the latter in his *Elogio* on Pietro Verri.

[3] In the most favoured countries of liberty, however, the reception of some of these principles had been comparatively recent; while of others, the establishment seems even yet to be remote. That work which has tended most to diffuse a knowledge of the progress and spirit of the English laws, viz. the *Commentaries* of Sir William Blackstone, was not published till the close of the year 1765, although his plan of delivering a public lecture on the judicial system of his country was formed in 1753. The professorship at Oxford, which gave full effect to that plan, was instituted by Mr Viner in 1758.

 among the first by whom these principles were publicly avowed, under a government in whose institutions they had no place, and over whose judicial administration they exercised no influence; and, when the age and country in which he wrote are considered, the boldness of his statements is not less to be admired than the justness of his reasoning. It is his honourable distinction, likewise, and that of the friends who shared his labours and his views, to have preserved, in the prosecution of these objects, an unblemished loyalty towards their prince, and, while combating, with manly perseverance, the errors which prevailed in the fundamental principles of legislation, to have abstained from all attacks which might either directly weaken the authority of the laws, or disturb the administration of the government.

According to the just exposition given by the author himself, the true tendency of such a work is not to lessen the power of the law, but to increase its influence, inasmuch as opinion has a greater command over the minds of men than force. It has frequently been repeated, indeed, that national manners must precede laws; and in the only allowable sense of that maxim, the same might be said, perhaps, with equal truth, of opinions. But the authority of this *dictum*, and the extent to which it may be followed, are not unfrequently mistaken. An important distinction is apt to be overlooked, between those general laws, which, as they are founded in permanent principles of our nature, admit of being drawn from the first springs, but which have been disturbed by ignorance, or a barbarous policy, or the temporary dominion of some prevailing passion—and those artificial or secondary arrangements, which the circumstances and stages of political society may equally render necessary in times of knowledge, and tranquillity, and civilization. It is to the latter class only that the maxim referred to can have any just application. But it may well be questioned, whether, in any case whatever, the popular feeling and opinion should be allowed to precede, by any considerable interval, the act of the legislature. It seems, on the contrary, to be a valuable secret in legislation, and one of its most important ends, to seize the proper moment for accomplishing that union. Above all, it is expedient, in those branches of the law which are interwoven with and derive their support from the moral feelings, that a legislator should seek to anticipate every better tendency of public sentiment. Through want of a well-timed interference in such cases, many advantages are relinquished, as well in the concocting and framing of the laws themselves, as in that silent influence which a well-directed system of jurisprudence carries into the opinions and habits of a community.

Of the prospects which Beccaria himself entertained as to the probable influence of his work, a judgment may be formed from the sentence of Lord Bacon, which he prefixed to some of the editions. "It is not to be expected in any difficult undertaking, of whatever kind, that the same person who sows the seed should also reap the harvest; but there must, of necessity, be a preparation, and gradual progress to maturity."

The book was received in foreign countries with avidity, and procured for its author an immediate and high reputation. "Never," says a writer in the *Biographie Universelle*, "did so small a book produce so great an effect." The medal given by the Academy of Bern was instantly bestowed upon Beccaria; and the empress Catherine II. invited him to St Petersburg, with the offer of an honourable station at her court; a proposal which was partly the means of procuring him a similar distinction at home. Of the reception which the work obtained in France, particularly among the literary societies of Paris, evidence is afforded by the correspondence of the Baron de Grimm. "This book," he writes, in a letter dated 1st August 1765, "is by M. Beccaria, a Milanese gentleman, who is said by some to be an abbé, by others a lawyer, but who, I answer for it, is one of the best heads at this moment in Europe." "You will not find in the Milanese philosopher," he elsewhere observes, "either the pitch or compass of genius which characterize the writings of the President Montesquieu; but you will discover a mind that is luminous, profound, correct, and penetrating." And he justly adds, that his is one of the few precious books, *qui font penser*. It was translated into French by the Abbé Morellet in 1766; and Voltaire soon after published a commentary upon it, under the assumed title of *Un Avocat de Besançon*. With respect to the former production, the translator took some liberties with the method and distribution of the work, which were not altogether warrantable. Voltaire's commentary is written in the light style peculiar to him; and was evidently intended as a vehicle for certain opinions of his own, with which the spirit and object of the original publication are entirely unconnected. But the circumstance itself sufficiently marks the impression which that publication had made, and the prominence of the views which it developed. It was rapidly translated into various other languages; its maxims became a species of current coin through a great part of Europe; and the sanction of the author's reasoning was thought not unworthy of being resorted to in British tribunals.

Although followed by many others, Beccaria's was the first work of note, in which the application of a milder and more sound system of penal jurisprudence was explicitly enforced. Nor would it be at all extravagant to refer some of the great improvements which from this era were successively introduced into the written laws of different European monarchies, to the direct influence of the opinions thus generally diffused. Many such enactments, at least, were from this time promulgated in a tone more consonant than heretofore with the dictates of humanity and equitable rule. Of this description were, among others, not only the *urbarium*, or regulations concerning villanage, issued in 1764, by the empress Maria Teresa, but also the more extended designs which took effect, at a somewhat later period, in the various reformed codes, published by the empress Catherine, the emperor Joseph II., the grand duke of Tuscany, and the Danish government under the administration of the late Count Bernstorf.

At one period a storm seemed to be preparing against the marquis in his own country, by those who probably intended, in this form, a service to the government; but it was soon dispersed by the authority of the government itself. Beccaria had considered it his duty to communicate to Count Firmiani the offers which had been made to him by the empress Catherine, and the intelligence was transmitted by the viceroy to his own court. The conduct of Prince Kaunitz-Ritzberg, on the occasion, is highly honourable to that minister and to his sovereign. Instead of treating the communication as a matter of no account, he makes it the subject of a long dispatch, and of repeated instructions. In one of these papers, dated 27th April 1767, after requiring particular information respecting the personal character of Beccaria, he adds, "Supposing his good qualities to preponderate, it would be desirable that the country should not lose a man whose fund of knowledge is so considerable, and who, as appears from his book, possesses a mind habituated to reflection, above all in our present penury of thinking and philosophical men; besides that it would do little honour to the whole administration to be anticipated by foreigners in the due

Beccaria. estimation of talents."[1] Nor were these merely empty professions; they were almost immediately followed by an imperial order for establishing, in the palatine college at Milan, a professorship of public law and economics, under the title of *Scienze Camerali*. To this chair, expressly endowed for him by a distinction so honourable, the marquis was appointed on the 1st of November 1768, and commenced the duties of it in the month of January following. From the preliminary discourse (*proluzione*) which he pronounced on this occasion, and in which he briefly sets forth the objects of the institution, and some of his own leading opinions regarding them, it appears that the only instructions which he received from the regency on his appointment, consisted in an order to deliver his discourses in the vulgar tongue; an injunction of which the motives are honourable to that government, in common with all the circumstances attending this transaction. His lectures, which he received a special permission to deliver in his own house, attracted much notice. They were not published during his life; but have since appeared, under the title of *Elementi di Economia Pubblica*, in the compilation of the *Scrittori Classici Italiani di Economia Politica*, printed at Milan.[2]

As he had, in his former work, set out with stating the object of municipal law to be "the greatest happiness of the greatest number," so here the same universal principle serves him for a guide; and he assumes it as the aim of public economy "to provide with peace and safety, things necessary and convenient for the whole community." He classes the objects of political economy under five heads; agriculture, manufactures, commerce, finance, and policy; comprehending, under the latter, those laws and institutions which have a respect to the sciences, to education, to police in the modern sense of that word, and to the various means of public defence and security. The design was not completed; no trace, at least, appears in the work published under the above title relative to the subjects of finance or public policy.[3] In estimating the value of these speculations, it is no less necessary than in the case of the former work, to consider them with a reference to the state of science at the time, rather than to the present extension of knowledge in this department. Under the first three divisions he enters at considerable length into some of the most interesting discussions which have arisen in this wide field; particularly as to the principles of public policy in regard to agriculture, to the commerce of grain, and foreign commerce generally, and to money and exchange.[4] In perspicuity of language, and distinct and patient illustration, the style of these discourses bears a considerable resemblance to that of the *Wealth of Nations;* but the coincidence between the two works, in some general and fundamental doctrines, is still more remarkable and interesting. Beccaria does not appear to have adopted the particular theory of the French economists, which was developed about that time; although his practical doctrines on some of the most important points were conformable to the conclusions deduced from that system.[5] Beccaria.

Among other inferences, to which the course of his reasoning leads him, as it were, by many different roads, may be noticed one, which he has himself ventured to state as a general proposition, and which marks the caution as well as enlargement of his mind in subjects of complicated inquiry. "Every restriction on freedom," he observes, "whether in the case of commerce or any other, ought to be a result from the necessity of preventing an actual disorder, not the effect of a purpose or aim at amelioration." And he has repeated the same doctrine under different views in various other passages.[6] On all these subjects he exercises, without ostentation, the privilege of examining and judging for himself; and in doing so, although he expresses himself with plainness and energy,[7] he is never dogmatical. He observes this further dictate of a sound philosophy,—to refrain as long as possible from any very general conclusions; and, although he appears to have disengaged his mind from the power of common and hereditary notions respecting political economy, he does not, by a transition too often made, substitute dangerous or extravagant positions in their place. He is even more distinguished by the temperate use which he makes of his liberty, than by the independence which secured him from the chain.

During the same period in which he pursued these labours, Beccaria undertook another literary task of a very different description, and commenced an *Inquiry into the Nature of Style*.[8] A first part of this *Inquiry* was published in 1770; but the author does not appear to have prosecuted his intention, and only one detached portion of the remainder was found among his papers.[9] The apology which he makes for this apparent deviation from his usual objects of pursuit, drawn from a consideration of the connection subsisting between the study of the fine arts, and that of moral and political science, affords a pleasing proof of the natural expansiveness of his mind.[10]

His scientific and literary studies were now to be interrupted, however, by new and more flattering marks of distinction from his government. By an imperial order of the 29th April 1771, he was appointed a member of the Supreme Economic Council; on the suppression of which, he was transferred to the magistracy of state; and, lastly, by a dispatch of the 17th January 1791, he was named one

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[1] The originals of these dispatches are among the state papers in the public archives of Milan.

[2] The editor states that this publication was made from a copy of the discourses, transcribed for the author himself when he visited Paris in 1776.

[3] Some of the others, too, are treated rather briefly. He has himself defended this method of teaching by the following just and striking observations, in that part of the work where he discourses of *Interest:* "But woe to the teacher who would say all that is to be said, and leave nothing to the penetration of the learner. What is heard slips away and vanishes from the hearer's mind, unless he has an opportunity of opposing the re-action, as it were, of his own intellect, to the impressions of his instructor; and more light is thrown upon a science by one process of exact reasoning which we carry on for ourselves, and it is more deeply and firmly rooted in us by that single operation, than by many and repeated trains of reasoning conducted by another."

[4] Under the head of Agriculture, he proposes the scheme of an experimental farm to be carried on at the public expense, as a school of that science, and enters into some detail of its objects and regulations.

[5] Mirabeau's *Tableau Economique* had already appeared in the publication entitled *La Philosophie Rurale;* as well as various papers of Quesnay.

[6] For example, "The operations of Economics amount only to not permitting, and most frequently to letting alone."

[7] "Con un non fanatico vigore," as he has himself somewhere expressed it. But on occasions where he conceived that there might be a danger of inflaming the passions, he has claimed the tribute due to him for employing a style "beyond the reach of the uninformed and impatient multitude."

[8] *Ricerche intorno alla Natura dello Stile.*

[9] This additional chapter is given in the edition printed at Milan in 1809.

[10] In no part of his writings is the enlargement of his comprehension, as well as soundness of his judgment, more to be remarked, than in the *Treatise* on the State of Currency, which was his first publication, and written at the age of twenty-seven.

Beccaria. of the Board for Reform of the Judicial Code, civil and criminal. His activity and usefulness in the discharge of these great trusts are best proved by the circumstance, that some of the most important matters in those different departments were committed to his direction, and regulated by his counsels. The most remarkable of his state papers were, various *Ordinances* relative to the grain; a very important *Dispatch* transmitted to the Court in 1771, which gave rise to the reform of the public money in 1778; a *Plan* proposed in 1780 for effecting a uniformity in the weights and measures; and certain *Proposals*, in 1786, founded on the tables of the population. His writings of this description are characterized by method, perspicuity, and precision. It deserves to be particularly noticed respecting his scheme for the equalization of measures, that, of the different natural bases for exact measurement, he explicitly recommends that which may be obtained from the celestial bodies, and, in the application of it, proposes to employ the decimal method of division; being the same system which was afterwards adopted by the late government of France.[1]

In the year 1776 Beccaria made a journey to France, in company with his friend Alessandro Verri. He remained at Paris for about three weeks, which he passed chiefly in the society of D'Alembert and other eminent men of letters; and, on his return, he visited Voltaire. This journey seems to have been the only considerable incident which, during a period of twenty-five years, diversified his manner of life, or interrupted his official duties. He died of apoplexy, in the year 1793. According to the editor of his *Elementi*, in 1804, his death was unnoticed by his country, and his tomb remained without a name or an epitaph.

Beccaria was twice married. He was stedfast in his friendships; modest, but tenacious of his opinions. He took pleasure in the society of literary men, and avoided that of the great. It is related of him, that the king of Naples, while at Milan, twice attempted to visit him at his house; but that the marquis found means, on both occasions, to escape the honour intended for him by his majesty. His exertions in the service of the public, and, above all, his earnest endeavours to promote, by every means, the cause of science, and a liberal system of education, formed the chief feature of his life. On the latter topic he has made many forcible and eloquent appeals, in he course of his different writings; and some passages of this description, which are interspersed in his discourses of Political Economy, are not less to be admired for their intrinsic excellence, than they are interesting from the circumstances in which they were written, and the contrasts which they indirectly exhibit.

One trait of his constitutional disposition or confirmed habit has been recorded, as furnishing a remarkable exception to the general vigour of his intellectual character, —that, notwithstanding the force with which he combated the prejudices and unreasonable apprehensions of other men, he was himself subject, when left alone, to an unconquerable timidity. We are not told whether this tendency was ascribed to early habits and a faulty education, or supposed to be the consequence of some sudden and fatal impression, which remained indissolubly associated with certain outward circumstances, or in what other manner it was formed and perpetuated. On a superficial view, it seems to denote a mind radically weak. But this is not a necessary or a just inference. The fact is, indeed, singular, and deeply impressive; but, in truth, it only serves as a new example to prove how mixed is the nature of Beccaria. our frame; how imperfectly the understanding acts upon the will, and the will upon the moral part; and how many things appear to be within the jurisdiction of our reason, which, nevertheless, are superior to its control.

This is not the place to engage in a more particular examination of the spirit and scope of Beccaria's writings. He is said to have expressed, at least during the early part of his life, too unqualified an approbation of the works of Helvetius, and others belonging to the same school of philosophy. On this score some excuse may, perhaps, be found for him in the attractions which the style of the author now mentioned possesses for a youthful and ardent mind. It is to be observed, likewise, that, when he expressed this admiration of the productions alluded to, the *Système de la Nature* had not yet made its appearance. Nor is it to be supposed that he could be insensible to the notice and the applause of such men as then held the stations of greatest eminence in the scientific world. Yet whatever temptations he may have been exposed to from the influence of some of his literary associates, it is consolatory to reflect, that, neither in the works which he himself gave to the public, nor in those which have been brought to light since his death, are sentiments to be found which have a tendency to subvert any one foundation of private or of public good. His labours were beneficent, and their natural fruits the dissemination of useful knowledge, the increase of industry, and the improvement of social order. But he was not fated to witness the spectacle which ensued, or to be an observer of that moral crisis, of the results of which it may be questioned, if, hitherto, they have less disturbed the calculations of the friends of humanity, than baffled the counsels of its foes.

Some further information with respect to Beccaria's publications will be found in the *Notizie* prefixed to his *Economia Pubblica* (*Scrittori Classici Italiani*, tom. xi.); in the fourth volume of the *Biographie Universelle*, printed at Paris in 1811; and in the fourth and fifth volumes of the *Correspondence par le Baron de Grimm*. In the compilation first mentioned are contained (besides his *Elementi*) republications of his *Relazione della Riduzione delle Misure di lunghezza all' Uniformità, per lo stato di Milano;* of his *Prolusione letta nell' apertura della nuova cattedra de Scienze Camerali;* and of his inquiry *Del Disordine e De' Rimedi delle Monete*. In the same collection is likewise to be found a paper written by him for the periodical work called *Il Caffè;* viz. *Tentativo Analitico sui i Contrabbandi*, being an attempt to apply the algebraical method to certain subjects of political economy. A new edition of Morellet's French translation of the *Treatise on Crimes and Punishments* was published by M. Roederer in 1797; and a version of the same treatise in modern Greek, by Coray, was published at Paris in 1802. (J.G.D.)

Beccaria, *Giambattista*, a very ingenious and industrious electrician and practical astronomer, was born at Mondovi on the 2d of October 1716, and entered the religious order of the Pious Schools in 1732. He became a professor of experimental physics, first at Palermo, and then at Rome, and was appointed to the same situation at Turin in 1748: he was afterwards made tutor to the young princes de Chablais and de Carignan, and continued to reside principally at Turin during the remainder of his life. In May 1755 he was elected a fellow of the Royal Society of London, to which he afterwards communicated several papers relating to his favourite pursuits He died on the 27th of May 1781.

[1] In the mathematical calculations connected with this subject, he was assisted, as he himself states, by Frisi, Professor of Mathematics at Pisa; and in the mechanical part by his brother Annibale.

Beccaria. 1. The most voluminous and most important of his works, entitled *Dell' Elettrismo Artificiale e Naturali*, appeared at Turin, 1753, 4to, and was reprinted in 1772. It was translated into English, and published, with the original engravings, under the title of *A Treatise upon Artificial Electricity, and an Essay on the Mild and Slow Electricity of the Atmosphere.* Lond. 1771, 4to.

2. *Risposta ad una Lettera intorno al suo Elettrismo.* Milan, 1753, 4to.

3. *Lettere dell' Elettrismo Atmosferico. 2da, Ed.* 2. Turin, 1758, 4to.

4. *Experimenta et Observationes quibus Electricitas vindex late constituitur atque explicatur.* Graz. 4to.

The accurate and elaborate experiments related in these works obtained for their author the warm and repeated encomiums of the scientific historian Dr Priestley, and the approbation and friendship of other contemporary philosophers; although it must be confessed that, amidst the multitude of important facts recorded in them, we sometimes observe a want of clearness of arrangement and closeness of reasoning; nor must we attempt to claim for Beccaria either the originality of a Franklin, the mathematical precision of an Æpinus, the enlarged views of a Cavendish, or the neatness and inventive talent of a Volta. The most remarkable novelties which deserve to be distinguished among our author's experiments and opinions relate to the limited conducting power of water, to the electrification of the air and smoke, to the velocity of electricity, to the reduction of metals by its powers, to the illumination of the solar phosphori by the spark, to the light excited by the motion of the air, and to a variety of meteorological phenomena, especially lightning, storms, rain, water-spouts, and atmospherical magnetism. The resistance exhibited by water to the passage of the electric fluid is demonstrated by the luminous appearance of its path, while it passes through more perfect conductors without producing light, as well as by the explosion of glass tubes containing water, through which the spark is taken; and this experiment is extended to the construction of an electrical water-gun, which is said to have carried a small bullet with considerable force.

Father Beccaria observed, about the same time with Mr Canton, that the air surrounding an electrified body was capable of becoming electric by slow degrees, and that it also parted slowly with its electricity; and, by means of some property of this kind, he produced the appearance of a luminous atmosphere about an electrified ball, to which another was presented, in a partial vacuum. The smoke of colophony, surrounding an electrified body, enabled it to give longer sparks; but this smoke was little attracted by the body when the heated spoon containing the colophony was insulated. Respecting the velocity of electricity, he relates some experiments, which amply deserve to be confirmed or confuted. He found the effect of a spark occupy at least half a second in passing through 500 feet of wire, and six and a half through a hempen cord of the same length, although when the cord was wetted, it passed through it in two or three seconds. It is well known, that, in the earlier experiments of Watson, a shock was transmitted through a much longer circuit of wire, without occupying any perceptible interval of time in its passage. Many of the metals were revived from their oxyds, and mercury was reproduced from cinnabar by the powers of electricity; and our author fancied that he had discovered a common principle in the different metals, as several of them gave the same colour to the surface of the glass to which they were attached. The brilliancy of the electric light was demonstrated by the permanency of its effect on the solar phosphori; and this subject was afterwards pursued by various experiments of Canton and others. The light often exhibited by the air rushing into a vacuum is attributed by Beccaria to the friction of the air against the sides of the glass. It may be remarked that the phenomenon is, in all probability, of the same kind as the appearance of light observed long ago in the air-gun by its first inventor, Ctesibius of Alexandria. With respect to atmospherical electricity, Beccaria's researches were most laborious and extensive, and he made a great variety of experiments illustrative of the nature of lightning, and of storms in general; showing, for instance, the facility with which small bodies are forced into the course of the electric current, as light clouds are made to assist in conveying a stroke of lightning; and proving that evaporation, and the deposition of vapour, are always accompanied by electrical changes. Thunder-storms, in general, he attributes to terrestrial electricity, and supposes the clouds to be merely the channels by which the fluid is carried from one part of the earth's surface to another, the equilibrium having been first disturbed by chemical changes within the earth; and it must be confessed that this opinion is in some measure countenanced by the frequent connection which is observable between these phenomena and those of earthquakes and volcanic eruptions. Water-spouts, he assures us on the authority of several eye-witnesses, may certainly be dispersed by pointing swords and knives at them; and, with respect to conductors erected for safety, though he appreciates their utility very highly, he thinks that every large building should be furnished with more than one or two. The *electricitas vindex*, so often mentioned, is the electricity made sensible in one body by the removal of another which has been situated near it;—a property which afterwards led to the elegant inventions of the electrophorus and the condenser of Wilke and Volta. Our author appears to be somewhat disposed to exaggerate the importance of electrical changes as the causes of other atmospherical phenomena, and, in particular, to overrate the intimacy of the connection of electricity with magnetism. The appearance of the *aurora borealis* he attributes to the circulation of electricity through the higher regions of the atmosphere, and he was well aware of the magnetical changes which usually accompany this remarkable occurrence.

5. His papers in the *Philosophical Transactions* are all in Latin. The first is entitled *Experiments in Electricity, in a Letter to Dr Franklin.* (*Phil. Trans.* 1760, p. 514.) These experiments relate principally to the subject of electrical attractions and repulsions, which the author attempts to reduce to the effect of currents of air displaced by the immediate action of the electric fluid. He supposes the air between two bodies, in dissimilar states, to be rarefied by the interchange of their electricity, so as to produce the appearance of attraction; and when the bodies are in similar states, he imagines the air interposed to be the immediate object of their apparently mutual repulsion. The paper is accompanied by a note of Dr Franklin, explanatory of the apparatus employed.

6. *An Account of the Double Refractions in Crystals.* (*Phil. Trans.* 1762, p. 486.) The double refraction of rock crystal had been observed by Huygens. Beccaria seems to have imagined that it was not discoverable when the surfaces concerned were parallel to each other; but later observations have shown that his observations were defective in this respect, at the same time that they have confirmed his conjecture respecting the existence of a similar property in almost all crystallized substances.

7. *Novorum quorundam in re Electrica Experimentorum Specimen.* (*Phil. Trans.* 1766, p. 105.) In this paper our author defends the simpler theory of Franklin against Mr Symmer's doctrine of the existence of two separate elec-

Beccaria. tric fluids. He also enumerates a great variety of cases of the excitement of positive or negative electricity by the friction of different substances with glass, hare-skin, a silk stocking, sealing-wax, and sulphur.

8. A second paper, with the same title, appeared in the *Philosophical Transactions* for 1767, p. 297. It contains an account of a repetition of experiments on the modification produced in the charge of two or more glass plates, by separating them, and by removing and replacing their coatings. These investigations were principally suggested by the well-known observations of the Jesuits, made at Pekin many years before, and by some subsequent experiments of Mr Symmer. The author calls the effect an oscillation of electricity; it depends on the same causes as the "vindicating electricity," which he has elsewhere described.

9. *De Atmosphæra Electrica libellus.* (*Phil. Trans.* 1770, p. 277.) The phenomena of induced electricity are here discussed, but not with great precision: the author adverts, however, to the Newtonian demonstration of the equilibrium of the force of a gravitating substance, distributed through the surface of a sphere, with respect to a particle within it, and gives somewhat clearer views of the theory of electricity than his former works had exhibited, but still falls far short of the perfection which Æpinus had attained more than ten years before.

10. A short *Letter to Mr John Canton, on his new phosphorus receiving several colours, and only emitting the same,* is printed in the *Philosophical Transactions* for 1771, p. 212. Our author admitted the sun's light through green, red, and yellow glass, and found that the pieces of sulphureted lime exposed to it emitted only a light similar to that which had been thrown on them. A multiplicity of later experiments have however shown, that the contrary result is by far the most common; and Zanotti's earlier observations have been fully confirmed by Wilson, Grosser, and Seebeck.

11. In 1759 Beccaria received orders from his sovereign, in consequence of a suggestion of Boscovich, to measure the length of a degree of the meridian in the immediate neighbourhood of Turin: the measurement was completed in 1768, and an account of it was published under the title of *Gradus Taurinensis*, Turin, 1774, 4to; prefaced by a proper compliment to the memory of the monarch who patronized the undertaking, and to the virtues of his successors, under whose auspices it was completed. The result did not, however, exhibit the appearance of any great accuracy or good fortune; for there is not only a difference of one seventieth of the whole in the lengths of the degree computed from the northern and southern portions of the arc, of 27′ and 41′ respectively, but the length deduced from the whole arc, which is 57468·59 French toises, is 445 toises more than would be inferred from other measurements in the neighbouring latitudes; hence it appears to have been thought necessary by later astronomers to reject the northern portion altogether, and to make some corrections in the calculation from the southern, by which the length of the degree has been reduced to 57069 toises. The zenith sector employed for the observations was made on Boscovich's construction, the length of the tangent being measured instead of that of the arc, a method by no means calculated to lessen the chances of error. A portable syphon barometer is also described, by means of which the elevations were ascertained; and a number of heights of places in the mountains of Piedmont are recorded.

12. This volume appears to have been the last of Beccaria's publications: An *Essay on Storms and Tempests* is mentioned without approbation in the *Dictionnaire Historique*, but it was probably extracted from some of his other works. In his private history and adventures there appears to have been little for a biographer to relate: his ambition having been in a great measure limited, by the religious profession which he had adopted, to the acquirement of literary celebrity, his taste was guided by his prevailing pursuits. His only luxuries consisted in his library and instruments; and on these he expended a considerable part of the remuneration which he received for his services to the public and to his royal pupils. (T. Y.)

Beccles ‖ Beck.

BECCLES, a market-town and borough, county of Suffolk, hundred of Wangford, on the right bank of the river Waveney, 32 miles N.N.E. of Ipswich. It consists of several streets, is well built, and contains a fine old parish church, several dissenting places of worship, a free school founded in the reign of James I., a free grammar-school with ten exhibitions at Emanuel College, Cambridge, a handsome town-house, custom-house, &c. By means of the river, which is navigable to Yarmouth, a considerable trade in coals and groceries is carried on. Market-day Saturday. Pop. 1851, 4398.

BECERRA, Gaspard, an eminent Spanish fresco-painter and sculptor, born about the year 1520, at Bajeza, in Andalucia. He studied at Rome under Michael Angelo, and adorned with his paintings many churches in Spain. His chef-d'œuvre is a statue of the Virgin at Madrid, where he died in 1570.

BECHER, Johann Joachim, a celebrated chemist, born at Spires in 1635. He was connected with the most learned men in Europe; and the emperor, the electors of Mentz and Bavaria, and other persons of high rank, furnished him with the means of making experiments in natural philosophy, medicine, and chemistry. As his thoughts had been much directed to economical subjects, and particularly to the means of increasing the revenues of a state, he was invited to Vienna, where he contributed greatly to the establishment of several manufactures, a chamber of commerce, and an Indian company. But the jealousy of some of the ministers eventually occasioned his disgrace and ruin. Equally unfortunate at Mentz, Munich, and Wurzburg, he determined to repair to Haerlem, and here he invented a machine for working a great quantity of silk in a little time, and with few hands. But new misfortunes forced him to seek refuge in England, and he died at London in 1682. He wrote many works, the principal of which are, 1. *Physica Subterranea*, which was printed at Leipsic in 1703 and 1739, in octavo, with a small treatise, by E. Stahl, entitled *Specimen Becherianum;* 2. *Experimentum chymicum novum*, 8vo; 3. *Character pro Notitia Linguarum universali;* 4. *Institutiones Chymicæ, seu Manuductio ad Philosophiam Hermeticam*, 4to; 5. *Institutionis Chymicæ, seu Œdipus Chemicus*, 12mo; 6. *Experimentum novum ac curiosum de Miniaria arenaria perpetua*, &c.

BECK, or Beke (Saxon, *becc;* Dutch, *beck*), a word which imports a small stream of water issuing from some rill or spring. Hence *hellbecks*, little brooks in the rough and wild mountains about Richmond in Yorkshire, so called from their ghastliness and depth. Beck is also used in the composition of names of places originally situated on rivulets; hence Walbeck, Bournbeck, &c. The Germans use *beck* or *bach* in the same manner; as Lübeck, Griesbach.

Beck, or Beek, *David*, an eminent portrait-painter, born in 1621 at Arnheim in Guelderland. He became a disciple of Vandyk, from whom he acquired the fine manner of pencilling and sweet style of colouring peculiar to that great master and to all the disciples trained up under his direction. He possessed likewise that freedom of hand, and readiness or rather rapidity of execution, for which Vandyk was so remarkable; insomuch that when King Charles I. observed the expeditious manner of Beck's painting, he exclaimed, "Faith! Beck, I believe you could paint riding

Becket. post." He was appointed portrait-painter and chamberlain to Queen Christina of Sweden; and he executed portraits of most of the sovereigns of Europe to adorn her gallery. He lived in the highest favour with his royal mistress, and left the court of Sweden much against her inclination. He died soon after, at the Hague; and it was suspected that he had been poisoned. This happened in 1656, when Beck had only attained his thirty-fifth year. A very singular adventure happened to this artist as he travelled through Germany. Having been taken suddenly and violently ill at the inn where he lodged, he seemed to all appearance quite dead, and was laid out as a corpse. His valets expressed the strongest grief for the loss of their master, and while they sat beside his bed, drank very freely, by way of consoling themselves. At last one of them, getting much intoxicated, said to his companions, "Our master was fond of his glass while alive, and out of gratitude let us give him a glass now he is dead." The rest of the servants having assented to the proposal, he raised up the head of his master, and endeavoured to pour some of the liquor into his mouth. From the fragrance of the wine, or probably from the irritation produced by a small quantity getting down his throat, Beck revived and opened his eyes; when the drunken servant, forgetting that his master was considered as dead, compelled him to swallow the whole contents of the glass. The painter gradually recovered, and by proper care and management was soon restored to perfect health.

BECKET, Thomas À, lord chancellor of England, and archbishop of Canterbury, in the twelfth century. The story of his birth is as extraordinary as that of his life. It is related that his father Gilbert Becket, sometime sheriff of London, went on a pilgrimage to Jerusalem, where he was surprised and enslaved by a party of Saracens. His master's daughter fell in love with him, and when he made his escape, she followed him to London. So singular an instance of heroic affection made a deep impression on his mind; and, after consulting with some bishops, he had her baptized by the name of Matilda, and then married her. From this marriage sprung the haughty Thomas à Becket. Raised to the primacy, à Becket began the dispute between the crown and the tiara, and sided with the pope in the quarrel. At this King Henry II. was greatly offended; and convoking an assembly of the bishops at Westminster, offered six articles against papal encroachments, to which he urged à Becket to assent. Yielding to the importunities of several lords, à Becket signed the articles; but speedily relapsing into his former opinions he was ordered to be tried as a traitor; upon which he fled into Flanders. The king lost no time in banishing all his relations, and à Becket retaliated by excommunicating all his opponents. At last, after seven years spent in unavailing hostility, by the intercession of the French king and the pope he was allowed to return; but he peremptorily refused to absolve the bishops and others whom he had excommunicated; upon which the king, enraged at his obstinacy, exclaimed, "that he was an unhappy prince, who maintained a great number of lazy insignificant persons about him, none of whom had gratitude or spirit enough to revenge him on a single insolent prelate who gave him so much disturbance." The deadly hint was understood; and four gentlemen, or rather ruffians, of the court, immediately formed a design against the archbishop's life, which they executed in the cathedral church of Canterbury on the 29th of December 1171. Superstitiously afraid of polluting the sanctuary with blood, more especially with that of a mitred priest, they endeavoured to drag him out of the church; but finding they could not effect this without difficulty, they killed him at the altar. Afraid they had gone too far in violating the sanctity of the church, the assassins durst not return to the king's court at Normandy, but retired to Knaresborough in Yorkshire, where everybody avoided their company; scarcely any one, however low, deigning to eat or drink with them. Finding the curse of murder pursue them, they at length took a voyage to Rome, and being admitted to penance by Pope Alexander III. set out for Jerusalem, where, according to the pope's orders, they spent the remainder of their lives in penitential austerities. They died in the Black Mountain, and were buried at Jerusalem, outside the door of the church belonging to the Templars. King Henry affected to be much disturbed at the news of à Becket's death, and despatched an embassy to Rome to clear himself from the imputation of having caused or suggested it. The celebration of divine offices was discontinued in the church of Canterbury for a year, deducting nine days; at the end of which period it was reconsecrated by order of the pope. Two years after this à Becket was canonized; and Henry returning to England the ensuing year, went to Canterbury, where he did penance in testimony of his regret for the murder of à Becket. When he came within sight of the church where the archbishop lay buried, he alighted from his horse, and walked barefooted in the habit of a pilgrim till he came to à Becket's tomb, where, after he had prostrated himself and prayed for a considerable time, he submitted to be scourged by the monks, and passed all that day and night without any refreshment, kneeling upon the bare stones. In 1221, fifty years after the murder, à Becket's body was disinterred in the presence of King Henry III. and a great concourse of the nobility and others, and deposited in a rich shrine, erected at the expense of Stephen Langton, archbishop of Canterbury. It was soon visited from all parts, and enriched with the most costly gifts and offerings; and the miracles said to have been wrought at the tomb of the saint were so numerous that Gervase of Canterbury tells us two large volumes kept in the cathedral church were filled with accounts of them. The monks used to raise his body every year; and the day on which this annual resurrection was performed, called the "day of his translation," was kept as a general holiday. Every fiftieth year a jubilee was celebrated in his honour, which lasted fifteen days; plenary indulgences were then granted to all who visited his tomb; and 100,000 pilgrims were registered at a time in Canterbury. The worship of the saint in that city indeed had quite effaced the adoration of the Deity, nay, even that of the Virgin. At God's altar, for instance, there were offered in one year only L.3, 2s. 6d.; at the Virgin's L.63, 5s. 6d.; but at St Thomas's, L.832, 12s. 3d. And next year the disproportion was still greater; for at God's altar not a penny was offered; the Virgin's obtained only L.4, 1s. 8d.; while St Thomas got for his share L.954, 6s. 3d.;—a large sum, if the value of money in those times be considered, and a correspondingly strong proof of the hold which superstition then possessed over men's minds. Even Louis VII. of France made a pilgrimage to this miraculous tomb, and bestowed on the shrine a jewel which was esteemed the richest in Christendom. But Henry VIII., to whom a saint of so high character was naturally very obnoxious, not only pillaged the rich shrine dedicated to St Thomas, but caused the saint himself to be cited to appear in court, and to be tried and condemned as a traitor; at the same time ordering his name to be struck out of the calendar, the office for his festival to be expunged from all breviaries, and his bones to be burnt, and the ashes thrown in the air. À Becket was the subject of poetical legends; and *The Lives of the Saints* in verse, a manuscript which is supposed to belong to the fourteenth century, contains an account of his martyrdom and translation. We also learn from Peter de Blois that the palace of à Becket was perpetually filled with bishops highly accomplished in literature, who passed their time there in reading, disputing, and deciding important questions relating to the state. "These prelates, though men of the world, were a society of scholars; yet very different from those who frequented the universities, in which nothing was taught but words and syllables, un-

Becket.

Beckford || Beckmann.

profitable subtilties, elementary speculations, and trifling distinctions." De Blois was himself eminently learned, and one of the most distinguished ornaments of à Becket's household. John of Salisbury, his intimate friend, the companion of his exile, and the writer of his life, was scarcely exceeded by any man of his time for his knowledge in philological and polite literature. (See Dr Giles', *A Becket and His Times.*)

BECKFORD, WILLIAM, was the son of alderman Beckford, noted for his manly reply to George III. on the presentation of an address from the city of London. He was born in 1761, and at the age of nine he inherited an immense fortune from his father. In early life he travelled in Italy, Sicily, Spain, and Portugal, and resided some time in the latter kingdom, where he had a princely residence. He afterwards returned to England, and built a fine residence at Fonthill, on which he expended in about eighteen years the enormous sum of L.273,000. This, together with its splendid library and pictures, he sold to Mr Farquhar in 1822; but soon after, a tower of 260 feet fell down and buried part of the villa in the ruins. Mr Beckford afterwards began the erection of another lofty structure on Lansdownehill, near Bath, where he continued to reside till his death, which happened in 1844. He was a powerful and original writer. His first work, *Biographical Memoirs of Extraordinary Painters*, which appeared in 1780, exhibits much knowledge of the art. In 1784 he published in French the singular tale entitled *History of the Caliph Vathek*, which soon afterwards appeared in English. In 1834 his first Continental tour appeared under the title of *Letters from Italy, with Sketches of Spain and Portugal*, a work never perhaps surpassed for striking description and refined sarcasm. His latest production, published in 1835, was entitled *Recollections of an Excursion to Alcobaza and Batallia in* 1794. All these works exhibit uncommon power of vivid description, and a cultivated taste. He left two daughters, the eldest of whom was married to the late Duke of Hamilton.

BECKMANN, JOHANN, the author of the *History of Inventions*, was born at Hoya in the electorate of Hanover, in 1739. His father, who was receiver of taxes and postmaster in that town, occupied himself in the cultivation of a small piece of land, and appears to have inspired his son with a taste for agriculture. All the honour of his education belongs, however, to his mother, who, having become a widow when young Beckmann was scarcely seven years old, sent him, in his fifteenth year, to the school at Stade, placing him under the care of Gehlen. Being intended for the clerical function, he repaired in 1759 to Göttingen, to finish his studies there; but, whether the advice of Hollmann, who testified much kindness towards him, produced a change in his plans, or that the instructions of the mathematicians Kaestner and Tobias Mayer had greater attractions for him than theology, he abandoned the career on which he had entered, in order to devote himself entirely to the natural sciences, and principally to the application of these sciences to economical purposes. His first studies were not without their use to him; he derived from them a methodical habit of mind, and a considerable knowledge of languages, which, in the sequel, assisted him greatly in the pursuits to which he owed his celebrity. In 1762, having lost his mother, and with her his former means of subsistence, he accepted the offer of Busching, who invited him to come and fill the situation of professor of natural philosophy in the Lutheran Academy at St Petersburg, of which this celebrated geographer had at that time the direction; but Busching quitting the institution shortly after, and dissensions having arisen among the superintendents, Beckmann gave up his place, and made a journey through Sweden to acquire a detailed knowledge of the mines of that country, and of the manner of working them. Linnæus having received him hospitably at Upsal, he prolonged his stay there, and availed himself of the friendship as well as the instructions of that great naturalist. In 1766, the governors of the university of Göttingen appointed him, on the recommendation of Busching, professor to that celebrated establishment, of which he became one of the principal ornaments. His mind, entirely directed to the practical uses of human knowledge, had early conceived the idea of an academical classification of the arts and different branches of economy, both political and domestic, which had hitherto been left to routine and accident. He composed, to serve him as a guide in this course of instruction, *Treatises on Rural Economy, on Policy, on Finance, on Commerce*, and other departments of practical knowledge; which, though since carried to a higher degree of perfection, owed to Beckmann their primary elements and their first scientific form. His lectures, which had at the time the recommendation of novelty, were attended by the flower of the studious youth, whom the most civilized nations of Europe sent to the university of Göttingen; and it may be added, that the most distinguished statesmen and public functionaries of Germany were among his auditors. He was in the habit of accompanying them himself into the workshops, to give them a knowledge of the different processes and handicrafts of which he had explained to them the theory. He never relinquished his public lectures; but his private studies took insensibly a direction altogether historical, the motives for which it will not, perhaps, be uninteresting to point out.

Beckmann.

At Göttingen it is considered that a professor, in teaching a particular science, cannot be excused from explaining the progress of that science in all the civilized nations of Europe at the same time. Any one who, two years after the appearance of a work of importance in his department, published in any country of Europe, should not have read and analyzed it in orde. to refute or else enrich his own observations from it, would not regard himself as a worthy successor to the chair of Haller, of Mosheim, of Gesner, and Michaelis. Beckmann, in particular, having studied at Göttingen at a time when the example of these great men dictated the law and gave the tone there, was determined to advance in a line with his age, and not to be ignorant of any of the steps which were being made in the numerous and extensive sciences which furnished the foundation and the subjects of practical principles. But these steps were the steps of a giant; and whatever might be his ardour or his love of study, it was impossible to read and digest all the important works which appeared from the year 1770, on chemistry theoretical and practical, on physics, natural history, and mathematics. His disappointment ended in chagrin, and excited in him a degree of anger against the new ideas, methods of reasoning, and materials, which changed the face, enlarged the limits, and facilitated the study of these sciences. His course of lectures, turning only on practical matters, suffered little from this circumstance; but feeling that his writings would be open to the objection of being behind the advanced state of the sciences which were the subject of them, he directed the researches with which he wished to occupy the attention of the public to the history of arts and trades. He employed, in illustration of the subject, the materials to which he had access in the Göttingen library, assisted by general information, a mind peculiarly fitted for this kind of study, and indefatigable industry. It is to these labours that we owe the *Notices* of Beckmann on the History of Discoveries in the most common Arts of Life; for instance, the history of watch-making, of distillation, of almanacs, of insurance, of the lighting of streets, of the original country and migrations of the fruits and flowers in our gardens, of the common materials for dyeing, of bellows, of fire-arms, of mills, of grinding corn, of carriages, of different parts of our dress, of different household utensils, of a multitude of machines and mechanical contrivances employed in common trades; and of most of the products of industry, such as the gathering of saffron, the preparation of alum, the

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printing-press, of fulling-mills, of book-keeping, of the digging of turf, of gazettes and newspapers, of stamped paper, of the pearl fishery, of pavings, of chimneys, of collections of natural curiosities, of mile-stones, of pharmacy, of quarantine, of painted paper, of ruffles, of milking, of pawnbrokers, of looking-glasses and glass in general, of soap, of musical glasses, of watchmen, of ices to be eaten, of the anatomy of plants, of exchange, of pens for writing, of instruments of husbandry, of fireworks, of the working of pewter, of the procuring of amber, of indigo, of the gilding of weather-cocks, of furs, of steel, of gardening, of crayons, of knives and forks, of corks, of sal-ammoniac, of hops, of weaving, of lotteries, of hospitals for orphans and foundlings, of infirmaries, of lazarettoes, of fighting-cocks, of saltpetre, of gunpowder, of aquafortis, &c. &c. We should form to ourselves a very false idea of these *Notices* if we expected to find in them only some general account of these arts, and of the different manner of practising them used in different times and places. Beckmann traces their first germ from the most remote periods of antiquity; he follows their development through the obscurity of the middle ages, and exhibits their latest improvements amongst the civilized nations of modern Europe, with a patience and a depth of learning which can only be equalled by the sagacity and the variety of knowledge displayed in his researches. We have thought it would be interesting to the reader to see a list of the most remarkable among these notices, in the order in which they were published. They make five volumes in octavo, published at Leipzig from 1783 to 1805, and furnish the most invaluable materials to the individual, or society of men of letters, who may hereafter venture to undertake the general history of the origin and progress of the mechanical arts, which are so important a branch in that of civilization. It is almost needless to add, that the most exact references to original authorities accompany each article, and give it a new value in the eyes of those who are unwilling to take things upon trust, or may be desirous to push still further the inquiries of the author. It has been translated into English.

The same merits belong to his *History of the earliest Voyages made in modern times;* a highly interesting collection, which occupied the last years of his life, and which he left at the eighth number. Another result of the literary application and industry of Beckmann was a return to the studies of humanity, to which we are indebted for editions of the work *De Mirabilibus Auscultationibus*, attributed to Aristotle (1786); of the *Wonderful Histories* of Antigonus Carystius (1791); and of Marbodius's *Treatise on Stones* (1799);—editions which required the rare union of physical knowledge and natural sagacity with philological learning. The Royal Society of Göttingen had, in the year 1772, admitted Beckmann among its members; and, from that period to 1783, he supplied their proceedings with interesting memoirs, among which are the following: *On the Reduction of Fossils to their Original Substances; On the History of Alum; On the Sap of Madder; On the Froth of the Sea, from which the Heads are formed for the Nicotian Fistulæ; On the History of Sugar.*[1] But from this period he withdrew from all further share in the labours of this learned body, probably from the same motives that we have assigned above for the change in the objects of his own particular studies. He was, besides, modest to an extreme degree; and his natural timidity did not find anything to counteract it in the traditional jealousy of reputation, which the example of his predecessors, who had founded the glory of Göttingen, had transmitted to a generation more confident of its powers, and more vain of its merit, but still restrained by habits difficult to lay aside, when the respect for great authorities had originally sanctioned them. His candour, his sincerity, his fidelity in friendship, his affability to his scholars, have been celebrated with one accord by his coadjutors and his auditors. Schlætzer, whom he had known from his youth in Russia, was the one among his colleagues with whom he maintained the most uninterrupted intimacy. He was better qualified than almost any one else to appreciate the researches of Beckmann, as he had himself insisted with so much force on the necessity of introducing into history a view of the influence exercised on social institutions by the efforts of industry, and by the birth or maturity of the most common arts. Beckmann died on the 3d of February 1811, after having been admitted into almost all the learned societies of Germany and the north, and after having impressed a tendency to pursuits of practical utility on the minds of a multitude of distinguished young men who had attended his lectures, and whom his celebrity drew to Göttingen during the forty-five years of his professorship. A portrait of him will be found at the head of the twelfth volume of the *Economical Encyclopædia* of Krunitz, and it has been engraved separately by Raid, Schwenterley, and Grape. Beckmann married the daughter of Hollmann, his tutor and friend; she survived him only a few weeks, and they left a son and daughter grown up. His eulogium was pronounced by his colleague, the illustrious Heyne, and was published at Göttingen with this title, *Memoria Joan. Beckmann, Soc. R. Sci. Götting. sodalis in concessu Soc. Publico D.* 16 *Febr.* 1811, *commendata.* (W. H–Z–T.)

Bectasse || Bed.

BECTASSE, or BEKTACHS, an order or set of religionists among the Turks, so called from their founder Bectach, preacher to Sultan Amurath. The habit of the Bectasse is white; and on their heads they wear white caps of several pieces, with turbans of wool twisted ropewise. They observe constantly the hour of prayer, which they perform in their own assemblies, and make frequent declarations of the unity of God.

BED, an article of furniture on which to stretch the body for sleep or repose. The modern bed is usually a sack or case of ticken, filled with feathers, chaff, wool, or other soft materials, placed upon a raised framework which is called the bedstead. In the first ages it was universally the practice for mankind to sleep upon skins of beasts. This was originally the custom of the Greeks and Romans, as also of the ancient Britons previous to the Roman invasion; and the skins thus employed were spread on the floor of their apartments. But they were afterwards changed for loose rushes and heath; and in process of time the Romans suggested to the central Britons the use, and the introduction of agriculture supplied them with the means, of the greater convenience of straw beds. The beds of the Roman patricians at this period were generally filled with feathers, and those of the inns with the soft down of reeds. But for many ages the beds of the Italians had been constantly composed of straw; it still formed those of the officers and soldiers present at the conquest of Lancashire; and from both, it is probable, our countrymen learnt the use of it. It appears, however, to have been used only by gentlemen, as the common Welsh had their beds thinly stuffed with rushes as late as the end of the twelfth century; and with the gentlemen it continued for many ages afterwards. Straw was used in the royal chambers of England as late as the close of the thirteenth century. Most of the peasants in different parts of the country sleep on chaff beds at present; in the Highlands heath is also very much employed as bedding; and in France and Italy straw beds remain in general use to this day.

Dining BED, *lectus triclíniaris* or *discubitorius*, that on which the ancients reclined at meals. The dining or discubitory beds were four or five feet in height. Three of these beds were ordinarily ranged by a square table (whence both the table and the apartment where it stood were called *tri-*

[1] See *Nov. Commentarii Soc. Sc. G.* tom. ii.-viii.; and *Commentar.* tom. i.-v.

Bed of Justice || Beddoes.

clinium), in such a manner that one of the sides of the table remained open and accessible to the waiters. See ACCUBATION.

Bed of Justice (*Lit de Justice*), in France, under the old régime, a throne upon which the king sat when he went to the parliament. The king never held a bed of justice unless for affairs that concerned the state, and then all the officers of parliament were clothed in scarlet robes. This ceremony in process of time became synonymous with an act of arbitrary power on the part of the sovereign. The last occasion on which a *lit de justice* was held, was on the 6th of August 1787, when the proposition for assembling the states-general was rejected.

BED-CHAMBER, *Lords of the*, officers of the royal household under the groom of the stole. They are twelve in number, and attend in turn, a week each. There are also thirteen grooms of the bed-chamber who wait by turn. Salaries are attached to these offices. A queen regnant in like manner is attended by *Ladies of the Bed-chamber*.

BEDA, commonly called *Venerable Bede*, one of our most ancient historians, was born about the year 673, in the neighbourhood of Wearmouth, in the bishopric of Durham. He was educated by the abbot Benedict, in the monastery of St Peter, near the mouth of the river Wear. He was ordained deacon at the age of nineteen, and priest at the age of thirty. About this time he was invited to Rome by Pope Sergius; but there is no good reason for believing that he accepted the invitation. In the year 731 he published his *Ecclesiastical History*; a work of great value, notwithstanding the legendary tales with which it is deformed. This work was first printed at Eslingen by Conrad Fyner in 1474, an edition extremely rare. Bede died in the year 735, of a lingering consumption, probably brought on by sedentary habits, and a long uninterrupted application to study and literary composition. He was buried in the church of his convent at Jarrow; but his bones were afterwards removed to Durham, and there deposited in the same coffin with those of St Cuthbert. Bede was undoubtedly a singular phenomenon in a rude and illiterate age. His learning, for the times, was extensive; his application incredible; his piety exemplary; and his modesty extreme. He was universally admired, consulted, and esteemed, during his life; and his writings are deservedly considered as the foundation of our ecclesiastical history. His language is neither elegant nor pure, but it is perspicuous and easy. All his works are in Latin. The first general collection of them appeared at Paris in 1544, in three volumes folio; and they were printed again at the same place in 1554, in eight volumes. They were also published in the same size and number of volumes at Basle in 1563, and reprinted at Cologne in 1612, and again in 1688. Besides this general collection, there are several of his compositions which have been printed separately, or in collections of the writings of ancient authors; and some manuscripts ascribed to him have been preserved in the different libraries of Oxford and Cambridge. A complete edition of the works of Bede, by Dr Giles, with an English translation of the historical treatises, was published at London in 1843–44, in 12 vols. 8vo.

BEDARRIÉUX, a town of France, department of Herault, on the Orbe, 18 miles north of Beziers. It is a neat, well-built town, and has very considerable manufactures of cloth, silk, hats, oil, paper, and soap, with dye-works and tanneries. Pop. (1846) 8722.

BEDDOES, THOMAS, a physician of equal eminence for his talents and philanthropy, was born at Shiffnall, in Shropshire, April 13. 1760. His family was of Welsh extraction. He received the first rudiments of his education at a school in his native town, and afterwards at a seminary at Brood, in Staffordshire. The strength of his intellectual powers was apparent at a very early period; and he was remarkable from his infancy for his insatiable thirst for books, and his indifference to those amusements which usually captivate the attention of children. His rising abilities were justly appreciated by his grandfather; and to this intelligent relative he was deeply indebted for many of the advantages of his early education, and for the decision of his father to educate him for one of the learned professions. When he was only nine years old, the circumstance of an accident which befell his benefactor, and which, after being followed by some remarkable symptoms, terminated fatally, was calculated to make a deep and lasting impression on a mind like that of young Beddoes. By the extraordinary acuteness and interest which he manifested on this occasion, he attracted the notice of Mr Yonge, the surgeon who attended the sufferer; and a foundation was thus laid for the friendship which ever after subsisted between them, and which appears to have had a considerable influence in his choice of that profession in which he was destined to run so brilliant a career. At the free grammar-school in Bridgenorth he made rapid progress in classical learning; and when about thirteen years of age, he was placed as a pupil with the Rev. Mr Dickenson, rector of Plymhill in Staffordshire, with whom he continued about two years. On quitting Mr Dickenson, he entered at Pembroke College, Oxford, in Michaelmas term 1776. The simplicity of his appearance, and the rusticity of his manners and address, could not long conceal the superiority of his mental powers. The themes and declamations of young Beddoes were remarkable for their elegant Latinity; and he soon acquired distinguished reputation as a classical scholar. Success in one acquisition was to him but an inducement to the possession of another. He was found one morning by a friend, who casually entered his apartment, very busily engaged with a French grammar and dictionary before him; and when his friend expressed his surprise that he should attempt to learn French without a master, he replied that he should be able to conquer the difficulties of the language by himself in about two months. His friend called upon him again at the expiration of that time, and inquired whether he had mastered the language. Beddoes answered in the affirmative, and proved his assertion by reading in English, with perfect fluency, a French book which the latter presented to him. From the French he proceeded to the Italian, which, from its analogy with the former, he acquired with greater ease. The German language presented more serious difficulties; but his perseverance triumphed over them without the aid of a master. He afterwards added the Spanish language to his other acquisitions.

Beddoes.

While attending the university, chemistry and the other sciences more closely connected with his future profession were always his favourite objects of pursuit. The splendid discoveries of Black and Priestley, which had opened a new field of discovery, were powerfully calculated to inflame the ardour of his inquisitive and sanguine spirit; and he accordingly soon became perfectly conversant with the new doctrines of pneumatic chemistry, and used to exhibit with great delight the experiments which supported them, to his friends in Shropshire, during the vacations. He was also much occupied with mineralogy and botany; and for the former of these sciences, especially, retained throughout life a remarkable fondness.

Having taken his bachelor's degree at one-and-twenty, he repaired to London, in order to commence the study of his profession. He became a pupil of the celebrated Sheldon, and devoted his time to the details of practical anatomy, and the physiological inquiries connected with it. It was while he was engaged in these studies that he gave to the world, in 1784, a translation from the Italian of Spallanzani's *Dissertations on Natural History*; a work which, in 1790, went through a second edition. In the year following, 1785, he published a translation of Bergman's *Essays on Elective Attractions*, the first work to which Beddoes affixed his name, accompanied by numerous original notes, which display an

Beddoes. accurate acquaintance with all the modern improvements in the physical sciences. In 1786 he became again known to the public as the editor of Scheele's *Chemical Essays*. Previous to this, in 1783, he took his degree of master of arts; and, in the autumn of 1784, removed to Edinburgh, where he remained during three successive winters and one summer. Shortly after his arrival, he became a member of the Medical Society and of the Natural History Society of that place, and took an active part in the series of physiological experiments in which some of the members of the former were at that period engaged. To the latter he contributed two papers, one on the *Sexual System of Linnæus*, the other on the *Scale of Being*, both of which have been preserved at full length in Dr Stock's memoirs of his life. At Edinburgh not only did he receive every mark of honourable distinction from his fellow-students which it was in their power to confer, but was also chosen as the organ of their remonstrances with the managers of the Infirmary, on the occasion of a misunderstanding which had arisen between them as to the hours at which they should be permitted to attend; and they were eminently indebted to him for the firmness with which he on that occasion maintained their privileges.

He took his degree of doctor of medicine at Oxford, in December 1786; and in the ensuing summer he visited the Highlands, and also spent a short time at Paris and Dijon, where he cultivated the acquaintance of Lavoisier and Guyton de Morveau. Soon afterwards he was appointed to succeed Dr Austin in the chemical lectureship at Oxford. The success which attended his exertions to inspire a taste for scientific researches was soon apparent, in the overflowing audience attracted by his lectures. Enjoying the reputation of distinguished talents, and surrounded by men of learning and abilities who courted his society, his situation at the university appears to have been truly enviable; and it is difficult to understand the motives which could have led him to relinquish all these advantages for the uncertain prospects afforded by his establishing himself in any other place. The decided part which he took in the political discussions that were agitated at the beginning of the French revolution, seems to have had a principal share in this determination. His opinions were on this occasion expressed with his usual freedom; and the circulation of a political article which he inserted in a Shropshire paper, in an advertisement soliciting relief for the French emigrant clergy, excited a clamour against him, which accelerated his adoption of the step he had previously determined upon.

During his connection with Oxford, he published, in 1790, an analytical account of the writings of Mayow, under the title of *Chemical Experiments and Opinions, extracted from a work published in the last century*, in which he asserts the claims of that extraordinary man to the discovery of the principal facts on which the modern system of pneumatic chemistry is founded; discoveries which had failed, for upwards of a century, to attract any notice from the philosophic world. In the *Philosophical Transactions* for 1791 and 1792 we also find three papers by Dr Beddoes; the one containing *Observations on the Affinity between Basaltes and Granite*, in which he rejects the common division of mountains into primary and secondary, and states some strong arguments in favour of the volcanic origin of both; the other giving *An Account of some Appearances attending the Conversion of Cast into Malleable Iron*, which he supposes to consist in its purification from oxygen, charcoal, and hydrogen, which escape, during the process, in the form of carbonic acid and carburetted hydrogen gases; and, in a paper which forms an appendix to the latter, he relates a variety of experiments which he had made, confirming this theory.

It was about the period of his retirement from Oxford that he published his *Observations on the Nature of Demonstrative Evidence, with an Explanation of Certain Difficulties occurring in the Elements of Geometry, and Reflections on Language*, 8vo, London, 1793. In this essay Beddoes. he contends, in opposition to the doctrines of the ontologists, and particularly to that of Mr Harris, the author of *Hermes*, that geometry is essentially founded in experiment; and that mathematical reasoning proceeds, at every step, upon the evidence of the senses; in short, that this science is founded as exclusively upon the induction of particular facts, as mechanics, astronomy, optics, or chemistry.

About the same period he published his *Observations on the Nature and Cure of Calculus, Sea-Scurvy, Consumption, Catarrh, and Fever; together with Conjectures upon several other Objects of Physiology and Pathology*.

On leaving Oxford, he retired to the house of his friend Mr Reynolds of Ketley, in Shropshire. It was here that he published his admirable *History of Isaac Jenkins*, a story exhibiting the reformation of a drunkard, and his return to habits of industry. There is, probably, no production of Dr Beddoes which unites so many peculiar excellencies as this inimitable fiction, or which displays at once in so favourable a light the vigour of his genius, his knowledge of the human heart, and the power with which he could command the interest and sympathy of his reader. Its success was immense; repeated editions, amounting to above forty thousand copies, were rapidly sold; and a large impression has since been issued at the request of a society for promoting knowledge by the distribution of useful popular books.

A prospect now opened to him of realizing his favourite scheme of establishing a pneumatic institution, where the medical efficacy of the permanently elastic fluids, the fruits of the modern improvements in chemistry, could be fairly put to the test of experiment; and, after some deliberation, the neighbourhood of Bristol was fixed upon as the most proper place for the purpose. In making the necessary arrangements, he derived material assistance from the co-operation of Mr Edgeworth, the author of *Practical Education*, with whose family he soon became more closely connected, by marrying one of that gentleman's daughters. The pneumatic institution continued to occupy his attention for many years, in the course of which a great number of publications issued from his pen, illustrating the principles on which he expected it to be useful, and detailing the experiments and the results to which it gave rise. The difficulty at first experienced in the construction and management of the apparatus of this institution, was in no long time entirely surmounted by the friendly assistance of Mr Watt, whose exertions at this critical period are acknowledged in a dedication prefixed to the first part of the *Considerations*. Mr William Clayfield and Mr Read also contributed their assistance in the invention of different parts of the pneumatic apparatus. At the opening of the institution in 1798, the sums subscribed were found to be very inadequate to the purposes for which it was designed; but by the liberality of Mr Thomas Wedgewood, who offered Dr Beddoes L.1000, he was enabled to carry the plan into immediate execution. All that was now wanted was to procure a superintendent; and he had the good fortune to engage in that capacity a young man who had already given proofs of extraordinary talents, and to whose penetrating genius chemistry has since been so deeply indebted. There needs no other indication to suggest the name of Davy,—a name that will descend to distant ages as associated with so many important discoveries in philosophical science. The history of the pneumatic institution indeed derives considerable splendour from many of these discoveries, which were perfected in its laboratory, and which were first announced to the world through the medium of the publications above mentioned; and in the work entitled *Researches Chemical and Philosophical, chiefly concerning Nitrous Oxide, or Dephlogisticated Nitrous Air, and its Respiration*; by Humphrey Davy, Superintendent of the Medical Pneumatic Institution,

London, 1800. The discovery of the chemical properties of this gas, and of its astonishing effect on the system when respired, were among the first, and must ever be esteemed the most brilliant, of the results of this institution: it raised the most sanguine anticipations in the mind of Dr Beddoes, and called forth all his eloquence in the description of what it already had and might be expected to accomplish. These, like the other splendid visions in which his ardent imagination was but too prone to indulge, have never been realized, and have even created, by their signal failure, an unfortunate prejudice against future attempts to improve the art of medicine by novel methods of treatment founded on chemical or philosophical principles. The original objects of the institution, being found unattainable, were successively abandoned; and it assumed, by insensible gradations, the form of the more common establishments for the relief of the sick; and the prevention rather than the cure of diseases became the principal aim of its conductors. In 1807 it was finally relinquished by Dr Beddoes to the care of Mr King and Dr Stock.

The object which Dr Beddoes had ever most at heart was, to excite a lively and general attention to the means of preserving health, and of repelling the first inroads of disease, by the diffusion of medical knowledge throughout all ranks of the community, as far as they were capable of acquiring it. His attention was uniformly directed to this favourite object, and he suffered no opportunity to escape of enforcing those maxims which tend to prevent the necessity of the interference of his art.

Dr Beddoes has been very justly characterized as a pioneer in the road to discovery. He was more active, however, in exciting the labours of others, than in labouring himself in the field of experiment. He had the imagination of a poet, and could paint in the most vivid colours the sufferings entailed by disease, and enforce with the most powerful eloquence whatever he wished to impress on the minds of his readers. He has been accused of versatility of opinion; but if he was, perhaps, hasty in publishing the first conceptions which he formed, he has atoned for this fault by the remarkable candour with which he retracted them the moment his confidence in them was shaken. Besides his numerous medical works, he was also the author of several political publications which appeared in 1795, 1796, 1797. (Stock's *Memoirs of Dr Beddoes*, Lond. 1811. (P. M. R.)

BEDE. See BEDA.

BEDELL, DR WILLIAM, a learned prelate, born in Essex in 1570. He accompanied Sir Henry Wotton, the English ambassador to Venice, in 1604, and spent eight years in that city, where he contracted an intimate acquaintance with the celebrated Father Paul. Of him Bedell learned enough of Italian to be able to translate the English Common Prayer Book into that language; and in return he drew up an English grammar for Father Paul, who declared that he had learned more from Bedell in all parts of divinity than from any other person. In 1629, he obtained the bishopric of Kilmore and Ardagh in Ireland, and finding these dioceses in very great disorder, applied himself vigorously to the reform of abuses. He procured an Irish translation of the Common Prayer Book, which he caused to be read in his cathedral every Sunday; and the New Testament having been translated by Archbishop Daniel, he caused a version of the Old Testament to be made, which was afterwards printed at the expense of the Honourable Robert Boyle. In 1624, he published a controversial book against the Roman Catholics; and he assisted the archbishop of Spalatro in finishing his famous work *De Republica Ecclesiastica*. When the rebellion broke out in Ireland in October 1641, the bishop's was the only house in the county of Cavan that remained inviolate. About the middle of December, however, the rebels, pursuant to orders received from their council of state at Kilkenny, required him to dismiss the people who had fled to him for protection; but he peremptorily refused to do so. Upon this the bishop and his family were carried prisoners to the castle of Cloughboughter; but after a confinement of about three weeks, the prisoners were exchanged for some of the principal rebels. The bishop, however, died soon after, Feb. 7. 1642, and the chiefs of the rebels honoured his memory by accompanying his remains to the tomb.

BEDFORD, the county town of Bedfordshire, is a municipal and parliamentary borough and market-town, situated in a fertile vale on both sides of the river Ouse, which is here crossed by a handsome stone bridge of five arches. It is 50 miles N.W. of London by road, and 62¾ by the North-Western Railway, a branch of which goes off from the main line at Bletchley to Bedford. The town consists chiefly of one long wide street, intersected by smaller ones at right angles, and is well built, paved, and lighted with gas. It has five parish churches, four of which are fine old Gothic edifices: the fifth is a recent erection in the Norman style. A district church was opened in 1841. There are also Independent, Methodist, and Baptist chapels, and a small Jewish synagogue. Bedford in proportion to its size has more public endowments than any other place in the kingdom, for which it is chiefly indebted to Sir W. Harper, Lord Mayor of London in 1561, who founded here a free school, and conveyed for its support, and for portioning poor maidens, a piece of ground in London, the overplus, if any, to be given to the poor. This ground has gradually risen in value so as now to produce nearly L.14,000 annually. It supports a grammar and other schools, and 58 almshouses, besides large sums given annually as marriage portions, for apprenticing youths, and other benevolent purposes. In 1849 above L.4000 were expended on the schools, L.1750 on the almshouses, L.858 in apprentice fees, L.400 in marriage portions, L.179 in donations to servants, and upwards of L.1000 in other charities. The grammar-school has eight exhibitions of L.80 per annum each, at Oxford, Cambridge, or Dublin. Among its public buildings are the county hall, the jail, built on the site of that in which Bunyan wrote his *Pilgrim's Progress*—house of correction, lunatic asylum, infirmary, Bedford library and subscription rooms, and the corn exchange. Its principal manufactures are straw-plait and lace; and a considerable trade is carried on with Lynn Regis, by means of the Ouse, in corn, malt, coals, timber, and iron. Market-days, for cattle, Monday, and for corn, Saturday. Bedford is governed by a mayor, 6 aldermen, and 18 councillors; and it sends two members to parliament. Pop. 1851, 11,693.

BEDFORD LEVEL, the name given to a flat district on the eastern coast of England, comprising the greater part (amounting to 450,000 acres) of the marshy district called the *Fens*, the whole isle of Ely in Cambridgeshire, and a portion of the south of that county, 30,000 acres of Suffolk, 63,000 acres of Norfolk, 57,000 of Huntingdon, about 8000 of Northamptonshire, and the south-eastern portion of Lincolnshire. The extent of the whole tract is 60 miles in length, from Milton in Cambridge to Toynton in Lincoln; its breadth is about 40 miles, from Peterborough in Northampton to Brandon in Suffolk. The boundary on three sides is of an irregular form, giving it something of a horse-shoe shape, with the opening terminated by the sea on the north.

This district obtained its present name from the agreement of Francis Earl of Bedford, the principal landholder, and thirteen other adventurers, with Charles I. in 1634, to drain the level, on condition of receiving 95,000 acres of the reclaimed land. This district has within historic periods undergone remarkable changes. In the time of the Romans it was a dense forest, which, as a stronghold of the Britons, those invaders destroyed. It then became a swamp, through which the lazy waters of the Ouse, the Welland, the Nene, and Wisbeach, crept to the sea. In the thirteenth century, the sea here, as in other parts of N.W. Europe, burst its

Bedford. boundaries, and the inundated land became a pestilential swamp. The first attempt to drain this morass seems to have been made in the year 1436, and embankments and ditches were formed at a great expense. These, however, were swept away during the ensuing winter by the flooding of the river Ouse. Another partial attempt at drainage was made by Bishop Moreton in the reign of Henry VII., but this also proved a failure. An act was passed in the 44th year of Queen Elizabeth for effecting its reclamation; but the first effectual attempt at reclaiming it was not made until 1634, as already mentioned; and many embankments and canals were constructed at various intervals at an expense above one million sterling. Three years after the agreement of the Earl of Bedford and his partners with the king, after an outlay of L.100,000 on the part of the company, the contract was annulled, on the fraudulent plea that the works were insufficient; and an offer was made by King Charles to undertake its completion on condition of receiving 57,000 acres in addition to the amount originally agreed on. This unjust attempt was frustrated by the breaking out of the civil war; and no further attempt at drainage was made till 1649, when the parliament reinstated the Earl of Bedford's successor in his father's rights. After an additional outlay of L.300,000, the adventurers received 95,000 acres of reclaimed land, according to the contract, which however fell far short of repaying the expense of the undertaking. In 1664 a royal charter was obtained to incorporate the company, which still exists, and carries on the concern under a governor, 6 bailiffs, 20 conservators, and a commonalty, each of whom must possess 100 acres of land in the level, and has a voice in the election of officers. The conservators must each possess not less than 280 acres, the governor and bailiffs each 400 acres. The original adventurers had allotments of land according to their interest of the original 95,000 acres; but Charles II., on granting the charter, took care to secure to the crown a lot of 12,000 acres out of the 95,000, which, however, is held under the directors, whereas the allotments are not held in common, though subject to the laws of the corporation. The level was divided in 1697 into three parts, called the North, Middle, and South Levels, comprising respectively the tracts between the Welland and the Nene, the Nene and Old Bedford rivers, and the third between Old Bedford river and the southern limit of the level.

Since then extensive works have at different times been carried on to complete the drainage of this district; but the most effectual are under the Acts of 1827 and 1829, for "improving the outfall of the Nene," "The Navigation of the Wisbeach," and "The Embanking of the Salt Marshes between the canal called Kinderley Cut and the sea." Vessels of 60 tons burden can now come up to the town of Wisbeach at all tides, and those of from 100 to 200 tons at spring tides. The draining of the lower lands, which, like the Dutch *Polders*, are below low-water mark, was carried on by windmills; but these have now been almost superseded by steam-engines, with great advantage: in the North Level the drainage is effected by sluices without either windmills or steam-engines. As the result of these extensive operations, the level now abounds in rich pasture and corn lands. (Moore, Dodson, and Burrell, on the Bedford Level; *Parliamentary Papers*, 1827–29.)

Bedford, *New*, a seaport town of North America, state of Massachusetts, near the entrance of Buzzard's Bay, 51 miles S.S.E. of Boston, with which it is connected by railway. The city is built on a commanding elevation above the west bank of the Acushnet river, and presents a very handsome appearance. The principal public buildings are the town-hall, custom-house, court-house, and several churches. This city is mainly indebted for its prosperity to the whale fishery, to which it furnishes no less than two-thirds of the whole shipping so employed by the United States. Besides oil and candles, it has large manufactures of cordage, hoops, &c. The ship-building also is very considerable. Pop. (1850) 16,464. Bedfordshire.

BEDFORDSHIRE, an inland English county, situated nearly in the centre of the island, but rather towards the eastern side. It is bounded on the north by Huntingdonshire and Northamptonshire, on the west by Buckingham shire, on the south by that county and Herefordshire, and on the east by the latter and Cambridgeshire. Its greatest length is about thirty-six miles, and its greatest breadth twenty-one miles. Its extent is 295,582 English statute acres, or nearly 462 square miles.

The face of the country is in general level, but with gentle undulations, scarcely deserving the name of hills, except towards Buckinghamshire, from which county a part of the Chiltern range enters, but only the lowest portion of that range. The chalk of these hills is found to be a valuable manure on some of the other soils of the county. From the S.E. to the centre of the county is a valuable district of dairy land. The western side is chiefly a sandy soil, but, being well cultivated on the Norfolk system, is productive; near Woburn it is generally sandy, and was sterile till the modern improvements in agriculture, fostered by the late Duke of Bedford, had extended their influence and productiveness. Near Biggleswade is a portion of land which yields the highest rent and most valuable products. It is cultivated by a class of market gardeners, and onion and other seeds are grown there for the supply of the shops of the seedsmen in London. Much of the former barren sandy soils has been planted of late years, and the inclosure of many of the largest common fields has improved both the beauty and the fertility of the county.

The land is drained by many brooks, which contribute to increase the rivers, and, by rendering them navigable, minister to the benefit of the inhabitants. No county is better accommodated with good roads than Bedfordshire, chiefly owing to the exertions of the late Mr Whitbread, before whose time they were in a very bad condition. The river Ouse enters this county on its north-western side, collects the water from a considerable district during a winding course, and becomes navigable at Bedford. In its progress towards Huntingdonshire it receives the waters of the Ivel, which is also navigable as high up as Shefford, and the united streams run to the German Ocean at Lynn. A small portion of the western side of the county is benefited by its water communication with London, and with the coal districts of Staffordshire, which it enjoys through the Grand Junction Canal.

As Bedfordshire is mainly an agricultural county, and as nearly four-fifths of the land are devoted to pasture or to the dairy, and little more than one-fifth is under tillage, the increased number of inhabitants has caused a scarcity of employment, and a consequent great advance in the poor rates. The present Duke of Bedford, the largest landowner in the county, has done much for the amelioration of his tenantry, by draining and otherwise improving their lands, erecting comfortable dwellings, establishing schools, and other means. The farms are let at valuation, the duke selecting his tenant from the various applicants. The chief occupation of the manufacturing kind consists in plaiting straw and forming it into chip hats, making baskets and other articles; and is confined almost exclusively to females. Dunstable has long been celebrated for this trade, and it is considerably extended over other parts of the county. Besides this, till of late years, the trade of bone lace, made both from silk and thread, afforded employment to the females, and still continues to do so in an inferior degree, though it has been much diminished by the introduction and improvements in machine lace. Some trade is carried on by the rivers and canal, by which corn and butter are conveyed to distant markets, and the inhabitants supplied with fuel. As the great north roads pass through the county in two lines,

Bedfordshire.

the traffic on these gives some activity to its commerce. Branches of the North-Western railway go to Bedford and Dunstable, and the Great Northern railway passes through the eastern part of the county.

The civil division of the county is into nine hundreds, which contain nine market-towns and 124 parishes. In an ecclesiastical view it forms part of the diocese of Ely and the archdeanery of Bedford; in its judicial relation it is in the Norfolk circuit.

The titles derived from the county are that of duke to the house of Russell, and of baron of Bletsoe to the family of Lord St John. Two members of the House of Commons are returned by the county, and two by the town of Bedford, the only borough within it.

The most distinguished residences in this county are, 1*st*, Woburn Abbey, near the town of that name. It was formerly a Cistercian abbey, granted at the Reformation by Henry VIII. to the family of Russell, the fourth duke of which house erected the present edifice. It is a very grand and capacious pile, situated in an extensive park, and is furnished with a large and valuable collection of paintings and statues. The collection of agricultural and arboricultural plants grown here is well deserving the notice of the student. 2*dly*, Luton Hoo, a mansion which was reconstructed and improved for John Earl of Bute by Adam the architect. A library, 146 feet in length, furnished with a valuable collection of books, and a large selection of paintings of some of the first masters, chiefly of the Italian school, are its distinguishing ornaments. The grounds have received every improvement that art can produce in a situation not naturally picturesque. 3*dly*, Ampthill Park, formerly the seat of the Earls of Upper Ossory, now of Lord Holland. This superb edifice, which contains a good library, a valuable collection of paintings, and a museum of natural history, stands in a delightful park, adorned with most beautiful spreading ancient oaks.

Besides these there are other mansions which are highly deserving of notice and admiration, especially that of Mr Whitbread at South-hill; Wrest Park, belonging to the Countess de Grey; Hawnes House, to Lord Carteret; Moggenhanger House, to Mr Thornton; Potten, to Sir John Burgoyne; Oakley House, to the Marquis of Tavistock; Old Warden Park to Lord Ongley; and, though not so distinguished by its extent as many others, Cardington House, once the residence of Howard the philanthropist, now of Mr S. C. Whitbread.

The population of the county stood at the three last decennial numerations as follows:—

Year.	Males.	Females.	Total.	Houses.
1831,	46,450	49,033	95,483	18,473
1841,	52,190	55,746	107,936	21,964
1851,	59,941	64,537	124,478	25,461

In the year 1841 the number of persons living by trade, commerce, &c., was 14,333; by agriculture 14,933: 19,923 were labourers, servants, &c. The towns and their populations in 1851 were as follow:—Bedford, 11,693; Biggleswade, 3976; Dunstable, 3589; Leighton-Buzzard, 4465; Luton, 10,648.

When the Romans landed in this kingdom Bedfordshire formed a portion of a district called Catieuchlana, whose sovereign or chief, Cassibelenus or Cassibelaunus, commanded the united forces which opposed Julius Cæsar. When, in the year 310, the Emperor Constantine ruled the whole island, and divided it into five provinces, Bedfordshire was included in the third division called *Flavia Cæsariensis*, and remained so till the final abandonment of Britain by the Romans. Under the Saxon heptarchy it formed part of the kingdom of Mercia, until with the rest of the island it was united to the kingdom of the West Saxons, which was divided by Alfred into counties, hundreds, and tythings; when this county first received the name it has since retained.

Bedlam ‖ Bedworth.

There are many remains of Roman, Saxon, and Norman antiquities. Traces of a Roman station are to be seen at Sandys near Potton, and at Maiden-Bower near Dunstable. Leighton-Buzzard, or Beaudesart, is supposed to have been a Roman camp; and vestiges of a Roman amphitheatre may be seen near Bradford Magna. The ancient Icknield and Watling Street roads passed through the county, and the remains of each may be definitely traced, as well as of some others constructed by the Romans. (W.J.)

BEDLAM, a house for lunatics. The word is a corruption of *Bethlehem*, the name of a religious house in London which was converted into an hospital for the insane.

BEDLOE, William, better known by his assumed title of *Captain*, was an infamous adventurer of low birth, who had travelled, under various disguises, over a great part of Europe. Encouraged by the success of Titus Oates, he turned general evidence, gave an account of Godfrey's murder, and added many circumstances to the narrative of Oates. A reward of L.500 was voted to Bedloe by the commons; and he is said to have asserted the reality of the Papist plot on his deathbed; but the whole story is overlaid with absurdity, contradiction, and perjury. Bedloe died in 1680. Giles Jacob states, that he was author of a play entitled *The Excommunicated Prince, or the False Relict*, 1679; but Anthony Wood asserts, that it was written by one Thomas Walter, M.A. of Jesus College, Oxford.

BEDNORE, a town of Hindustan, in the territories of the rajah of Mysore. In 1645 the seat of government of the rajahs of Ikeri was transferred to this place; and as the inhabitants of the former capital removed with the court, Bednore became a city of great importance, containing, it is said, 20,000 houses, besides huts. It was taken and plundered by Hyder in 1763, who ordered it to be called Hydernagur. It is still however known by its original name of Bednore. At that time it was estimated at eight miles in circumference. In 1783 it surrendered to a British detachment under General Matthews, but being shortly after invested by Tippoo Sultan, the garrison capitulated on condition of safe conduct to the coast. Tippoo violated the stipulation, put General Matthews and the principal officers to death, and imprisoned the remainder of the force. At Tippoo's death it contained 1500 houses, besides huts. Distance N.W. from Seringapatam 150 miles. Lat. 13. 50. Long. 75. 6.

The district of Bednore is situated on the summit of that range of hills, the Western Ghauts, which overlooks the provinces of Canara and Malabar. In consequence of its elevation above the sea, and the steepness of the mountain chain, which rises like a wall to the height of 4000 or 5000 feet, the clouds of the south-west monsoon are here intercepted, and their contents precipitated on the table-land in deluges of rain, which continue for six months in the year, and are extremely favourable to vegetation. Its products are pepper, betel-nut, cardamums, and sandal-wood. Cattle of small size are also bred in the district. The imports are salt, rice, cocoa-nuts, oil, turmeric and cotton cloths. (E.T.)

BEDOUINS, or Bedouis, a modern name of the wild Arabs, whether in Asia or Africa. See Arabia.

BEDRIACUM, a village of Cisalpine Gaul, situated between Verona and Cremona. From the account given by Tacitus, Cluverius conjectures that the ancient Bedriacum stood in the place where the city of Canneto now stands. Here the army of the Emperor Otho was defeated A.D. 69, by the united forces of Cæcina and Valens, generals of Vitellius. A few months later the Vitellian forces were defeated at the same place by Antonius Primus, the lieutenant of Vespasian.

BEDWORTH, a town and parish of Warwickshire, 3½ miles south of Nuneaton. Area 2157 acres. Pop. of pa-

Bedwyn || Bee.

rish (1851) 5059; of town, 3012, chiefly employed in the manufacture of ribbons, of bricks, and malt. In the vicinity are extensive coal-pits and stone-quarries.

BEDWYN, GREAT, a borough, market-town, and parish in the county of Wilts, 70 miles from London. on the Kennet and Avon Canal. It is a place of great antiquity, and, till the Reform bill passed, returned two members to parliament. It has little trade; and the only building that merits attention is the church, which contains several very ancient monuments. Pop. of parish in 1851, 2193.

Bedwyn || Bee.

BEE.

Progress of knowledge regarding this insect.

THE bee, from its singular instincts, its active industry, and the useful products resulting from its labours, has, from the remotest times, attracted the attention, not only of naturalists, but of mankind in general. No nation upon earth has had so many historians as this remarkable tribe of insects. The patience and sagacity of the naturalist have had an ample field for exercise in the study of their structure, physiology, and domestic economy. Their preservation and increase have been objects of assiduous care to the agriculturist; and their reputed perfection of policy and government have long been the theme of admiration, and have afforded copious materials for argument and allusion to the poet and the moralist in every age. It is a subject that has been celebrated and adorned by the muse of Virgil, as well as illustrated by the philosophic genius of Aristotle. Cicero and Pliny report that Aristomachus devoted himself during sixty years to the study of these insects; and Philiscus is said to have retired into a desert wood, that he might pursue his observations on them without interruption. A prodigious number of authors have written express treatises on bees; periodical works have been published relating exclusively to their management and economy; and learned societies have been established for the sole purpose of conducting researches on this subject. The most celebrated association of this kind is the *Société des Abeilles*, founded about fifty years ago in Little Bautzen, a village in Upper Lausatia, under the auspices of the elector of Saxony. Its labours, as we shall presently find, have enriched the science with a number of valuable discoveries.

In so complicated a branch of natural history, the application of the difficult art of observing correctly, and of the cautious processes of induction, cannot be effected without laborious and long-continued efforts. But, on the subject of bees, the inquirer after truth had, besides, many obstacles to encounter, from the very general diffusion of errors, which had been transmitted without due examination from one author to another. The history of the opinions of successive writers will sufficiently prove how gradual and how slow has been the advancement of real knowledge in what concerns these insects, and will teach us to estimate the value of that which we at length possess, as being the result of the labour of ages, and as being extorted from nature by indefatigable and persevering exertions. So great an accumulation of curious and interesting facts, indeed, has accrued to us from the researches of Swammerdam, Maraldi, Reaumur, Schirach, and Huber, as to constitute almost a new science. Many of these have been discovered subsequently to the time of the compilation of the article BEE in the preceding edition of this work. It will therefore be proper, in this place, to give a connected and systematic account of the natural history of this remarkable insect. For the details of the external characters and distinctions of species, we shall refer to the article ENTOMOLOGY. The principal features of their internal conformation will be described when treating of the particular functions to which they are more immediately subservient; and our descriptions will apply, more especially, to the common and best-known species, the *Apis mellifica*, which is the one particularly prized on account of the rich products it affords.

Plan of this article.

The economy of bees comprehends so wide a field of inquiry, the different parts of which are so connected and dependent upon one another, that it is impossible to treat of them distinctly, without supposing the reader to possess some general acquaintance with the history of these insects. We shall therefore premise a brief account of the different sorts of bees inhabiting the hive, and of the respective offices of each. We shall then proceed to consider their comparative physiology; under which head we shall state the leading particulars relating to their nutrition, secretion, respiration, progressive motion, external senses, and instincts. We shall next follow them in their different labours, from the period when the swarm has settled in a new habitation; we shall detail the complex structure of their hives,—their curious processes of architecture,—the pains they bestow on rearing their progeny, and in sending forth new swarms; and this will lead us to the subject of the fecundation of the queens, and the massacre of the drones. After having thus given an account of their usual condition, we shall, in the last place, describe the result of several experiments and observations which have been made when they were placed in unusual circumstances; experiments which have exhibited many interesting features of their character, and have thrown considerable light on the whole of their history, as well as suggested various practical and economic applications in the management of these insects.

Functions of the males, females, and neuters.

The leading feature in their history, and one which distinguishes them from almost all insects, is their singular distribution into three different kinds, constituting, to all appearance, so many different modifications of sex. The drone, which is characterized by a thicker body, a round head, a more flattened shape, and more obtusely-terminated abdomen, within which are contained the male organs of generation, has been admitted as the male of the species. It is distinguished also by the absence of a sting, and by the humming noise that accompanies its flight. The queen-bee, which is larger than any of the others, has the abdomen of greater length, and is provided with a sting, and with two ovaria of considerable size, is unequivocally recognised as the female. The working bees compose the third class, and are distinguished by the smallness of their size, their lengthened proboscis, the peculiar structure of their legs and thighs, which are adapted to the collection of certain materials obtained from vegetables, and by the apparent absence of every trace of generative organs,—we say apparent absence, because, as will be hereafter stated, rudiments of ovaria have been very lately discovered to exist, which, however, are not perceptible without a very minute and careful dissection. Till within a few years the working bees were regarded as animals deprived of sex, and were accordingly termed *neuters* or *mules*. It is these which perform all the laborious offices for the community,—which construct the interior of their habitation,—which explore the country in search of nourishment and other materials,—which collect and bring them to the hive, and apply them to different purposes; it is this kind that assiduously attend upon the queen, and supply all her wants,—that defend the hive from the attacks of depredators, and carry on hostilities against the various enemies of the tribe. The life of the

Bee.

females is chiefly engrossed with the duties of laying eggs, and conducting the colonies, which, at certain periods, emigrate from the parent state. The drones, producing neither wax nor honey, and depending on the rest for their subsistence, are idle spectators of these labours. They appear to be formed only for the momentary but important duty of impregnation, since they perish when this purpose is accomplished. There is commonly only one perfect queen existing at a time within each hive; and she appears to be treated by all the other bees with every mark of affection and of deference. The number of labourers is very different in different hives; sometimes there are only a few thousands; at other times from twenty to forty, or even fifty thousand. The drones, even in the spring, seldom compose more than one thirtieth or one fortieth of the whole; and, at other seasons, there are none to be found in the hive. In order to form some estimate of the number of bees which can occupy a certain space, Mr Hunter counted what number of drowned bees could be contained in an alehouse pint, and found it to be 2160; so that if a swarm were to fill two quarts, their numbers would be nearly 9000. Reaumur, with the same view of ascertaining their numbers, employed the more accurate method of weighing them; he found that a collection of them, weighing one ounce, consisted of 336 bees; and, therefore, that 16 ounces, or one pound, would consist of 5376 bees.

Real sex of the working bees.

Notwithstanding these differences in conformation, instincts, and offices, between the queen-bee and the workers, it is now established, upon the most incontrovertible evidence, that they both originally proceed from the same kind of larva, and that the queen-bee lays only two kinds of eggs, the one destined to produce the drone, the others capable of being converted, according to circumstances, either into a worker or a queen. It has been proved that the former, although exhibiting no appearance of sexual organs on a superficial examination, are in reality females, and have the rudiments of these organs, which, from their not being developed, are incapable of exercising their proper functions. It may be remarked, that the idea of the working bees being radically females, had been suggested long ago by Dr Warder, in his *Monarchy of Bees*, in which he terms them "True Amazons;" but no attention had been paid to his opinion. The real merit of this great discovery, which affords the key to a multitude of hitherto inexplicable facts, unquestionably belongs to Mr Schirach, vicar of Little Bautzen, the secretary of the Lausatian Society, to which we formerly adverted. When first announced to the world, it was received with suspicion by the greater number of naturalists, and with complete incredulity by others. It was, indeed, at variance with the whole tenor of the observations of Swammerdam, Maraldi, and Reaumur. Wilhelmi, the brother-in-law of Schirach, though an eye-witness of the experiments from which he had deduced this theory, for a long time refused to admit the doctrine, but became at length one of its most strenuous supporters. It is noticed in a vein of sarcastic ridicule by Mr John Hunter, in his otherwise excellent paper on bees in the *Philosophical Transactions*. Needham wrote a memoir for the Imperial Academy of Brussels in 1777, for the express purpose of refuting it; and he then inveighs in strong language against those naturalists who had deigned to give it the least countenance. Mr Key, in the *Bath Society Papers*, declares that he made experiments on this subject for eight years, without obtaining a single result in conformity to Schirach's views. Bonnet, after exercising a laudable scepticism, and making a diligent inquiry, in which he displays a genuine spirit of philosophy, yielded a reluctant assent. But the truth of the doctrine has since been placed beyond the reach of controversy by multiplied series of observations and experiments in different parts of Europe; and more especially by the recent investigations of Mr Huber of Geneva. We shall not at present enter into the detail of proofs, because their force will be better appreciated when other particulars belonging to the history of the bee have been explained.

Bee.

In considering the physiology of the bee, the first function that claims our notice is that of nutrition. The food of bees is principally of two kinds, namely, the fluid secretions of vegetables contained in the nectarea of the flowers, and the dust of the antheræ, which has been termed by botanists the pollen, but which, when collected by the bees, has received a variety of appellations, such as farina, bee-bread, raw wax (*cire brute*), &c. Occasionally, however, we find bees feeding upon other saccharine substances besides honey, such as honey-dew, treacle, syrup, &c.

Nutrition.

The organs by which they collect food are extremely complex, for they comprise instruments adapted to the reception of liquid aliment as well as those fitted for the division of solid materials. Reaumur has given the most elaborate description of these organs, in which he has corrected some errors that Swammerdam had fallen into. For the purpose of taking up fluids, they are provided, in common with all hymenopterous insects, with a long and flexible proboscis or trunk, which may be considered as a lengthened tongue, though, strictly speaking, it is formed by a prolongation of the under lip. It is not tubular, as Swammerdam had supposed, but solid throughout; and the minute depression at its extremity is not the aperture of any canal through which liquids can be absorbed. Cuvier, in his *Leçons d'Anatomie Comparée*, has not marked this distinguishing feature in the proboscis of the bee, but speaks of it in common with the tubular trunks of the other hymenoptera, and describes its aperture as being situated in the lower part. But Reaumur has very satisfactorily shown that the trunk of the bee performs strictly the office of a tongue, and not that of a tube for suction; for when it takes up honey or other fluid aliment, the under or the upper surfaces are more immediately applied to it, and rolled from side to side, and the bee thus licks up what adheres to it, while the extremity of the trunk is frequently not applied at all to the substance taken up. The trunk is supported on a pedicle, which admits of being bent back or propelled forwards, and thus can retract or stretch out the trunk to a considerable extent. Protection is given to it by a double sheath; the external, consisting of two scales furnished by the expansion of one of the portions of the labial palpi; and the internal, formed by the prolongation of the two external portions of the jaw. The whole member thus consists of five principal parts, on which account Fabricius termed it *lingua quinquefida*.

Organs for collecting food.

Proboscis.

For the purpose of mechanically dividing solid materials, the mouth is furnished with two strong mandibles and four palpi; they are but little employed in eating, but are of great use in enabling the insect to seize and break down hard substances for other purposes. In the working bee all these parts are of larger dimensions than in the other kinds. The teeth are two in number, and have the form of concave scales with sharp edges; they are fixed to the ends of the jaws, and play horizontally as in other insects. Reaumur describes and delineates a large aperture above the root of the proboscis, which is so surrounded with fleshy parts as not to be readily seen unless the proboscis be extended and bent downwards. This he considers as the mouth or orifice of the gullet; on the upper side of which, and of course opposite to the root of the proboscis, a small fleshy and pointed organ is seen, which he regards as the tongue, assisting in the deglutition of the

Mandibles.

Bee. food. Through this orifice, it is presumed, all the aliment, whether liquid or solid, passes; the former being conveyed to it by the trunk, which, by its contractile power, presses forward the fluids it has collected between itself and the inner sheath, and the latter being received directly after its comminution by the teeth, behind which it is situated. Latreille, however, whose authority is great on a point of this nature, thinks that Reaumur has deceived himself with regard to such an aperture, and disbelieves its existence. He conceives that the food simply passes on by the sides of the tongue, finding its way from thence into the œsophagus, and so on to the stomach.

Stomachs. The bee has two stomachs; the first is a large transparent membranous bag, pointed in front, and swelling out into two pouches behind. It performs an office in some respects analogous to that of the crop in birds; for it receives and retains for a time the fluid of the nectarea, which does not appear to differ in any respect from honey. Mr Hunter observes, that, whatever time the contents of this reservoir may be retained, he never found them altered, so as to give the idea of digestion having taken place. The coats of this reservoir are muscular, by which means it is capable of throwing up the honey into the mouth, so that it is regurgitated into the honey cells, or imparted to other bees. None of it ever passes out from the extremity of the trunk, as Swammerdam had believed. For the purpose of digestion, a second stomach is provided, which takes its origin from the middle of the two posterior lobes of the former, and is of a lengthened cylindrical shape. Its communication with the intestine is not direct, but takes place by a projecting or inverted pylorus, thickest at its most prominent part, with a very small opening in the centre, of a peculiar construction. This inward projecting part is easily seen through the coats of the reservoir, especially if full of honey. A similar kind of structure takes place at the communication of the first with the second stomach, and, having the properties of a valve, must effectually prevent all regurgitation from the latter into the former.

Collection of pollen. The pollen of flowers, which is the other principal article of food, was shown by Swammerdam to consist of an infinite number of small particles, generally of a globular shape, each of which is found to be a small capsule, inclosing the still finer dust or fecundating principle destined to be shed on the pistils for the purpose of germination. Geoffroy has given a memoir, published in the *Collection Académique des Sciences*, containing a minute description of the shapes of these capsules, taken from different flowers. The working bees, by means of the pencil of hair which grows on the tarsi, first collect a certain quantity of pollen, which they knead together into a ball, and place it in the concave space which is situated at the middle joint of the hinder feet, and has been termed the basket. The surrounding rows of hairs keep the ball from falling off. In order to gather larger quantities at once, the bees are sometimes observed to roll their bodies on the flower, and then, brushing off the pollen which adheres to them with their feet, form it into two masses, which they dispose of as before mentioned; and it is said that, in moist weather, when the particles of pollen cannot be readily made to cohere together, they return to their hive dusted all over with pollen, which they then brush off with their feet. They are often obliged to tear open the capsules which contain the pollen, in order to procure a supply of this substance, when it has not yet been shed by the flowers.

Pollen is yielded by flowers during the spring in such abundance that the bees of a single hive will often bring back one pound, or even more, in a day. Some agriculturists have accordingly imagined, that the vegetation of some plants might be endangered from this great consumption of the fecundating principle by insects in general; for other insects besides bees seek it with avidity. But this fear has been proved to be totally without foundation, and the practice of destroying bees in order to prevent this imaginary danger is therefore as useless as it is barbarous. It would appear, indeed, that so far from obstructing the fecundation of plants, the labours of the bee have often tended materially to promote it, by the agitation which they give to the flower, and by transporting the pollen from one flower to another. In this manner may we account for the number of hybrid flowers that are met with near the haunts of bees. Bee.

It has been shown very clearly by Huber, in a paper in the *Journal de Physique*, that pollen is peculiarly the food of the young bees, and is collected by the working bees with this intention. Reaumur, however, asserts that he has seen adult bees devour pollen. Swammerdam, who conceived the trunk to be tubular, rejected the idea that pollen could ever be the food of bees, as the globules of which it consists are incapable of entering an orifice so minute as that which appears at the extremity of the trunk, and which, as he was unacquainted with the real mouth, he thought was the only passage to the stomach. Latreille, who does not admit the existence of the large mouth described by Reaumur, states that the mandibles lay hold of the pollen, and carry it to the base of the trunk, from whence it finds its way into the œsophagus by the sides of that organ.

Of honey-dew, which forms part of the food of bees, we shall merely remark that it is an excrementitious matter deposited on the leaves of plants by certain species of aphides.

An abundant supply of water is essential to the healthy condition of bees. They consume a large quantity, and often stop to drink at the edge of stagnant pools, and seem even to prefer putrid and urinous waters to purer streams, as if their saline and pungent qualities were grateful to them.

Production of wax. It has been long the opinion that wax was but a slight modification of pollen, which required for this conversion merely the application of a certain pressure, and a kind of kneading by the feet of the bees. Many naturalists, such as Bernard de Jussieu, had persuaded themselves that the dust of the stamina of flowers contained wax ready formed as one of its ingredients, and quoted the following experiment in proof of this opinion: If the minute grains of pollen be put into water, they gradually swell, till they at length burst, at which moment a small jet of an oily liquor will be perceived, which floats on the water without mixing with it. But Reaumur had attempted in vain to extract any thing like wax from dust of the anthers; and, indeed, an attention to the chemical properties of these two substances would have sufficiently pointed out their essential differences. From the upper surface of the leaves of many kinds of trees, a substance has indeed been obtained, which possesses all the qualities of bees' wax; but nothing like it can be extracted from pollen. Reaumur was persuaded that the pollen was elaborated in the second stomach of the bee, and thrown up into the mouth in the form of a white foam, which, by exposure to the air, hardened, and became wax; and that the bee took advantage of its soft state to apply it in the building of the combs. So circumstantial an account, given to us by a scrupulous observer of facts, appeared to be perfectly satisfactory, and was acquiesced in by naturalists in general. But it has since been completely proved by the researches of Duchet, of Hunter, and of Huber, but principally by the latter, that wax is a secretion from the abdomen of the bee; and that it depends not at all

Bee. on the pollen which the insect may consume, but on the quantity of honey or other saccharine substance which it receives into the stomach. The first step in this discovery was made by one of the members of the Lausatian Society, whose name has not been preserved. It was mentioned in a letter of Mr Wilhelmi to Bonnet, in August 1768, in which he says that wax, instead of being rejected by the mouth, exudes from the rings which inclose the posterior part of the body. Of this we may satisfy ourselves by drawing out the bee from the cell in which it is working with wax, by means of the point of a fine needle; and we may perceive, in proportion as the body is elongated, that the wax will make its appearance under the rings, in the form of small scales. Mr Duchet, in his *Culture des Abeilles*, gives a full statement of the principal circumstances attending the production of wax, which he very justly ascribes to the conversion of honey into this substance in the body of the bee. These facts appear to have been entirely overlooked till the subject was again brought forward by Mr John Hunter, in his paper in the *Philosophical Transactions* for 1792. Wildman, however, had cursorily remarked that portions of wax, in the form of scales, and which he conceived must have been moulded on the body of the bee, are sometimes found at the bottom of the hive. Mr Huber was engaged in prosecuting his inquiries on this subject at the same period with Mr Hunter, and discovered, in 1793, the existence of regular receptacles or pouches, from the coats of which the wax is secreted, and within which it accumulates till its edges raise the scales, and become apparent externally. These plates of wax are withdrawn by the bee itself, or some of its fellow-labourers, and are applied in a manner hereafter to be described.

Huber has shown, by a series of well-conducted experiments, that, in a natural state, the quantity of wax secreted is in proportion to the consumption of honey; but that an equal or even greater quantity will be formed if the bee be fed on a solution of sugar in water. Warmth and rest promote this process of secretion; for the bees, after feeding plentifully on saccharine food, hang together in a cluster without moving, for several hours, at the end of which time large plates of wax are found under the abdominal rings. This happened when bees were confined and restricted from any other sort of nourishment; whilst those that were fed on pollen and fruits alone did not produce any wax. It appears also from his researches that the formation of wax is the office of a particular set of bees, which may be distinguished from the rest, and particularly from those that nurse the young larvæ, by the greater size and more cylindrical shape of their abdomen. Dissection also shows that their stomachs are more capacious. In the second volume of Huber's *Nouvelles Observations sur les Abeilles*, he describes minutely the anatomy of the pouches or receptacles for the wax, which are parts peculiar to the working bees, being totally absent in the males and queens. It is a structure that had escaped the keen eyes of Swammerdam, and has not been noticed by any subsequent anatomist. The cavities are lined with a membrane, which presents a number of folds, forming an hexagonal net-work, not unlike the appearance in the second stomach of ruminant quadrupeds, and evidently destined to perform the office of secretion.

Among the secretions peculiar to the bee, the poison which is poured into the wounds made by the sting deserves to be noticed. It is said to owe its mischievous efficacy to certain pungent salts. If a bee is provoked to strike its sting against a plate of glass, a drop of poison will be discharged; and if this is placed under a microscope, the salts may be seen to concrete, as the liquor dries, into clear, oblong, pointed crystals. The sting consists of bearded darts, which are protruded from the end of a sheath; and the venomous juice is likewise injected through the sheath, from a little bag at the root of the sting. Bee.

As no organs for the circulation of blood have been yet demonstrated in insects, respiration is supposed to be effected by means totally different from those which are adopted in the higher classes of the animal kingdom. As the blood, or fluid corresponding to the blood, cannot be presented to the air in any separate organ, the air must be conducted to the blood, wherever such a fluid is met with. For this purpose, tracheæ or air-tubes, having several external openings or spiracles, are made to ramify like arteries, and are distributed in an infinite number of branches to every part of the body. The analogy of other insects might perhaps be admitted as sufficient evidence that bees respire atmospheric air, the constant renewal of which is essentially necessary to the continuance of the vital functions. It is, however, not always safe to trust to analogical reasoning in subjects of natural history; and direct evidence is, in all cases, to be preferred when it can be obtained. We must therefore consider as valuable the complete series of experiments on the respiration of bees, that have been lately given to the world by Huber, to whom we already owe so large a portion of the information we possess with regard to these insects. We might indeed have anticipated, with the strongest probability, many of the results to which these experiments have led; but there are others which are quite unexpected, and possess as much of interest as of novelty. Function of respiration.

The condition of a hive of bees, in which many thousand individuals, full of animation and activity, are crowded together in the very small space of one or two cubic feet, having no communication with the external air but by means of a small aperture in the lowest part, which entrance is frequently obstructed by a throng of bees that are passing in and out during sultry weather, is of all possible conditions the one least favourable to the renewal of heated air. The most crowded theatres or hospitals are not to be compared with it in point of closeness. Direct experiment, indeed, shows that the combustion of a taper could not be carried on in so limited a space; for Mr Huber found that, in a glass ball of the same dimensions as the hive, and with a similar aperture, the taper went out in a few minutes. So great was the difficulty of explaining the respiration of bees under these circumstances, that Mr Huber was led to examine into the truth of the opinion, that respiration was equally necessary to bees as to other insects. The results were unequivocal. They perish speedily in the vacuum of the air-pump. They are easily drowned by placing them so that the spiracles on the corslet are under water; but revive readily when they are dried. The action of the spiracles is, in this experiment, rendered manifest by the escape of bubbles of air from each of their orifices. When a number of bees are confined in a bottle accurately closed, they exhibit unequivocal symptoms of distress, and fall into complete asphyxia. These changes occur more rapidly when they are placed in any gas which contains no admixture of oxygen, such as carbonic acid, hydrogenous and azotic gases. When they are rendered torpid by cold, and respiration is thereby suspended, these effects do not take place. All these effects are more considerable in adult bees than in the larvæ, though they are also distinctly exhibited in the latter. Suffocation is retarded if the proportion of oxygen be greater than in atmospheric air, and it may be averted altogether by a continual renewal of oxygen. It was ascertained by the eudiometer that the same changes were produced on the air as in the respiration of other animals; namely, the subtraction of Its necessity.

Bee. oxygen and the addition of an equal volume of carbonic acid gas.

Yet, on examining the air of the hive itself, it was found scarcely to differ in purity from atmospheric air. It was at one time conjectured that some of the contents of the hive, such as the pollen, the honey, or the wax, might have some power of evolving oxygen, so as to afford the requisite supply of this gas. Experiments, however, proved that they had no such power. Amidst so great an uncertainty, it was thought worth while to ascertain whether bees might not exert some unknown process by which oxygen was generated in the hive itself. If this were true, they could support life although all communication with the external air were intercepted. A hive was selected having glass sides, so as to allow of the observer's seeing what was passing in the interior, and the entrance was completely closed. In a quarter of an hour the bees became sensible of their situation, and showed great uneasiness; all business was suspended; an extraordinary agitation, accompanied by a remarkable noise, prevailed in every quarter. All the bees were seen beating their wings with the same rapidity as in flying. They were thus incessantly occupied during ten minutes. Their motions became then more languid, and, after being utterly exhausted, they fell in succession to the bottom of the hive, till every one of them was in a state of complete asphyxia. It is remarkable that, at this period, the temperature of the hive, which had been previously at 95° of Fahrenheit, suddenly cooled down to that of the external air. On opening the door and the top of the hive, and establishing a current of air through it, the bees were soon restored to animation.

Their mode of ventilating the hive. It was proved by this experiment that the air is renewed through the small opening which serves as a door to the hive. By suspending light substances near the entrance, the existence of different currents of air was rendered manifest. After much reflection, it occurred that the violent agitation of the wings might have some influence in procuring this renewal of air. This conjecture was confirmed by an experiment with a glass bell, to the aperture of which an apparatus was fitted, consisting of a small ventilator, which could be moved rapidly round by machinery. When the ventilator was set in motion, the air within could support the combustion of a candle for an unlimited time. Observation further showed that some bees are actually always employed in the office of ventilating the hive; they vibrate their wings with great vigour and constancy, producing so rapid a movement of them, that they cannot be seen except in the two extremities of the arc of vibration, which is at least one of 90°. While thus imitating the actions of flying, they fasten themselves with their feet to the floor of the hive, so that the whole effect of that impulse which, were they at liberty, would carry them forwards with considerable velocity, is exerted on the air, which is therefore driven backwards in a powerful current. Some bees occasionally perform these ventilating motions on the outside of the hive, near the entrance; but a still greater number are employed in this office within doors: sometimes twenty are thus occupied at once, and each bee continues its motions for a certain time, occasionally for nearly half an hour, and is then relieved by another, who takes its place. This is the occasion of that humming sound which is constantly heard from the interior of the hive when the bees are not in a state of torpidity. But it is often heard with even more than usual loudness in the depth of winter. The warmth of the sun's rays, however, always occasions an increased activity among the ventilating bees. The immediate cause of these actions is probably some impression made on their organs by the presence of vitiated air; for a bee may be made to ventilate itself by placing near it substances which have to them an unpleasant odour, such as spirit of wine or oil of turpentine. Bee.

Temperature of the hive. The connection between an active respiration and a high temperature is remarkably exemplified in bees, among which, in consequence of their collecting together in large numbers, the heat is not so easily dissipated, and admits also of being easily ascertained by the thermometer. Mr Hunter found it to vary from 73° to 84° of Fahrenheit; and Mr Huber observed it on some occasions to rise suddenly from about 92° to above 104°.

Progressive motion. Bees are well fitted, by their structure, for rapid flight through the air. They possess great muscular strength in proportion to their size, and their indefatigable activity in the different labours of the hive is truly astonishing. Aristotle and Pliny have pretended that, during high winds, they endeavour to steady their flight by holding a small stone with their feet, by way of ballast. This assertion has been shown, both by Swammerdam and Reaumur, to be erroneous in as far as it applied to the common bee; but there are other species which build nests with stones and other hard materials, and which, while transporting them for this purpose, were probably mistaken for the honey-bee.

Sensitive powers. The physiology of the external senses must necessarily be very imperfectly understood in a class of animals of a nature so remote from our own species. The infinite diversity of characters presented to us by the different tribes of insects, as well as of other animals, naturally suggests the idea that external objects produce on their sentient organs impressions widely different from what they communicate to ourselves. The notions we form of their senses must not only be liable to great inaccuracy, but must often be totally inadequate representations of the truth. A finer organization, and more subtle perceptions, would alone suffice to extend the sphere of their ordinary senses to an inconceivable degree, as the telescope and the microscope have with us extended the powers of vision. But they possess, in all probability, other organs, appropriated to unknown kinds of impressions, and which must open to them avenues to knowledge of various kinds, to which we must ever remain total strangers. Art has with us supplied many elaborate modes of bringing within our cognizance some of the properties of matter which nature has not immediately furnished us with the means of detecting. But who will compare our thermometers, electroscopes, or hygrometers, however elaborately constructed, with those refined instruments with which the lower classes, and particularly insects, appear to be so liberally provided? The antennæ, which are so universally met with in this class of animals, are doubtless organs of the greatest importance in conveying impressions from without. Their continual motion, the constant use which is made of them in examining objects, the total derangement in the instincts of those insects which have been deprived of them, point them out as exquisite organs of more than one sense. To impressions of touch, arising from the immediate contact of bodies, they are highly sensible; but their motions evidently show that they are affected by objects at some distance. They are no doubt alive to all the tremulous motions of the surrounding air, and probably communicate perceptions of some of its other qualities. Composed of a great number of articulations, they are exceedingly flexible in every direction, and can readily embrace the outline of any body that the bee wishes to examine, however small its diameter, and are capable of following all its movements. It is by means of these instruments that the bee is enabled to execute so many works in the interior of the hive, from which the light must be totally exclud-

Functions of the antennæ.

Bee.

ed. Aided by these, it builds its combs, pours honey into its magazines, feeds the larvæ, and ministers to every want, which it discovers and judges of solely by this species of touch.

The antennæ appear also to be the principal means employed for mutual communication of impressions. The different modes of contact constitute a sort of language, which appears to be susceptible of a great variety of modifications, and to be capable of supplying at once every species of information for which they have occasion. It is in this way alone that they satisfy themselves of the presence of their queen, or communicate to others the alarming intelligence that she has disappeared.

Vision.

The sense residing in the antennæ appears to be, on many occasions, supplementary to that of vision, which in bees, as in other insects, is less perfect than in the larger animals. During the night, therefore, they are chiefly guided in their movements by the former of these senses. This will sufficiently appear from observing by moon-light the mode in which the bees guard the entrance of the hive against the intrusion of moths which flutter in the neighbourhood. They act as vigilant sentinels, performing continual rounds near this important post, extending their antennæ to the utmost, and moving them alternately to the right and to the left. Woe to the unfortunate moth that comes within their reach. Aware of its danger, and of the defective sight of the bees, the moths adroitly avoid the slightest contact, and endeavour to insinuate themselves between the bees, so as to get unperceived into the hive, where they riot upon the honey which they find.

If bees require full day-light for the exercise of vision, it must at the same time be acknowledged, that, when they are so assisted, they appear to enjoy this sense in great perfection. A bee will recognise its habitation from great distances, and distinguish it at once from many others in a numerous apiary. It passes through the air in a straight line towards its object with extreme rapidity. On quitting the hive, it flies towards the field which is most in flower; and as soon as it has determined on its course, it takes as direct a line as a ball issuing from a musket. When it has collected sufficient provision, it rises in the air to discover its hive, and then darts forward with the velocity of an arrow, and with unerring precision in its aim.

Perceptions of temperature.

Their perceptions of heat and cold, which are generally referred to the sense of touch, appear to be extremely delicate. In several experiments of Huber's, the influence of the rays of the sun excited them to a vigorous action of the wings. It is well known that great cold reduces them to a state of torpor, and inferior degrees of cold are evidently unpleasant to them. They show by their conduct that they are sensible of alterations in the state of the weather for some time before we can perceive them. Sometimes, when working with great assiduity, they will suddenly desist from their labours; none will stir out of the hive, while all the working-bees that are abroad hurry home in crowds, and press forward so as to obstruct the entrance of the hive. Often when they are thus warned of the approach of bad weather, we can distinguish no alteration in the state of the atmosphere. Gathering clouds sometimes produce this effect on them; but perhaps they possess some species of hygrometrical sense, unconnected with any impression of vision. It is alleged that no bee is ever caught in a sudden shower, unless from some cause it has wandered very far from the hive, or been disabled by some accident from returning to it. There is reason for thinking, however, that much exaggeration has prevailed in the statements of authors as to the extent of this kind of foresight. Huber supposes that it is the rapid diminution of light that alarms them; for if the sky be uniformly overcast, they proceed on their excursions, and even the first drops of a soft shower do not make them return with any great precipitation. Bee.

Taste.

Their taste is perhaps the most imperfect of their senses. They exert hardly any discrimination in the collection of honey from different flowers. They are not repelled by the scent or flavour of such as are extremely offensive to our organs, and scruple not to derive supplies from such as are highly poisonous. In some districts in America, it is well known that the honey acquires in this way very deleterious properties. The qualities of honey are, indeed, observed to vary much, according to the particular situation from which it is obtained. The most stagnant and putrid waters, as we have already noticed, are resorted to by bees with the same avidity as the purest. In their selection of flowers they are guided by the quantity of honey they expect to meet with, and in no respect by its quality. When the scythe has cut down all the flowers which before yielded them a plentiful supply, they discontinue their excursions, although the weather be in all respects propitious. Their smell must, therefore, be sufficiently acute to enable them to discover the presence of honey at great distances. Direct experiment has, indeed, proved this to be the case. Mr Huber found that they proceeded immediately towards boxes which contained honey concealed from their view; and such in fact is the situation of the fluid of the nectarea in flowers. Some odours, especially the fumes of tobacco, and indeed all kinds of smoke, are highly obnoxious to them; this is the case, also, with the smell of oil of turpentine, alcohol, ammonia, the nitric and muriatic acids, and several other volatile chemical agents, upon receiving the impressions of which, they immediately set about ventilating themselves in the manner above described. But nothing excites their displeasure in a greater degree than the breath of the spectator; as soon as they feel which, they show signs of anger, and prepare to revenge it as an insult. The odour of the poison of their sting produces similar effects, exciting them to immediate rage and hostility.

Smell.

Although it is sufficiently clear that many insects possess the power of smell, yet the particular organ of this sense has never been accurately ascertained; and the opinions of naturalists have been much divided on the subject. These opinions have been supported more by arguments drawn from the analogy of what happens in other classes of animals, than by any direct experiments on insects themselves. We know that, in all animals respiring by means of lungs, the organs of smell are placed at the entrance of the passages of the air; and it has often been concluded, that in like manner the stigmata, or the orifices of the air-tubes, were the seat of this sense in insects. By others the antennæ have been assigned as the organs through which these impressions were conveyed to the sensorium. The experiments of Huber have proved that neither of these opinions is correct; and have satisfactorily shown that in the bee this sense resides in the mouth itself, or in its immediate vicinity. Here, indeed, would be its proper station, if this faculty be intended, as we may reasonably suppose it to be, to apprize the individual of the qualities of the food prior to its being eaten. When the mouth of the bee was plugged up with paste, which was allowed to dry before the insect was set at liberty, it remained quite insensible to the same odours to which it had before manifested the strongest repugnance.

Hearing.

It is generally supposed that bees possess the sense of hearing. The common practice of making a loud noise by drums and kettles in order to attract a swarm is founded on this supposition. But the evidence is by no means conclusive; for we find that they are nowise disturbed by a loud clap of thunder, or by the report of a gun, or any

Bee.

other noises that may happen to arise around them. It is, however, certain that they are capable of emitting a variety of sounds, which appear expressive of anger, fear, satisfaction, and other passions; and it would seem that they were even capable of communicating certain emotions to one another in this manner. Huber observed that the queens, during their captivity, sent forth a peculiar sound, which he supposes to be a note of lamentation. A certain cry or humming noise from the queen will strike with sudden consternation all the bees in the hive; and they remain for a considerable time motionless and stupified. Hunter has noticed a number of modulations of sound emitted by bees under different circumstances, and has instituted an inquiry concerning the means employed by them in producing these sounds; for an account of which we shall refer the reader to his paper in the *Philosophical Transactions*.

Instincts of bees.

If the function of sensation in insects be involved in doubt and obscurity, the knowledge of those more interior faculties which are the springs of voluntary action is hid in still deeper mystery. Buffon refuses to allow bees any portion of intelligence, and contends that the actions we behold, however admirably they are directed to certain ends, are in fact merely the results of their peculiar mechanism. Other philosophers, such as Reaumur, have gone into the opposite extreme, and have considered them as endued with extraordinary wisdom and foresight, as animated by a disinterested patriotism, and as uniting a variety of moral and intellectual qualities of a higher order. The truth, no doubt, lies between these overstrained opinions; but it is nevertheless extremely difficult to decide in what degree these respective principles operate in the production of the effects we witness. We have been too long in the habit of sheltering our ignorance of the causes of this class of phenomena, by referring them indiscriminately to what is called *instinct*, to submit to a cautious and patient investigation of the hidden springs of action. The term *instinct* should properly be regarded, not as denoting a particular and definite principle of action, whose operation we can anticipate in any new or untried combination of circumstances, but as expressive of our inability to refer the phenomena we contemplate to any previously known principle. Thus the actions which an animal performs in obedience to the calls of appetite are not properly said to be instinctive; nor can the term be applied to actions which are the consequence of acquired knowledge, and of which the object is with certainty foreseen by the agent. But when an animal acts apparently under a blind impulse, and produces effects useful to itself or to the species, which effects it could not have previously contemplated as resulting from those actions, it is then customary to say that it is under the guidance of instinct, that is, of some unknown principle of action. It will be proper, therefore, to keep this distinction in view in judging of the voluntary actions of the lower animals.

In no department of natural history is it more necessary to be aware of the proper import of the term instinct, than in studying the phenomena presented by the bee; for nowhere is it more difficult to discriminate between the regular operation of implanted motives, and the result of acquired knowledge and habits. The most striking feature of their history, and the one which apparently lays the foundation for those extraordinary qualities which raise them above the level of other insects, is the disposition to social union. It may in general, indeed, be remarked, that animals which associate together so as to form large communities, display a higher degree of sagacity than those which lead a solitary life. This is especially observable among insects. The spider and *Formica leonis* may exhibit particular talents, or practise particular stratagems in the pursuit and capture of their prey; but their history is limited to a single generation, and embraces none of those interesting relations which obtain between individuals composing the gregarious tribes, such as the ant, the wasp, and the bee. Among these we trace a community of wants and desires, and a mutual intelligence and sympathy, which lead to the constant interchange of good offices, and which, by introducing a systematic division of labour, amidst a unity of design, leads to the execution of public works on a scale of astonishing magnitude. The attachment of bees to their hive, which they defend with a courage and self-devotion truly admirable; their jealousy of intruders; their ready co-operation in all the labours required for the welfare of the community; their tender care of their young; the affection and homage which they bestow on their queen, and which they manifest on all occasions in the most unequivocal manner; imply qualities such as we could hardly persuade ourselves could animate a mere insect, on which we are in the habit of proudly looking down as placed in one of the lowest orders of created beings.

Bee.

We shall content ourselves at present with these general observations, as the instances which serve to illustrate their moral and intellectual character belong properly to the history of the different processes they follow in the construction of their combs, the hatching and rearing of their progeny, and the mode of conducting their migrations. To these subjects, therefore, we shall now proceed: and in order to present the most connected and complete account of their economy, we shall begin the history from the period when a new swarm has just occupied a hive, and when all the arrangements for their habitation, and the construction of the cells in which their eggs and provisions are to be deposited, are yet to be effected.

Preparation of the hive.

The first care of the labouring bees, on their settlement in their new abode, is to clean it out thoroughly. While one set of bees is thus employed, another is distributed about the country in order to procure the proper materials for blocking up the small holes and chinks of the hive, and for laying a firm foundation for the edifice which is to be constructed within it. The substance which is principally employed in this preliminary stage is *propolis*, a species of glutinous resin, of an agreeable aromatic odour, and reddish-brown colour, in process of time becoming darker, and acquiring a firmer consistence. According to the analysis of Vauquelin (*Mém. Soc. Agricult. Departem. Seine*), it is composed chiefly of resin, with a small proportion of wax, and of acid and aromatic principles. It is soluble in alcohol, ether, and oils, both fixed and volatile; and tinges the solvent of a beautiful red colour. Cadet has since ascertained in it the presence of benzoic and gallic acids. Reaumur had not been able to discover from what plants the bees collect this substance. Riem asserts that it is chiefly from pines and other trees of the fir kind. The recent observations of Huber have assisted in the solution of this question. On placing branches of the wild poplar tree before the hive, he found that the bees eagerly seized upon the varnish which exudes from the buds; and examining the chemical properties of this varnish, he identified it with the propolis with which the inside of the hive is lined.

Nature and origin of propolis.

Mode of its application.

The propolis adheres so strongly to the legs and feet of the bee which has collected it, that it cannot be detached without the assistance of its fellow-labourers. For this purpose the bee that is loaded presents its legs to the workers in the hive, which carry off with their jaws this adhesive substance, and immediately apply it, while yet ductile, all round the interior of the hive, and particularly over all the projecting parts; hence its name, of Greek

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derivation, signifying *before the city*. In like manner all the foreign bodies that are introduced into the common habitation, and are too heavy to be removed, are covered over with this resinous substance. If a snail, for instance, should happen to introduce itself into the hive, after dispatching it with their stings, they encrust it over with propolis. Mr Knight has observed that, besides propolis, bees will occasionally carry home, and employ as cement, other substances, having the same glutinous properties. He frequently covered the decorticated parts of trees, on which he was making experiments, with a cement composed of bees' wax and turpentine; and in the autumn has observed a great number of bees occupied in carrying off this substance. They detached it from the tree with their forceps, and the little portion thus obtained was then transferred by the first to the second leg, by which it was deposited on the thigh of the third, precisely in the same manner as the pollen of flowers is collected and transferred. Whilst the bees were employed in the collection of this substance, Mr Knight had many opportunities of observing their peaceful and patient disposition as individuals, which Mr Hunter had also in some measure noticed. When one bee had collected its load, and was just prepared to take flight, another often came behind it and despoiled it of all it had collected. A second, and even a third load was collected, and lost in the same manner; and still the patient insect pursued its labour, without betraying any symptoms of impatience or resentment. When, however, the hive is approached, the bee appears to be the most irritable of all animals, and is animated with the most vindictive spirit against a public enemy, without displaying any peculiar hostility in the revenge of a private injury.

Construction of the combs.

The next object of their labours is to prepare the combs, which are to be the receptacles for the eggs with which the queen is pregnant, and which are now about to be laid. The material employed for this purpose is not propolis, but wax, the production of which, by secretion from a particular set of bees who feed largely upon honey, was formerly explained. The bees are for this purpose actively employed in collecting honey, and in imparting it to their companions in the hive, who, when they have filled their crops with it, hang together in a thick cluster from the top of the hive, and thus remain in a state of inactivity for a considerable period. During this time the secretion of wax is proceeding, and may be seen collected in laminæ under the abdominal scales, whence it is removed by the hind-legs of the bee, and transferred to the fore-legs, and from thence taken up by the jaws. In this operation they are often assisted by their companions, who even directly seize upon the wax from under the abdomen of those who are before them. When a sufficient quantity of materials has thus been collected together, the process of building is commenced. But, in order to understand the subsequent operations, it is necessary to have a correct idea of the form of the cells which compose the combs. We shall, therefore, proceed to give some account of the structure when they have attained their perfect state.

Form of the combs.

The combs of a bee-hive are formed into parallel and vertical strata, each of which is about an inch in thickness, the distances between the surfaces of each being about half an inch, an interval which serves for the passage of the bees over both surfaces. They generally extend the whole breadth of the hive, and often descend the whole length, from the top to the bottom. They consist altogether of thin partitions, which inclose hexagonal cells about half an inch in depth and a quarter of an inch in diameter, opening on both surfaces of the comb, and closed by a partition common to those on both sides, and which occupies the middle distance between the two surfaces. This partition is not, however, a plane, but is composed of a collection of rhombs. Three, and sometimes four of these rhombs, inclined to one another at a certain angle, form the bottoms of each cell, which thus has the shape of a flattened pyramid, of which the basis is towards the mouth of the cell. The geometric form of each individual cell is, therefore, an hexagonal prism, terminated by a trihedral pyramid, the three sides of which pyramid are rhombs, which meet at the apex by their obtuse angles, and, forming oblique angles with the sides of the prism, truncate a portion of these, and convert them from rectangles, which they would be in a regular prism, into trapeziums. Of the two angles of these trapeziums adjoining to the base of the pyramid, one must be acute and the other obtuse, the acute angle of one trapezium being next to the acute angle of the adjoining trapezium, and the obtuse angle being in like manner next to another obtuse angle of the preceding trapezium, so that, in going round the base, we meet with pairs of acute and of obtuse angles alternately succeeding each other. The two adjoining acute angles of the trapezia are adjoining to two of the terminal rhombs, which here present their acute angles; so that at these points a solid angle of four planes is formed, all the angles being acute. Each pair of obtuse angles of the trapezia, on the other hand, are adjacent to the obtuse angle of one of the rhombs only, thus composing a solid angle of three planes, of which the angles are all obtuse; and these two kinds of solid angles succeed one another alternately all round the base of the pyramid, there being three of each kind, and six in all. The axis of each cell coincides, not with the axis of the cell on the opposite surface, but with one of its angles, so that each of the three obtuse angles at the base of the terminal pyramid corresponds to the central parts of three of the cells on the opposite side; and each of the sides of the pyramid, which closes a cell on one side, contributes in part to the closing of three of the cells on the opposite side. We may easily satisfy ourselves that this is the case, by piercing the centres of each of the three planes which close the bottom of a cell, with a pin, when, on turning the comb, the three pins will be found to have passed into three different cells on the opposite side.

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Geometric properties of the cells.

A structure of this kind is obviously the one of all others calculated to afford the greatest space for each cell, with the same expense of materials. It is easy to perceive, in the first place, that, in a plane surface, when a number of small spaces are to be divided by partitions, the hexagonal form is the one which comprehends the largest space compatible with the extent of the lines which inclose them. For the equilateral triangle, the square, and the regular hexagon, are the only regular forms that admit of being joined together in the same plane, without leaving interstices; and the proportion of the area to the periphery in every polygon increases as the figure consists of a greater number of sides, and is therefore greater in the hexagon than in any of the other two. The truth of this proposition was perceived by Pappus, and even its application to the subject of the honeycomb was made by that ancient geometrician. But the determination of the form and inclination that should be given to the partitions which close the bottoms of the cells, and which may of course belong equally to those on both sides of the comb, is a problem much more complicated and difficult of solution. It has exercised the skill of several modern mathematicians of great eminence, and has generally been resolved by the assistance of the infinitesimal calculus, or the methods of maxima and minima. A mistake has sometimes been committed in supposing that the capacity of the cells would be affected by varying

Bee. the inclination of the partitions, whereas, if abstraction be made of the thickness of these partitions, all the space which is gained on the one side must be obtained at the expense of the space on the other, and the sum total will therefore remain the same. This error has been pointed out by Le Sage of Geneva, and also by others. The whole question, therefore, resolves itself into that of the form producing the greatest saving of materials. Kœnig, the pupil of the celebrated Bernoulli, calculated that the angles of the rhombs, which should answer this condition, must be 109° 26′ and 70° 34′. Cramer, professor of mathematics in the university of Geneva, has given a very elegant demonstration of this problem, from which it results that the obtuse angle of the rhomb must be such, that its half has for its tangent the square root of 2. This is the case with the angle 54° 44′ 8″; the two angles of the rhomb are therefore 109° 28′ 16″ and 70° 31′ 44″. It follows also that the two diagonals of this rhomb are to one another in the same proportion as the side and diagonal of a square, that is, as 1 to 1·41421356237, &c. It is also another consequence from the same data, that the angles of the trapezia forming the sides of the hexagonal prism adjacent to the rhombs are precisely equal to those of the rhombs themselves, and that the solid angle formed at the apex of the pyramid, and which is composed of those equal obtuse angles, is precisely equal to each of the three angles at the base, which are also formed of three obtuse angles. It is also true that these are the only angles which will give this perfect equality. Maraldi had already made the same remark; and, assuming the principle of the equality of the angles as the basis of his reasoning, had calculated them on this hypothesis, making them 109° 28′ and 70° 32′, which is nearly accurate. To the same author we are indebted for the comparison of the results of theory with fact, by the admeasurement of the actual angles of the honeycomb; these he states to be about 110° and 70°, which is as near an agreement with theory as could well be expected.

Boscovich, who has also given a solution of the same problem, conceives that the equality of inclination of the planes gives greater facility to the construction of the comb, and might, therefore, be a motive of preference, independently of the greater economy of wax. Maclaurin has exercised his abilities in resolving this problem, and has demonstrated by simple geometry, that the most advantageous form is that which results from the supposed equality of the three plane angles forming the solid angles at the base. He estimates the saving of wax by partitions so constructed, above what would be required for a flat partition, at one fourth of the wax which would be wanted to complete the truncated sides of the cells, so as to form them into rectangles. L'Huillier, in the *Memoirs of the Berlin Academy*, has given a demonstration which is remarkable for its simplicity, and for its involving none but elementary propositions; he values the economy of wax at $\frac{1}{51}$ of the whole wax employed. Le Sage, as appears from the life of that philosopher by Professor Prevost, has shown that this celebrated problem reduces itself to the finding of the angle at which two planes with a given inclination (such as 120°) can be cut by a third plane, so as to make all the angles resulting from the section equal to one another.

But a more essential advantage than even the economy of wax results from this structure, namely, that the whole fabric has much greater strength than if it were composed of planes at right angles to one another; and when we consider the weight they have to support when stored with honey, pollen, and the young brood, besides that of the bees themselves, it is evident that strength is a material requisite in the work.

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It has often been a subject of wonder how such diminutive insects could have adopted and adhered to so regular a plan of architecture, and what principles can actuate so great a multitude to co-operate by the most effectual and systematic mode in its completion. Buffon has endeavoured to explain the hexagonal form by the uniform pressure of a great number of bees all working at the same time, exerted equally in all directions in a limited space; and illustrates his theory by supposing a number of similar cylinders compressed together, and taking the form of hexagonal prisms by the uniform expansion of each. The analogy of the forms produced by the law of crystallization,—of the figures assumed by various parts in the animal and vegetable world, such as the skin of the bat, and the inner coat of the second stomach of ruminant quadrupeds,—is also adduced by this captivating but superficial writer in support of his argument. But however plausible this theory may at first sight appear, it will not stand the test of a more serious examination. The explanation he has attempted applies no further than to the inclination of the sides of the cells; but he did not take into account, perhaps from not having studied the subject mathematically, the inclinations and forms of the planes which close each cell, and so curiously conspire on both sides to serve a similar office, while they at the same time accurately fulfil a refined geometrical condition. But it is sufficient confutation of the whole theory to show, that it is directly at variance with the actual process employed by the insects in the construction of their combs. Buffon's theory of the formation of the combs.

It might be supposed that bees had been provided by nature with instruments for building of a form somewhat analogous to the angles of the cells; but in no part, either of the teeth, antennæ, or feet, can any such correspondence be traced. Their shape in no respect answers to that of the rhombs, which are constructed by their means, any more than the chisel of the sculptor resembles the statue which it has carved. The shape of the head is indeed triangular, but its three angles are acute, and different from that of the planes of the cells. The form of the plates of wax, as they are moulded in the pouches into which this substance is secreted, is an irregular pentagon, in no respect affording a model for any of the parts which compose the honeycomb. Hunter, observing that the thickness of the partition was nearly equal to that of the scale of wax, thought that the bees apply these scales immediately to the formation of the partition, by merely cementing them together. Reaumur, notwithstanding the use of glass hives, had not been able to discover the mystery of their process of architecture; but inferred, from what he saw, that the wax was rejected from the stomach in the form of a white frothy liquor. No naturalist, indeed, prior to Huber, had been able to follow these insects in their labours, on account of their crowding together in a thick mass while they are building; but the expedients resorted to by that ingenious philosopher have unfolded the whole process, which he has given with great detail in the second volume of his *Observations sur les Abeilles*. Huber witnessed the whole of their actions, and saw that each bee drew out, with its hind feet, one of the plates of wax from under the scales where it was lodged, and, carrying it to the mouth in a vertical position, turned it round, so that every part of its edge was made to pass in succession under the cutting edge of the jaws; it was thus soon divided into very small fragments, while at the same time a frothy liquor was poured upon it from the tongue, so as to form it into a perfectly plastic mass. This liquor gave the wax a whiteness and opacity which it did not possess originally, and rendered it at the same time tenacious and ductile. A quantity of wax thus prepared for use is accumulated, Mode of their construction.

Bee. and applied to further the work in the manner we are presently to describe.

But, in considering the process by which the comb is formed, a circumstance should be pointed out, which seems not to have been particularly noticed by any author except Huber; and yet it is one of essential importance in studying their process of architecture;—namely, that the first row of cells on either side are of a form very different from that of the subsequent rows. As they take their origin from a plane surface, two of the sides necessary to complete the hexagon are cut off by this plane, so that the general form of the orifice is pentagonal; and the bottom of the cells on one side is composed of two equal rhombs only, and on the other side of two trapezoidal planes, with one rhomb. Such a modification of shape was necessary, in order to prepare the way for the regularly-formed cells which were to follow.

The foundations of the combs are laid by the bees raising a solid block or plate of wax of a semicircular form. In this they scoop out a small vertical channel, of the size of an ordinary cell. The sides of this channel are then strengthened by additions of wax. On the opposite side two other channels are formed, one on each side of the plane opposite to the former channel. The extremities of these channels, which at first present a curved outline, are then fashioned into straight walls, forming an angle at each vertex. The bottom of each cell being thus sketched out, the design is completed by raising walls round the sides. Different bees generally work on the opposite sides at the same time, and appear to have some perception of the thickness of the partitions, and of the situation of the opposite walls, in which they are perhaps guided by slight prominences, occasioned by the depressions which correspond to them on the other side; and they scrape off the wax in those places where its thickness is greatest; that is, where the bees on the other side had accumulated materials. In this way, then, in constructing the successive rows, the axis of each cell will be found to occupy the most retiring parts of the partition, and will be opposite to the junction of three of the opposite cells.

Soon after the bees have completed the foundations, and constructed a few of the cells of the central comb, they begin two others, one on each side, at the proper distance, and in this manner continue to form others in succession, in proportion as the former are advanced. Their object at first seems to be to extend the surface of the work, so as to admit of the greatest possible number of workers being employed at one and the same time. In this way, then, the work proceeds from all points at once, new cells being begun before the former are completed, so that the whole comb, while it is in progress of construction, has a semi-lenticular shape, broader at the top, and tapering below and towards the sides. It extends downwards, however, more rapidly than in any other direction, and its surfaces do not become parallel to each other till the last stage of the building process. When this is completed, the whole is further strengthened by an additional coating of propolis round the margin of all the cells; and the junctions of every plane, both of the sides and bottoms of the cells, are also soldered together by a lining of the same substance. The edges of the combs are also secured in their situations by being glued to the side of the hive, and supported by fresh abutments of propolis. Sometimes a mixture of wax and propolis, manufactured by the bees themselves, is employed as the cementing material. The first coating of this compound substance is denominated *Commosis* by Pliny, and described as having a bitter taste; the second, or the *Pissoceros* of the same author, is stated to be of a thinner consistence, and more adhesive than the former; while the third substance or propolis is completely solid. Bee.

The cells recently constructed are perfectly white, but in a short time they are found of a yellow tint, which becomes gradually deeper, and, when very ancient, gives them a dark brown cast. It is therefore easy to distinguish in a hive the successive periods of formation of different portions of the combs. From the researches of Huber, it appears that these variations of colour are not owing to any changes in the wax itself, but to additional coatings of a peculiar varnish, consisting of propolis and a colouring matter. The latter differs materially from propolis, being wholly insoluble in alcohol. It loses its colour by the action of nitric acid or the light of the sun. Its origin has not yet been discovered; nor has the mode in which it is applied been clearly made out; although Huber presumes, from his observations, that they spread it by means of their mandibles, which he has seen them rub against the sides of the cells, while they acquired a yellow colour from the operation.

Such is the general outline of the architectural labours of the bee. A number of modifications are however met with, adapting them to various purposes and to new circumstances. The cells are required to be of different sizes for the reception of different sorts of eggs and larvæ The smallest, which are also the most numerous, are appropriated to the eggs of the working bees; a larger sort receive those of the males; and a small number of very large cells are destined for the education of the young queens, and are therefore called royal cells. The first set are generally five and one third lines in depth, and two and a half in diameter; the second are from seven to seven and a half lines in depth, and three and three fourths in diameter; while the royal cells are above one inch deep, one third of an inch wide, and their walls are about one eighth of an inch in thickness. Other cells, again, are set apart as magazines of honey or of pollen; they are made twice as deep as the common cells, and their axes are inclined to the horizon, so that their mouths are in the highest part, and their liquid contents may be more easily retained. When these are filled, they are closed up by the bees with a wall of wax, and opened only when necessity requires. Different kinds of cells

The regularity of the cells is often disturbed in consequence of the admixture of rows of larger cells with those of smaller dimensions; but the pyramidal partitions are adapted by successive gradations to these changes; so that in many rows of what may be called cells of transition, the bottom presents four planes instead of three, two being trapeziums, and the other two irregular hexagons. These irregularities are met with chiefly in the combs most distant from the central one. When an abundant supply of honey induces them to lay up a large quantity in store, they build up for this purpose the walls of common cells, so as to give them a greater depth. The royal cells are often raised from the ruins of a number of other cells, which are destroyed to make room for them; they are usually built on the edge of some of the shorter combs, and often in the very centre of the hive. Sometimes there are but three or four of them; at other times eleven, or even fourteen, have been counted in the same hive. They are formed of a mixture of propolis and wax; their form is oblong, resembling that of a pear; their position is always vertical, so that when they arise from amidst other cells, they are placed against the mouths of those cells, and project beyond the common surface of the comb. They are perfectly smooth on the inner surface; while their outer side is covered with a kind of hexagonal fret-work, as if they were intended for the foundation of regular cells. Cells of transition.

As soon as a sufficient number of cells have been con-

structed, the queen begins to deposit her eggs. In those that have been impregnated the preceding year, the oviducts begin to swell early in the spring, so that by the month of March they are ready to come forth. The queen-bee is, therefore, the earliest breeder of any insect we are acquainted with. But the young queens are capable of laying eggs thirty-six hours after impregnation. It appears to be now well ascertained by the experiments of Huber, that she is aware of the nature of the eggs she is laying, and deposits each in the kind of cell adapted to receive it. She may be seen examining attentively the capacity of the cell before laying her egg. She passes thus from one cell to another, allowing herself hardly any interval of repose. She commonly lays two hundred eggs in a day; but if the weather be warm, and vegetation luxuriant, she will lay a much greater number. The cold of autumn suspends this process. The eggs first produced are those of labourers, and their deposition continues for ten or twelve days, during which interval the working bees are busily employed in constructing the larger cells. The queen next acquires a considerable increase of size, so as to walk with difficulty. She then lays male eggs in the large cells, during a period of from sixteen to twenty-four days. They are less numerous than the former eggs, in the proportion of one to thirty.

Deposition of the eggs.

These industrious insects now set about constructing royal cells; and the queen-bee, having finished her deposition of male eggs, begins again to lay those of the common bees; and finding royal cells open for their reception, deposits a single egg in each, but only at intervals of one or two days; the common cells receiving those laid in the mean time. When the hive is not sufficiently numerous, or the season has been unproductive, no royal cells are formed; and the education of a queen is not attempted.

As soon as the eggs are deposited, the bees eagerly seek for that species of nourishment on which the larva is to be fed. This consists of pollen, with a proportion of honey and of water, which is partly digested in the stomachs of the nursing bees, and which is made to vary in its qualities according to the age of the young. Pollen is afforded by flowers in the spring in such abundance that the bees of a single hive will often carry home above a pound of this substance in one day. The eggs of bees are of a lengthened oval shape, with a slight curvature, and of a bluish white colour. They are hatched without requiring any particular attention on the part of the bees, except that of keeping up a proper temperature; in which case three days are sufficient for the exclusion of the larva. The larva has the appearance of a small white worm without feet, which remains generally coiled up at the bottom of the cell. The nursing bees feed it with great assiduity, with the kind of jelly above described, and in every respect exhibit the greatest attachment for them. Mr Hunter says that a young bee-maggot might easily be brought up by any person who would be attentive to feed it. It may be seen opening its two lateral pincers to receive the food, and then swallowing it. As it grows up it casts its cuticle, like the larvæ of other insects. In the course of five or six days it has attained its full size, and nearly fills the cell in which it is lodged: it now ceases to eat, and the bees close up its cell with a covering of wax, or rather a mixture of wax and propolis, which they possess the art of amalgamating together. During the next thirty-six hours the larva is engaged in spinning its cocoon, and in three days more it is converted into the state of pupa or chrysalis. In this state it is perfectly white, and every part of the future bee may be distinguished through its transparent covering. In the course of a week it tears asunder its investing membrane, makes its way through the outer wall of its prison, and emerges in its perfect form. Reckoning from the time that the egg is laid, it is only on the twentieth day of its existence that this last metamorphosis is completed. No sooner has it thus emancipated itself, than its guardians assemble round it, caress it with their tongues, and supply it plentifully with food. They clean out the cell which it had been occupying, leaving untouched, however, the greater part of the web, which thus serves to bind together still more firmly the sides of the comb. The colour of the bee when it quits the cell is a light gray; it requires two days before it can attain sufficient strength for flying. The metamorphoses of the male bee follow the same progress, but require a few days longer for their completion, occupying about twenty-four days from the time of the egg being laid to the attainment of the perfect state.

Nourishment of the larvæ.

The eggs deposited in the royal cells are precisely similar to those of the working bees, and might be substituted the one for the other. The larva arises from it precisely in the same manner, and does not differ from the larva of the workers. But the attention of the nursing bees is more incessantly bestowed on them; they are supplied with a peculiar kind of food, which appears to be more stimulating than that of ordinary bees. It has not the same mawkish taste, and is evidently acescent. It is furnished to the royal larva in greater quantities than it can consume, so that a portion always remains behind in the cell after its transformation. The growth of the larva, and the development of all its organs, are very much accelerated by this treatment; so that in five days it is prepared to spin its web; and the bees inclose it by building up a wall at the mouth of its cell. The web is completed in twenty-four hours; two days and a half are consumed in a state of inaction, and then the larva transforms itself into a pupa. It remains between four and five days in this state; and thus, on the sixteenth day after the egg has been laid, it has produced the perfect insect. When this change is about to take place, the bees gnaw away part of the wax covering of the cell, till at last it becomes pellucid from its extreme thinness. This must not only facilitate the exit of the fly, but may possibly be useful in permitting the evaporation of the superabundant fluids.

Process of rearing the queen-bee.

But the queen-bee, although perfectly formed, is not always at liberty to come out of her prison; for if the queen-mother be still in the hive, waiting a favourable state of the weather to conduct another swarm, the bees do not suffer the young queens to stir out; they even strengthen the covering of the cell by an additional coating of wax, perforating it with a small hole, through which the prisoner can thrust out its trunk in order to be fed by those who guard it. The royal prisoners continually utter a kind of plaintive song, the modulations of which are said to vary. One consequence of their detention is, that they are capable of flying as soon as they are set at liberty. But the motive of this proceeding on the part of the bees who guard them, is to be found in the implacable hatred which the old queen bears against all those of her own sex, and which impels her to destroy without mercy all the young queens that come within her reach. The working bees are, on this account, very solicitous to prevent her even approaching the royal cells while there is any prospect of a swarm being about to take place. They establish themselves as a guard around these cells, and, forgetting their allegiance on this occasion, actually beat her off as often as she endeavours to come near them. If, on the other hand, the swarming season is over, or circumstances prevent any further swarms from being sent off, the bees do not interpose any obstacle to the fury of the old queen, who immediately begins the work of destruction, transfixing with her sting, one after the other, the whole of the royal brood while they are yet confined

Rivalship of the queens.

Bee.

in their cells. It is observed by Huber, that the royal larvæ construct only imperfect cocoons, open behind, and enveloping only the head, thorax, and first ring of the abdomen; and he conceives that the intention of nature in this apparent imperfection is, that they may be exposed to the mortal sting of the queen, to whom they may be given up as a sacrifice.

When the old queen has taken her departure along with the first swarm, the young queens are liberated in succession, at intervals of a few days, in order to prevent their attacking and destroying one another, which would be the infallible consequence of their meeting. This exterminating warfare is prevented by the vigilance of the bees who guard them, so long as new swarms are expected to take place. When a young queen is liberated, she is, like others of her sex, anxious to get rid of her rivals, and even at that early age seeks to destroy her sisters, who are still confined in the other royal cells; but as often as she approaches them she is bit, pulled, and chased without ceremony by the sentinels. But when the season is too far advanced for swarming, or when the hive is too much exhausted in its population by the swarms that have already been sent off, they no longer interfere in preserving peace, and the first that acquires her liberty proceeds to massacre all her rivals. If two or more queens should happen to issue out at the same moment, they mutually seek each other, and fight till one is killed, and the survivor is immediately received as the sovereign of the hive. The bees, far from seeking to prevent these battles, appear to excite the combatants against each other, surrounding and bringing them back to the charge when they are disposed to recede from each other; but when either of the queens shows a disposition to approach her antagonist, all the bees forming the clusters instantly give way to allow her full liberty for the attack. The first use which the conquering queen makes of her victory is to secure herself against fresh dangers by destroying all her future rivals in the royal cells; while the other bees, who are spectators of the carnage, share in the spoil, greedily devouring any food which may be found at the bottom of the cells, and even sucking the fluid from the abdomen of the pupæ before they toss out the carcasses.

Impregnation.

The impregnation of the queen-bee was formerly involved in the deepest obscurity, and has given rise to a multitude of very fanciful opinions. Some have denied that any intercourse with the male was necessary for the fecundation of the eggs. Swammerdam supposed that the mere effluvia proceeding from the males, where they were collected in clusters, was sufficiently active to produce this effect, by penetrating the body of the female. Huber proved, by a decisive experiment, that no such consequence resulted from these effluvia. Maraldi imagined that the eggs were fecundated by the drones, after being deposited in the cells, in the same way that the spawn of fishes is rendered prolific by the milters. Mr Debraw of Cambridge, in a paper published in the *Philosophical Transactions*, fancied that he had seen the milt-like fluid in the cells. But this appearance has been shown by Huber to be a mere optical illusion, arising from the reflection of light at the bottom of the cell. When the males are excluded from the hive, the queen is as fertile, and the eggs as prolific, as when they are present. Hattorff supposed that the queen is capable of impregnating herself; an opinion which was supported by Schirach and Wilhelmi, and was even favourably received by Bonnet, as it in some measure accorded with his discoveries respecting the aphis, of which our readers will find an account in the article Aphis. (See Entomology, *Index*.) Linnæus was of opinion that an actual union between the sexes took place, and Reaumur fancied that he had seen this happen within the hive. There is, however, great reason to think that he was mistaken. Huber has clearly proved that the queen is never impregnated as long as she remains in the interior of the hive; and, if confined within it, continues barren, though surrounded by males. It is only during her flight, at a considerable height in the air, that the male has complete access to her so as to effect the impregnation. In half an hour the queen-bee returns to the hive with unequivocal proofs of the intercourse that has taken place, for she has in fact robbed the drone of the organs concerned in this operation; and the drone, thus mutilated, is left to perish on the ground. From its being necessary that the queen should fly to a distance in order to be impregnated, Huber infers the necessity of a great number of drones being attached to the hive, that there may be a sufficient chance of her meeting one of them during her aërial excursion.

Bee.

Preparation for swarming.

We are now to direct our attention to the migrations of bees, by which new colonies, similar to that which had originally peopled the parent hive, are founded. The final causes of this phenomenon are sufficiently obvious; but it does not so clearly appear to what circumstances it is immediately owing. The increasing population of a hive probably occasions inconvenience from the want of room, the increase of heat, and the greater vitiation of the air; inconveniences which become still more serious as the summer advances. The spring is accordingly the commencement of the swarming season; no swarm, indeed, will ever take place while the weather is cold, nor until the hive is well stocked with eggs of every kind. The queen-bee, in consequence of the great number of eggs she has been laying, is now reduced to a more slender shape, and is well fitted for flight. Her aversion for the royal brood, which she seems to foresee will in no long time become able to dispute the throne with her, and the vain attempts she makes to destroy them in the cradle, in which she is invariably repelled by the bees who guard them, produce in her a constant restlessness and agitation, which, as Huber represents it, rises to a degree of delirium. This frenzy, from whatever cause it may originate, is communicated to the workers; they may be seen hurrying to and fro in the combs, with evident marks of impatience; the heat of the hive is increased by their tumultuous movements; it sometimes rises suddenly, on these occasions, from 92° to above 104°. A general buzz is heard throughout the hive. This state recurs from time to time, for some days before the swarm is actually on the wing; and the interval is occupied in making preparations for the approaching expedition. Provisions are collected in greater quantity by the working bees. Mr Hunter killed several of those that came away, and found their crops full, while those that remained in the hive had their crops not near so full. Scouts are sent out to look for a proper habitation. Mr Knight, in the *Philosophical Transactions*, gives us a curious account of his observations on their manœuvres in this respect. In the cavity of a hollow tree, which, by the application of a board, had been fitted up for the reception of the swarms, he constantly observed, "that, about fourteen days previous to their arrival, a small number of bees, varying from twenty to fifty, were every day employed in examining, and apparently in keeping possession of, the cavity; for if molested, they showed evident signs of displeasure, though they never employed their stings in defending their proposed habitation. Their examination was not confined to the cavity, but extended to the external parts of the tree above; every dead knot particularly arrested their attention, as if they had been apprehensive of being injured by moisture, which this might admit into the cavity below; and they apparently did not leave any part of the bark near the ca-

Bee.

vity unexamined. A part of the colony which purposed to emigrate appeared in this case to have been delegated to search for a proper habitation; and the individual who succeeded must have apparently had some means of conveying information of his success to others; for it cannot be supposed that fifty bees should each accidentally meet at and fix upon the same cavity, at a mile distant from their hive, which Mr Knight has frequently observed them to do, in a wood where several trees were adapted for their reception; and indeed he observed that they almost uniformly selected that cavity which he himself thought was the best adapted to their use. It not unfrequently happened that swarms of his own bees took possession of these cavities, and such swarms were in several instances followed from his garden to the trees; and they were observed to deviate very little from the direct line between the one point and the other, which seems to indicate that those bees who had formerly acted as purveyors now became guides."

Departure of the swarm.

On the day on which the swarm quits the hive, few of the workers roam to any distance, but several are seen performing circles in the air round the hive. The noise is on a sudden hushed, and all the bees enter the hive; this silence announces their immediate departure. A few workers appear at the door, turn towards the hive, and striking with their wings, give, as it were, the signal for flight. All those who are to accompany the expedition rush towards the door, and issue forth with wonderful rapidity, rising in the air and hovering for some time, as if in order to wait for the assemblage of the whole troop; then, following the motions of the queen, they settle wherever she alights, forming a dense cluster around her. Sometimes, from weakness, or some other cause, she returns back to the hive, and is immediately attended thither by the rest. But if the weather be fine, the expedition is only deferred for one or two days, and they again take their departure. If their return be owing to the loss of their queen, they remain a fortnight or longer before the attempt to migrate is renewed, and then the swarm is much larger than before, which renders it probable that they have waited for the queen that was to go off with the next swarm. Sometimes, when every thing indicates an approaching emigration, the passage of a cloud across the sun will suspend all their operations, and the previous bustle gives place to a state of perfect calm. But, if the day be not far advanced, the breaking out of sunshine will renew the commotion, and determine the moment of actual flight.

Succession of swarms.

The swarm having rested for some time on the first landing-place, and collected the whole of its numbers, soars again in the air, keeping in a close phalanx, and directing its course with great velocity to the spot which their guides had selected; giving out, at the same time, a loud and acute-toned hum by the action of their wings.

The parent hive, thus deserted by its queen and a large proportion of its inhabitants, is busily occupied in repairing its loss. The bees which remain quietly pursue their labours; the young brood, soon arriving at maturity, quickly fill up every deficiency; and young queens, being allowed their liberty, one after the other, conduct in their turns new swarms, in the same manner as the first. The second swarm is not sent off till after the space of from five to ten days after the first. The following swarms succeed quicker to each other, but consist of smaller numbers than the earlier ones. If it happen that two queens are found in a swarm, either the swarm divides itself into two, and have separate destinations, or a single combat between the queens decides on which of them the empire is to devolve. Sometimes, indeed, they appear not to perceive each other, and the parties belonging to each construct separate combs within the same hive; but no sooner do these combs come in contact, and thus give occasion to the queens meeting each other, than the contest begins, and it does not terminate but by the death of one of the rival queens. Successive swarms are sent off as long as the increase of population admits of it, and the number thus produced in a season depends on a variety of circumstances, such as the abundance of flowers, and the warmth of the climate, and the capacity of the hive. Bosc, while he was French consul in Carolina, found a hive in the woods which had been robbed of its wax and honey by the negroes: he contrived to convey the bees in his hat to a hive in his garden; he obtained from this hive eleven swarms before the end of autumn; and these again afforded him the same number of secondary swarms, so that, by the end of the year, he had twenty-two hives stocked from the one he had thus saved from destruction. In this country a hive commonly sends off only two, and sometimes three swarms in the course of the summer.

Bee.

Massacre of the drones.

Very few drones accompany the new colonies, so that almost all those produced in the spring remain in the hive. But when the queens are impregnated, and no new swarms are about to take place, the workers, who had till then suffered them to live unmolested in the hive, are on a sudden seized with a deadly fury towards them, and a scene of carnage ensues. This usually happens in July or August. They chase their unhappy victims in every quarter, till they seek a refuge at the bottom of the hive, where they collect in crowds, and are indiscriminately, and without a single exception, massacred by the working bees, who, with implacable fury, transfix them with their stings, and throw the dead bodies out of the hive. So great is their antipathy to all the race of drones, that they destroy, at the same time, the male eggs and larvæ, and tear open the cocoons of their pupæ, in order to devote them to one common destruction. This sacrifice of the males is not, however, the effect of a blind and indiscriminating instinct; for if a hive be deprived of its queen, the massacre does not take place, while the hottest persecution rages in all the surrounding hives. In this case the males are allowed to survive one winter.

Provision for the winter.

Having thus got rid of the useless mouths, which consumed, without any advantage to the public, a large portion of their provisions, the bees spend the remainder of the summer in collecting stores of honey and of pollen for the ensuing winter. Their gleanings are now less abundant than in the spring, and require more labour in the search and collection. But at this season the leaves of many kinds of trees, which are covered in the morning with a saccharine fluid that transudes through them, furnish them with a species of nourishment, which, though of very inferior quality to the fluid of the nectarea, still contributes to their support. Fruit is also attacked by bees, after the cuticular covering has been broken through by birds or snails. They also find nutriment in the *honey-dew*, which, as already stated, is an excrementitious fluid from the aphis. Often, however, these resources fail, and the hive is threatened with famine. On these occasions the distressed bees frequently betake themselves to plunder. Spies are sent out to examine the neighbouring hives; allured by the smell of honey, they examine the appearance and strength of its possessors; and, selecting the weakest hive as the object of attack, they begin a furious onset, which costs great numbers their lives. If the invaders should fail in their attempt to force the entrance, they retreat, and are not pursued by those whom they have assailed; but if they succeed in making good the assault, the war continues to rage in the interior of the hive, till one party is utterly exterminated; reinforcements are sent for by the invading army, and the bees

Mutual depredations.

from the neighbouring hives often join the assailants and share in the plunder. In a short time the whole of the enemy's magazines are completely emptied. If, on the other hand, the invaders should be defeated, the successful party is by no means safe from the attacks of the bees from other hives, if any of them should chance to have mingled in the fray, and especially if they have once penetrated as far as the magazines, for in that case they are sure to return, accompanied with a large reinforcement, and the unfortunate hive that has once been attacked ultimately falls a sacrifice to these repeated invasions.

The close of autumn puts a period to their labours abroad. They then live on the provisions they have amassed, till the cold of winter reduces them to a torpid state; from which they awake on the return of vernal warmth, and renew the same circle of labours. Sometimes the strong light reflected from the snow during a clear sunshine deceives them with the appearance of warmth, and some bees are tempted to issue forth in order to collect provisions. All who thus venture out perish by the cold in a few minutes.

Duration of life.

Bees seldom die a natural death. They are at all times exposed to a variety of accidents, which thin their numbers; so that the average duration of their lives does not exceed one year. We may conclude that the whole generation is renewed in that space of time, from the results of experiments which have been tried of marking all the individuals of a hive in the spring, when it was found that none were in existence the next season. They are the natural prey of a number of quadrupeds, birds, and insects; many are overtaken by stormy weather, or fly to too great a distance, and never find their way back again to the hive; others are benumbed by cold; and numbers perish in battle with others of their own species, or lose their lives by being unable to withdraw the stings which they have employed against their enemies. The fecundity of the queen-bee is, however, adequate not only to repair these losses, but to multiply the population in a very high progression. It is computed that in France a single queen will lay from 30,000 to 60,000 eggs. This however varies according to the climate; for in Carolina and the West Indies they are known to produce at least three times this number. A single intercourse with the male is sufficient for the fecundation of all the eggs which the queen lays for at least two years, as has been proved by Huber; but its influence probably extends to all the eggs which the queen may lay during the rest of her life. The same queen has been observed to conduct swarms for two successive years; but the natural period of their lives is not known with any certainty. The ancients supposed it to be seven years; but Féburier suspects that, like the males, they are destroyed by the labourers when they have fulfilled their destination; for he was witness to an attack made by six labourers on a queen, whom he rescued with difficulty. Mr Hunter observes, that, judging from analogy, a bee's natural life is limited to a certain number of seasons; for he conceives that no individual insect of any species lives one month longer than the others of the same species. In the bee, one might suppose the period of life to be equal to the time that a hive can last; but this is not a necessary consequence, since they keep up a succession of generations. The comb of the hive may be said to be the furniture and storehouse of the bees, which by use must wear out; but, independently of this, it will in time become unfit for use, by the accumulation of cocoons, together with the excrements of the maggots, which are never removed. The former, indeed, lines the whole cell, top, sides, and bottom; and may be distinguished from the cocoons of former maggots that have been hatched in the same cell, by a portion of dried excrement, which is interposed between them at the bottom of the cell. Mr Hunter counted above twenty different linings in one cell, and found the cell about one quarter or one third filled up. A piece of comb so circumstanced, when boiled for the wax, will keep its form, and the small quantity of wax is squeezed out at different parts, as if squeezed out of a sponge, and runs together in the crevices; while a piece of comb that never has been bred in, even of the same hive, melts almost wholly down. Hence the combs can only last a certain number of years. However, to make them last longer, the bees often add a little to the mouth of the cell, which is seldom done with wax alone, but with some sort of mixture; and they sometimes cover the silk lining of the last chrysalis; but all this, observes Mr Hunter, makes such cells clumsy, in comparison of the original ones.

Fecundity of the queen-bee.

Durability of the combs.

We have thus given an account of the principal facts in the history of bees, as far as they relate to the usual or natural condition of these insects. We shall conclude with the relation of several curious phenomena which they exhibit under particular and unusual circumstances, in which accident, or the designs of the experimenter, may have placed them.

What happens when they lose their queen.

The loss of the queen is an event which has the most marked influence on their conduct. Although the queen is constantly an object of attention and of strong affection to the whole community, they are not immediately sensible of her absence when she is removed from the hive. The ordinary labours are continued without interruption, and it is not till a whole hour has elapsed that symptoms of uneasiness are manifested, and it is even then only partially displayed. The inquietude begins in one part of the hive, the workers become restless, abandon the young which they were feeding, run to and fro, and, by striking each other with their antennæ, communicate the alarming intelligence very quickly to their companions. The ferment soon extends to the whole community; the bees rush precipitately out of the hive, and seek for their lost queen in every direction. This state of confusion continues for two or three, and sometimes for five hours, but never longer. Tranquillity is again re-established; they return to their labours; and selecting one of the larvæ that is not more than three days old, they break down two of the contiguous cells, sacrificing the larvæ contained in them, and proceed to build up one royal cell from their ruins. They then supply the worm with the food necessary to promote its quick growth, and, leaving untouched the rhomboidal bottom, they raise around it a cylindrical inclosure. In three days the larva has grown to such a size as to require an extension of its lodging, and must inhabit a cell nearly of a pyramidal figure, and hanging perpendicularly. A new pyramidal tube is therefore constructed with the wax of the surrounding cells, which is soldered at right angles to the first, and the bees, working downwards, gradually contract its diameter from the base, which is very wide, to the point. In proportion as the worm grows the bees labour in extending the cell, and bring food, which they place before its mouth and round its body, forming a kind of coiled zone around it. The worm, which can move only in a spiral direction, turns incessantly to take its food before its head; it insensibly descends, and at length arrives at the orifice of the cell. It then transforms itself into a pupa, is inclosed with a covering of wax, as before described, and, in the space of ten days, the original loss is thus repaired by the birth of a new queen. Schirach found, that if a number of bees be confined with even a single larva, which, in the natural course would have become a working bee, they immediately set about giving it the royal education above related, and thus raise it to the dignity of queen.

Bee. This discovery, which has since been amply confirmed by recent experiment and observation, was at first chiefly admired for its singularity in a physiological point of view. But it is evidently capable of being very advantageously applied towards the formation of artificial swarms, or new colonies of bees, by which the produce in honey and wax may be proportionally augmented. In the early months of spring, and even during the succeeding months, so late as November, M. Schirach cut off from an old hive a piece of that part of the comb which contained the eggs of the working bees, taking care, however, that it likewise included some worms hatched within the three preceding days. He fixed this in an empty hive, or box, together with a portion of honey-comb, &c.; or, in other words, with a sufficiency of food and building materials, or wax, for the use of the intended colony. He then put into, and confined within the box, a sufficient number of common working bees, taken from the same or any other hive. As soon as the members of this small community found themselves deprived of their liberty, and without a queen, a dreadful uproar ensued, which continued generally, with some short intervals of silence, for the space of about 24 hours; during which time it is to be supposed they were alternately meditating and holding counsel on the future support of the new republic. On the final cessation of this tumult, the general and almost constant result was, that they betook themselves to work, first proceeding to the construction of royal cells, and then taking the proper measures for hatching and feeding such of the brood as were placed within them. Sometimes even on the second day the foundations of one or more royal cells were perceptible. This operation has been hitherto conducted within doors. The new colony may now be safely trusted in the garden, if the weather be warm, and have the liberty allowed them of passing out of the box; of which they instantly avail themselves, and are seen in a short time almost totally to desert their new habitation. In about two hours, however, they begin to re-enter it. We should not neglect to observe, that if they should be placed near the old hive from which they were taken, they will very often attempt to enter it, but are as constantly repulsed by their former companions and brethren. It is prudent, therefore, to place them at a distance from the mother state, in order to avoid the inconveniences of a civil war. The final result of the experiment is, that the colony of working bees thus shut up, with a morsel of common brood, not only hatch it, but are found, at the end of eighteen or twenty days, to have produced from thence one or two queens, which have apparently proceeded from worms of the common sort, pitched upon by them for that purpose; and which, under other circumstances, that is, if they had remained in the old hive, would, in the course of their metamorphosis, have attained only to the condition of working bees. In the present instance, the common worm appears to be converted by them into a queen-bee merely because the hive was in want of one. Hence we may justly infer that the kingdom of the bees is not, if the expression may be used, a *jure divino*, or hereditary monarchy, but an elective kingdom; in which the choice of their future ruler is made by the body of the people.

While the hive remains without a queen, swarming can never take place, however crowded the hive may be. The young queens are suffered to come out of their cells without impediment, and, after a number of deadly combats, the empire remains with the survivor. Huber has made the singular observation, that two queens, however inveterate may be their mutual hostility, never actually both destroy each other; and that when, in the course of their contest, they are placed in such a relative position as that each has it in her power to strike a mortal blow on the other with its sting, they suddenly separate, and fly from each other with every appearance of being panic-struck. The final cause of the instinct that prompts this conduct is sufficiently obvious, as, without it, the hive would be altogether deprived of a queen. Bee.

The bees recognise the individual person of their own queen. If another be palmed upon them, they seize and surround her, so that she is either suffocated or perishes with hunger; for it is very remarkable that the workers are never seen to attack a queen-bee with their stings. If, however, more than eighteen hours have elapsed before the stranger queen be introduced, she has some chance of escape. The bees do, indeed, at first seize and confine her, but less rigidly; and they soon begin to disperse, and at length leave her to reign over a hive, in which she was at first treated as a prisoner. If twenty-four hours have elapsed, the stranger will be well received from the first, and at once admitted to the sovereignty of the hive. If a supernumerary queen be introduced into the hive, she is laid hold of by the bees, and presented to the reigning queen, while a ring is formed by the bees, who continue to be spectators, and even promoters of the combat, in which one or other of the queens is destined to perish. Schirach and Reims had imagined that, in these circumstances, the stranger met her death from the hands of the working bees; but this mistake has been rectified by Huber, who gives the account above stated.

Retarded fecundation. If the impregnation of the queen be delayed beyond the twenty-first day of her life, she begins soon after to lay the eggs of drones, and produces no other kind of eggs during the remainder of her life. This very curious and unexpected fact was discovered by Huber, and has been satisfactorily established by his very numerous and varied experiments, although its explanation is perhaps attended with insuperable difficulties. The body of a queen whose impregnation has thus been retarded is shorter than common, and the extremities remain slender, while the first two rings of the abdomen, or those next the thorax, are uncommonly swollen. On dissecting the double ovary, both branches were found to be equally expanded and equally sound, but the eggs were apparently not placed so closely together as in common queens. It was not correctly ascertained whether the queens whose impregnation was retarded laid a number of drone eggs corresponding to the whole number of eggs, both of workers and drones, which they ought to have deposited; but it is certain that they laid a greater number of drone eggs than they ought naturally to have done. On these occasions the instinct of the queen-bee appears to suffer, for she then lays her eggs indiscriminately in large and in small cells, those laid in large cells producing large drones, those in small cells small drones; and she has been known to lay the eggs of drones even in royal cells, some of which are always constructed when the queen begins to lay male eggs. It is curious that the workers were, on these last occasions, deceived, and treated the embryo drones as if they had been truly of the royal brood.

Prolific working bees. One of the most remarkable facts concerning the generation of bees, is the existence occasionally of prolific workers, the discovery of which we owe to Reims. Although it was doubted by Bonnet, its reality has been fully confirmed by the researches of Huber; and it explains what was before unaccountable, the production of eggs in hives absolutely destitute of a queen. It is also remarkable, that the eggs thus produced are always those of drones. The origin of these supplementary queens is accounted for from their having passed the vermicular state in cells contiguous to the royal ones, and from their having, at an early period, devoured some portion of the

stimulating jelly which was destined for the nourishment of the royal brood; and from their ovaria thus receiving a partial development, which renders them susceptible of being impregnated. It is curious that these imperfect queens are still objects of jealousy and animosity to the queen-bee. How they become impregnated has not been ascertained; but the fact of their being productive was a strong confirmation of the truth of Schirach's theory concerning the sexes of bees. Needham, to whom the fact was known, had eluded the force of the argument by pretending that these bees did not belong to the working class, but were real queens of an unusually small size. The supposed absence of ovaria in the working bee was still, indeed, a difficulty which tended to throw some degree of doubt on the correctness of Schirach's doctrine. No person, as Bonnet repeatedly alleges, could suppose that these organs, however minute they might be, had escaped the penetration of Swammerdam, who was unrivalled in his anatomical skill in all that related to insects, and who had bestowed great labour in the examination of the structure of the bee. What had eluded his scalpel and microscope was reserved for the still finer hand and more dexterous dissection of a lady. Miss Jurine, the daughter of the celebrated naturalist of Geneva, has discovered, by adopting a particular method of preparing the object to be viewed, the rudiments of ovaria in the common working bee; she examined a great number, and never failed to find them. Cuvier, in his *Leçons d'Anatomie Comparée*, mentions a suspicion that he had seen some very small oviducts in the working bees, a suspicion which we now find to be completely verified.

Effects of mutilations.

We have next to relate the results of experiments of a more cruel kind, but which illustrate several points in the physiology of these insects. The amputation of the four wings of the queen did not interfere with her laying of the eggs, and the workers did not show her the less attention on account of her being thus mutilated. Of course, if the operation be performed before she is impregnated, she remains barren, since it is necessary for the sexual congress that she should fly out of the hive. The amputation of a single antenna appeared to be productive of no bad consequence of any kind; but the removal of both the antennæ was followed by singular effects. The queen who had suffered this operation ran about in apparent disorder, dropping her eggs at random, and was incapable of directing her trunk with precision to the food that was offered her. At times she appeared desirous of escaping from the hive, and when this was prevented, she returned in a state of delirium, was indifferent to the caresses of the workers, and received another similarly mutilated queen, that was presented to her, without the least symptom of dislike. The workers, on the other hand, received the stranger queen with great respect, although the first still remained in the hive. A third queen, not mutilated, was next introduced; she was very ill received, and immediately detained and kept close prisoner. When the queen, deprived of her antennæ, was allowed to quit the hive, she was followed by none of the workers, and was abandoned to her fate.

Variations in their mode of building.

Bees naturally build from above downwards, but may, by a particular artifice, devised by Huber, be induced to reverse this process. For this purpose a glass hive, with slender laths fixed at the bottom of it, must be provided, and the bees confined in it. They are unable to fasten themselves to the smooth surfaces, and, therefore, establish the foundations of the combs on the wood, and are forced to proceed in a direction opposite to the usual one; in this way Huber was enabled to observe their proceedings. But the readiest mode of inducing them to build in any particular direction is to supply them with portions of ready-made combs, which should be fixed with wires in the proper position; and they will always continue to complete them upon the model presented to them. The hive which Huber recommends is constructed on this principle, consisting of upright frames of a square form, fitted to each other, and of such a size as just to contain each of them a single comb; by separating these, every part of the hive can be laid open and examined with the utmost ease. Féburier has improved upon this construction by changing the shape of the frames from a square to a trapezium, having an acute angle at the summit; a form which allows the moisture that collects at the top to run down the sides more easily than it would do from a flat roof. In this way, any portion of the honey or wax may be removed at pleasure, without hurting or incommoding any one of the bees; and artificial swarms may, at the proper season, be readily procured, by dividing the hive into two portions, and adapting empty frames to each portion.

Enemies of bees.

The wasp and the hornet have long been known as the determined enemies of the bee, committing great ravages among these weaker insects: they attack them individually, but oftener commit their aggressions in large armies, on which occasions numbers perish on both sides. In some parts of America, wasps have multiplied to so great a degree, as to render it impossible to rear bees. Among quadrupeds, the ant-eater occasionally devours them. The bear and the badger overturn the hives, and plunder their contents. Rats and mice are very formidable enemies, as they invade them at all seasons, and especially during their torpid state, when they are incapable of revenging the aggression. The woodpecker may succeed in breaking through the hive, and then speedily destroys all its inhabitants; the swallow, the sparrow, the titmouse, the cuckoo, and the *Merops apiaster*, or bee-eater, and poultry of every kind, prey upon them separately. According to Bosc, they are also food for the shrikes, and for the *Falco apivorus*. Lizards watch for them, and seize them as they alight near the hive. Toads occasionally devour them. They are in some danger from the larger kinds of spiders, and of *Libellulæ*, as also from the *Philanthus apivorus* of Fabricius. But the most insidious and destructive enemy of these insects is the moth; various species of which, particularly the *Phalena mellolcna*, insinuate themselves into the hive, and deposit their eggs unperceived between the cells in such numbers, that the hive is soon overrun with the larvæ, where they are hatched, and the bees are forced to abandon the hive. A new enemy of the same tribe has been lately discovered by Huber, in the *Sphinx atropos*, well known by the name of death's head. Towards the end of autumn, when the bees have filled their magazines, a loud hum is sometimes heard near their habitation, and a multitude of bees come out during the night, and fly about in the utmost confusion. The tumult continues for several hours, and the next morning a number of dead bees are strewed before the hive. On examining the hive, it is found to have been robbed of all its honey, and the bees do not return to it.[1] These effects result from the incursions of the sphinx, which watches its opportunity to introduce itself into the hive during the night, when the bees are depriv-

[1] There appears to be some exaggeration or misconception in this statement of the Genevese observer. The death's head moth is one of the largest of the lepidopterous insects of Europe, and could not possibly effect an entrance into any hive constructed with ordinary care. Nor is it probable that it could consume more than a very small portion of honey, even if it were to obtain admission.

Bee. ed of the advantages of vision, which the sphinx enjoys in greater perfection at this period. By rendering the door-way extremely narrow, so as only to admit a single bee at a time, this accident may be prevented; and it is curious that the bees themselves frequently anticipate this danger, and provide against it by employing, of their own accord, the very same mode of defence. They construct a thick wall, which barricades the entrance, and resembles a regular fortification, with bastions, casemates, and massive gateways. They often, indeed, have recourse to a similar contrivance for protection against the pillaging bees, enabling them to repel the assault with greater effect. At other times, when the danger is less pressing, the inconveniences of so narrow a gateway being strongly felt, they enlarge it by removing the fortification they had built, and do not again construct it unless the appearance of the enemy in the ensuing season should inspire them with fresh alarms. If, on the other hand, the precaution of narrowing the gateway should already have been taken by the cultivator, the bees, feeling themselves secure, spare themselves the unnecessary labour of erecting these walls. This single trait in their history is a sufficient refutation of those theories which ascribe all their actions to the operation of a blind indiscriminating instinct, and would exclude every species of foresight and reflection. (P. M. R.)

In the article APIARY of this work we have already described the leaf and book hives of M. Huber, with the proposed improvements of several other apiarians. The chief objection to some of these is the expense and difficulty of their construction, and the greater degree of attention which they exact on the part of the cultivator. Those made of straw are generally preferred, as being less liable to be overheated by the rays of the sun: they are likewise of easy purchase, from their cheapness; and in winter they exclude the cold better than hives made of other materials. The following is Mr Wildman's account of the structure and general management of his hives:—"My hives are seven inches in height and ten in width. The sides are upright, so that the top and bottom are of the same diameter. A hive holds nearly a peck. In the upper row of straw there is a hoop of about half an inch in breadth, to which are nailed five bars of deal, full a quarter of an inch in thickness and an inch and quarter wide, and half an inch asunder from one another; a narrow short bar is nailed at each side, half an inch distant from the bars next them, in order to fill up the remaining parts of the circle; so that there are in all seven bars of deal, to which the bees fix their combs. The space of half an inch between the bars allows a sufficient and easy passage for the bees from one comb to another. In order to give great steadiness to the combs, so that, upon moving the hive, the combs may not fall off, or incline out of their direction, a stick should be run through the middle of the hive, in a direction directly across the bars, or at right angles with them. When the hives are made, a piece of wood should be worked into the lower row of straw, long enough to allow a door for the bees, of four inches in length, and half an inch in height.

"The proprietor of the bees should provide himself with several flat covers of straw, worked of the same thickness as the hives, and a foot in diameter, that so it may be of the same width as the outside of the hives. Before the cover is applied to the hive, a piece of clean paper, of the size of the top of the hive, should be laid over it; and a coat of cow-dung, which is the least apt to crack of any cement easily to be obtained, should be laid all round the circumference of the hive. Let the cover be laid upon this, and made fast to the hive with a packing-needle and pack-thread, so that neither cold nor vermin may enter.

"Each hive should stand single on a piece of deal or other wood, somewhat larger than the bottom of the hive. That part of the stand which is at the mouth of the hive should project some inches for the bees to rest on when they return from the field. This stand should be supported upon a single post, two and a half feet high, to which it should be screwed very securely, that high winds or other accidents may not blow down both stand and hive. A quantity of soot mixed with barley chaff should be strewed on the ground round the post, which will effectually prevent ants, slugs, and other vermin, from rising up to the hive. The soot and chaff should from time to time be renewed as it is blown or washed away, though, as it is sheltered by the stand, it remains a considerable time, especially if care be taken that no weeds rise through it. Weeds, indeed, should not be permitted to rise near the hive, for they may give shelter to vermin which may be hurtful to the bees. Bee.

"The stands for bees should be four yards asunder, or, if the apiary will not admit of so much, as far asunder as may be, that the bees of one hive may not interfere with those of another hive, as is sometimes the case when the hives are near one another, or on the same stand; for the bees, mistaking their own hives, light sometimes at the wrong door, and a fray ensues, in which one or more may lose their lives."

He further directs, that whoever intends to construct an apiary should purchase a proper number of hives at the latter part of the year, when they are cheapest. These should be full of combs, and well stored with bees. The purchaser should also examine the combs, with a view to ascertain the age of the hives. The combs of the season are white; those of the former year are of a darkish yellow; and where the combs are black, the hive should be rejected, because when old they are more subject to the attacks of vermin and other accidents. If the requisite number of hives have not been purchased in the autumn, it will be necessary to remedy this neglect as soon as the severity of the cold has passed in spring. At this season, according to Mr Wildman, bees which are in good condition will go into the fields early in the morning, return well laden, enter boldly, and will seldom leave their home in bad weather. They are alert on the least disturbance; and we may judge of their strength by the loudness of their humming. The summer is not an advisable season for purchasing bees, because the heat of the weather softens the wax, and renders the combs liable to break and give way, if they are not well secured in the interior. The honey, too, being thinner than at other times, is more apt to run from the cells, which not only occasions a loss of the material, but daubs, and possibly destroys, the bees.

Mr Wildman's feats in the handling of these irritable and pugnacious creatures have been the frequent subject of surprise. As it is often of consequence to be able to regulate the settling of a swarm, we shall here subjoin his method in his own words. "Long experience has taught me, that as soon as I turn up a hive, and give it some taps on the sides and bottom, the queen immediately appears to know the cause of this alarm, but soon retires again among her people. Being accustomed to see her so often, I readily perceive her at first glance; and long practice has enabled me to seize her instantly with a tenderness that does not in the least endanger her person. This is of the utmost importance, for the least injury done to her brings immediate destruction to the hive, if you have not a spare queen to put in her place, as I have too often experienced in my first attempts. When possessed of her, I can without injury to her, or exciting that degree of resentment that may tempt her to sting me, slip her into my other

Bee. hand, and, returning the hive to its place, hold her there, till the bees, missing her, are all on wing, and in the utmost confusion. When the bees are thus distressed, I place the queen wherever I would have the bees to settle. The moment a few of them discover her, they give notice to those near them, and those to the rest, the knowledge of which soon becomes so general, that in a few minutes they all collect themselves round her, and are so happy in having recovered this sole support of their state, that they will long remain quiet in their situation. Nay, the scent of her body is so attractive of them, that the slightest touch of her along any place or substance will attach the bees to it, and induce them to pursue any path she takes." This was the only witchcraft used by Mr Wildman, and is that alone which is practised by others who have since made similar exhibitions.

In the management of bees a great deal must of course depend on supplying them with an abundant pasture. A rich corn country is well known to be to them as a barren desert during a great portion of the year. Hence the judicious practice of shifting them from place to place according to the circumstances of the season. It was the advice of Celsus, that after the vernal pastures were consumed, bees should be transported to places abounding with autumnal flowers; and it was in accordance with such advice that they were annually carried in ancient times from Achaia to Attica, and from Eubœa and the islands of the Cyclades to Scyrus. In Sicily, also, they were brought to Hybla from other parts of the island. So also in our own country the people of the lowlands, as soon as the "bright consummate flowers" of summer are on the wane, dispatch their hives in cart loads to the blooming heather of the mountain pastures, where a never-ending wilderness of sweets is spread before them. It is indeed to be regretted that our moorlands, in this respect, are so much more neglected than they ought to be. The very air of the highland hills is often redolent with the rich perfume, while here and there a solitary bee is seen or heard labouring with wearied wing among the inexhaustible stores of nature, and scarcely able to regain its lonely shieling in the distant vale. When we consider the poverty of our mountaineers, and their frequent want of occupation, it is the more to be lamented that so easy a source of emolument should lie open to them in vain. It has been calculated that the pastures of Scotland could maintain as many bees as would produce 4,000,000 pints of honey and 1,000,000 pounds of wax; and were these quantities tripled for England and Ireland, the produce of the British empire would be 12,000,000 pints of honey, and 3,000,000 pounds of wax per annum. If we allow five shillings per pint for the honey and one shilling and sixpence per pound for the wax, we have an annual produce in money of L.3,225,000. But, in consequence of the present neglect of this branch of rural economy, we pay every year a large sum to foreign nations for articles which we could raise ourselves, with scarcely any outlay either of capital or time.

We learn from Pliny that the practice of removing bees from place to place was frequent in the Roman territories. "As soon," says he, "as the spring food for bees has failed in the valleys near our towns, the hives of bees are put into boats, and carried up against the stream of the river in the night, in search of better pasture. The bees go out in the morning in quest of provisions, and return regularly to their hives in the boats, with the stores they have collected. This method is continued till the sinking of the boats to a certain depth in the water shows that the hives are sufficiently full; and they are then carried back to their former homes, where their honey is taken out of them." And this is still the practice of the Italians who live near the banks of the Po, the river which Pliny instanced particularly in the passage above quoted. Bee.

M. Maillet relates, in his description of Egypt, that, in "spite of the ignorance and rusticity which have got possession of that country, there yet remain in it several footsteps of the industry and skill of the ancient Egyptians. One of their most admirable contrivances is, their sending their bees annually into distant countries, in order to procure them sustenance there, at a time when they could not find any at home; and their afterwards bringing them back, like shepherds who should travel with their flock, and make them feed as they go. It was observed by the ancient inhabitants of Lower Egypt, that all plants blossomed, and the fruits of the earth ripened, above six weeks earlier in Upper Egypt than with them. They applied this remark to their bees; and the means then made use of by them to enable these usefully industrious insects to reap advantage from the more forward state of nature there, were exactly the same as are now practised for the like purpose in that country. About the end of October, all such inhabitants of Lower Egypt as have hives of bees, embark them on the Nile, and convey them up that river quite into Upper Egypt; observing to time it so that they arrive there just when the inundation is withdrawn, the lands have been sown, and the flowers begin to bud. The hives thus sent are marked and numbered by their respective owners, and placed pyramidically in boats prepared for the purpose. After they have remained some days at their farthest station, and are supposed to have gathered all the wax and honey they could find in the fields within two or three leagues around, their conductors convey them in the same boats two or three leagues lower down, and there leave the laborious insects as long time as is necessary for them to collect all the riches of this spot. Thus the nearer they come to the place of their more permanent abode, they find the productions of the earth, and the plants which afford them food, forward in proportion. In fine, about the beginning of February, after having travelled through the whole length of Egypt, gathering all the rich produce of the delightful banks of the Nile, they arrive at the mouth of that river, towards the ocean, from whence they set out, and from whence they are now returned to their several homes; for care is taken to keep an exact register of every district from whence the hives were sent in the beginning of the season, of their numbers, of the names of the persons who sent them, and likewise of the mark or number of the boat in which they were placed."

In many parts of France floating bee-houses are very common. They have on board one barge three score or a hundred bee-hives, well defended from the inclemency of an accidental storm. With these the owners suffer themselves to float gently down the river, the bees continually choosing their flowery pasture along the banks of the stream; and thus a single floating bee-house yields the proprietor a considerable income.

They have also a method of transporting their bees by land, well worth our imitation in many parts of this kingdom. Their first care is to examine those hives, some of whose honeycombs might be broken or separated by the jolting of the vehicle; they are then made fast one to the other, and against the sides of the hive, by means of small sticks, which may be disposed differently as occasion points out. This being done, every hive is set upon a packing-cloth, or something like it, the threads of which are very wide; the sides of this cloth are then turned up and laid on the outside of each hive, in which state they are tied together with a piece of small packthread wound several times round the hive. As many hives as a cart built for the purpose will hold are after-

Bee || Beech Oil.

wards placed in the vehicle. The hives are set two and two, the whole length of the cart. Over these are placed others, which make as it were a second story or bed of hives. Care is taken in this stowage not to let one hive stop up another, it being essentially necessary for the bees to have air; and it is for this reason they are wrapped up in a coarse cloth, the threads of which have been wove very wide, in order that the air may have a free passage, and lessen the heat which these insects raise in their hives, especially when they move about very tumultuously, as often happens in these carts. Those used for this purpose in Yevre hold from thirty to forty-eight hives. As soon as all are thus stowed, the caravan sets out. If the season is sultry, they travel only in the night; but a proper advantage is taken of cool days. These caravans do not travel fast. The horses must not be permitted even to trot: they are led slowly, and along the smoothest roads. When there are not combs in the hives sufficient to support the bees during their journey, the owner takes the earliest opportunity of resting them wherever they can collect the materials for wax. The hives are taken out of the cart, then set upon the ground, and after removing the cloth from over them, the bees go forth in search of food. The first field they come to serves them as an inn. In the evening, as soon as they are all returned, the hives are shut up; and being placed again in the cart, they proceed on their journey. When the caravan has arrived at the journey's end, the hives are distributed in the gardens, or in the fields adjacent to the houses of different peasants, who, for a very small reward, undertake to look after them. Thus it is that, in such spots as do not abound in flowers at all seasons, means are found to supply the bees with food during the whole year.

These instances of the great advantages which attend the shifting of bees in search of pasture afford an excellent lesson to many places in this kingdom: they direct particularly the inhabitants of the rich vales, where the harvest for bees ends early, to remove their stocks to places which abound in heath; this plant continuing in bloom during a considerable part of autumn, and yielding great abundance of food to bees. Persons in the neighbourhood of hills and mountains will save the bees a great deal of labour, by also taking the advantage of shifting their places of abode.

The degree of cold which bees can endure has not been ascertained, though it is no doubt considerable. They survive the winter in many cold parts of Russia, in hollow trees, without any attention being paid to them; and their hives are frequently made of the bark of trees, which does not afford a very complete protection from the effects of frost. Many hives which are thought to die of cold in winter die in reality of famine, when a rainy summer and cold autumn have prevented their laying in a sufficient store of provisions. The hives should therefore be carefully examined in the after-part of the season, and the amount of food ascertained. Mr White judiciously observes, that bees which stand on the north side of a building whose height intercepts the sun's beams all the winter will waste less of their provisions than others which stand in the sun; for, coming forth seldom, they eat little, and yet are as forward in the spring to work and swarm as those which had twice as much honey left with them the preceding autumn. The owner ought, however, to examine their condition in the course of the winter, and if he finds that, instead of being clustered between the combs, numbers have fallen to the bottom of the hive, it should immediately be shifted to a warmer place.

Bee || Beechey.

In regard to the destruction of bees, it has been observed that no true lover of these industrious insects ever lighted the fatal match without concern. A simple method of obtaining possession of a portion of their store is the following: Uncover the hole in the upper centre of a flat-topped straw hive or box, and place a glass vessel over it in such a way that no bee can get either in or out except by the ordinary opening of the lower hive. The glass hive must be covered with an empty hive or with a cloth, that too much light may not prevent the bees from working. As soon as they have filled the straw hive or box, they will begin to work up into the glass hive. Mr Thorley junior informs us, that he himself has had one of these glass hives filled by the bees in thirty days in a fine season; and that it contained 38 pounds of fine honey. When the glass is completely filled, slide a tin plate between it and the hive or box, so as to cover the passage, and in half an hour the glass may be taken off with safety. What few bees remain in it will readily go to their companions. He has added a glass window to his straw hives, in order to see what progress bees make; which is of some importance, especially if one hive is to be taken away whilst the season still continues favourable for their collecting honey; for when the combs are filled with honey, the cells are sealed up, and the bees forsake them and reside mostly in the hive in which their works are chiefly carried on. Observing also that the bees were apt to extend their combs through the passage of communication in the upper hive, whether glass or other, which rendered it necessary to divide the comb when the upper hive was taken away, he now puts in that passage a wire screen or netting, the meshes of which are large enough for a loaded bee to go easily through them. This prevents the joining of the combs from one box to the other, and consequently obviates the necessity of cutting them, and of spilling some of the honey, which, running down among a crowd of bees, used before to incommode them much, it being difficult for them to disencumber their wings.

Chloroform has been employed with success in uniting swarms and artificial swarming, as well as for the purpose of extracting the honey from the hive. A quarter of an ounce of chloroform, in a saucer covered with a perforated card or with wire-gauze, is to be placed on the board of the hive, and all apertures to be carefully closed. In about half a minute the bees will be completely under its influence; and on the admission of air, after a lapse of fifteen or twenty minutes they will revive and soon recover the use of their wings.

We shall conclude by observing, that the honey-bee (*apis mellifica*) is supposed to be of Asiatic origin. They were imported from Europe to America, where they are now found wild in great numbers, and at a vast distance from human habitations. An excellent treatise on the "Honey Bee," its natural history, physiology, and management, was published in 1827 by Dr Edward Bevan. It contains some of the best practical remarks on this subject with which we are acquainted; and gives a fair account of the labours of his predecessors, Reaumur, Hunter, Huber, Keys, Vicat, and Dunbar, with a few remarks of the more noted authors who have treated of bees. (J. W.)

BEE-EATER (*Merops*). See ORNITHOLOGY, *Index*.

BEECH, see PLANTING; TIMBER; STRENGTH OF MATERIALS; and *Index*.

BEECH-MAST, the fruit or nuts of the beech-tree, used for fattening hogs, deer, and other animals. It has sometimes proved a useful substitute for bread, as experienced at Chios during a memorable siege.

BEECH OIL, an oil expressed from the mast of the beech-tree. It is in common use in Picardy, and in other parts of France, instead of butter; but it is said to be unwholesome.

BEECHEY, SIR WILLIAM, R.A., an eminent portrait-painter, born at Burford in December 1753, was originally bred as a conveyancer; but a strong love for painting induced him to become a pupil at the Royal Academy in 1772. He soon became noted for the spirit of his attitudes and the clearness of his colouring. His finest production is a review

of cavalry, a large composition in the foreground of which he introduced portraits of George III., the Prince of Wales, and the Duke of York, surrounded with a brilliant staff on horseback. It was painted in 1793, and obtained for the artist the honour of knighthood, and the rank of R.A. The earlier portraits of Beechey were carefully drawn and well finished, but in his later days the extent of his employment rendered him less careful in his design. But a series of his cartoon sketches in the Royal Institution of Liverpool shows that his skill in drawing was very considerable. He died in January 1839, at the advanced age of eighty-six. (T. S. T.)

BEEDER, in Southern India, a town of Hyderabad, or the dominions of the Nizam, is situate on an elevated tableland 2359 feet above the level of the sea. This place is fortified with a stone wall about six miles in circumference, a dry ditch, and many round towers. The town is much decayed, but the remains of many old buildings are still visible. Before the Mahometan invasion it was the seat of a Hindu sovereignty; but upon the revolt of the Deccan in 1347 against the supremacy of Delhi, Beeder was selected as the seat of government of the newly-founded Mahometan kingdom of Bahmani. Towards the close of the following century, upon the dismemberment of the territories of which it had formed the capital, Beeder, with an adjacent district, rose to the dignity of a separate state, and though of inconsiderable dimensions contrived to maintain its independence until the commencement of the seventeenth century, when it merged into the neighbouring kingdom of Ahmednuggur. In 1636 Shah Jehan, Emperor of Delhi, invaded the Deccan, and subjected Ahmednuggur to tribute; but in the anarchy and confusion which prevailed during the decay of the Mogul empire, the town and territory composing the former principality of Beeder fell to the Nizam, and were by him incorporated with the present dominions of Hyderabad. Distant N.W. from Hyderabad 75 miles. Lat. 17. 53. Long. 77. 36. (E. T.)

BEEF, the flesh of an ox, bull, or cow. According to Dr Cullen, beef, though of a more firm texture and less soluble than mutton, is equally alkalescent, perspirable, and nutritious.

BEEF-EATER (from the French *beauffetier*), a yeoman of the royal guard. See APPELLATION.

BEEF-EATER, *Buphaga*. See ORNITHOLOGY.

BEELE, a kind of pick-axe used by miners.

BEELZEBUL, (Βεελζεβουλ, *dominus stercoris, i.e.* metaphorically *Lord of idolatry*), the name given by the Jews to the prince of the demons. It is incorrectly written *Beelzebub* in the New Testament. See BAALZEBUB, and PHILISTINES.

BEEMAH, a river of Hindustan which rises in the mountains to the north of Poonah, and flowing S.E., passes within thirty miles of that city. It is one of the principal tributaries of the Krishna, which it joins near the town of Kadloor in the dominions of the Nizam. The Hindus regard it as a sacred river. The length of its course is about 510 miles.

BEER, a town of Asiatic Turkey. See BIR.

BEER. See BREWING.

BEERALSTON, a borough-town in the county of Devon, hundred of Roborough, and parish of Beerferris, near the confluence of the Tavy with the Tamar, 215 miles from London. It formerly returned two members to parliament, who were chosen by the holders of ancient burgages; and as there were few houses, the elections of members were held under a large tree. Near it are four lead mines, which occasionally yield a small quantity of silver. Pop. of parish in 1851, 3401.

BEER REGIS, a market-town of Dorset, 112 miles from London. Near it is a hill which was formerly a Roman encampment, where a great fair is annually held on 18th September and five following days. The church is a handsome edifice. Pop. in 1851, 1242.

BEERSHEBA, or BERSABE, a place in the southernmost part of Canaan, celebrated for the sojourn of the patriarchs. This name, signifying the *well of the oath*, was bestowed in allusion to the covenant there made between Abraham and Abimelech. It is mentioned by Eusebius and Jerome, in the fourth century, as a large village. The well of Abraham, or rather two wells, lie 27 miles S.E. from Gaza, and still afford an abundant supply of pure water.

BEES, ST, a parish of England, county of Cumberland, on the sea-coast, comprising the town of Whitehaven and the village of St Bees. Pop. (1851) 23,486. St Bees is a place of great antiquity. The parish church, a cruciform building with a massive tower, was once a part of the monastery of St Bega, founded about A.D. 650. The chancel is occupied by the theological college, established in 1817 by Bishop Law. The grammar-school, founded in the sixteenth century by Archbishop Grindall, has several exhibitions and fellowships both at Oxford and Cambridge. Pop. of township (1851) 971.

BEESTINGS, or BIESTINGS (German, *biestmilch*), the first milk taken from a cow after calving. It seems to be intended by nature to cleanse the young animal from the recrements gathered in its intestines during uterogestation. The first milk of women possesses a similar quality; and hence the natural inference that a mother should suckle her own child, rather than commit it to a nurse whose first milk is gone.

BEET or BETA, a well-known genus of plants. The common beet, *Beta vulgaris*, a variety of the red beet, has long been cultivated as a food for cattle, and is also used for the table as a pickle. It was introduced for this purpose in the latter part of the last century from Germany, where it is known by the name of *mangel-wurzel*. See AGRICULTURE. The variety termed *white beet* is smaller than the former, and has chiefly been cultivated on a large scale for the formation of sugar from its root. The chemical elements of beet-root sugar are expressed *atomically* thus:—C_{12}, H_9, O_9 + 2 HO, or twelve atoms of carbon, nine of hydrogen, nine of oxygen, and two of water. The largest extract of pure sugar from beet-root in Belgium was formerly three per cent., but is now six per cent., and is capable of further increase by improvement in the process of manufacture. The cultivation of beet-root was especially fostered in France by Napoleon, whose policy it was to encourage everything that tended to render the Continent independent of Britain, then in possession of the chief sugar colonies. It is only within a comparatively recent period, however, that the manufacture of beet-root sugar in Europe has assumed any degree of importance, the total quantity produced in 1828 not exceeding 7000 tons, while in 1851 it was estimated at not less than 180,000 tons. We subjoin a few statistics relative to the increasing importance of this manufacture from *The Economist* (Nos. 431 and 432, Nov. 29th, and Dec. 26th 1851). The quantity of beet-root sugar annually produced in France is 60,000 tons, or fully one-half of the entire consumption. Though now subject to a higher duty than colonial cane sugar, it is considered probable that very shortly it will exclude foreign sugar from the French market altogether. The production of beet-root sugar in Belgium also is rapidly on the increase, the quantity produced in 1850 being 7000 tons, or half the entire consumption of that kingdom. This had increased in 1851 to 10,000 tons, while of foreign cane sugar only 4000 tons were imported. In Germany it has made similar progress. In 1848 the quantity produced was 26,000 tons, which had risen in 1851 to 43,000, with a corresponding decrease in the imports of foreign sugar. Of 85,000 tons of sugar estimated to have been consumed in Russia, 35,000 tons were beet-root sugar. In Austria also the production of this article increased from 8000 tons in 1848, to 15,000 tons in 1851, while the consumption of cane sugar had sunk from 32,000 to 25,000 tons. This subject, in all its bearings, will be found fully discussed under the head SUGAR.

Beethoven.

BEETHOVEN, LUDWIG VAN, one of the greatest pianists and musical composers of modern times, was born on the 17th December 1770, at Bonn, on the Rhine. Beethoven's father, Theodore van Beethoven, a native of Maestricht, was a tenor in the Elector of Cologne's chapel, and had four sons and one daughter. The subject of this article was the second son. His musical genius showed itself very early. When five years old he began the study of music under Vander Eden, the court organist. In 1782 he was placed under C. G. Neefe, the successor of Eden, who set his pupil to study the works of J. S. Bach and Handel. Beethoven's early powers of execution and of improvisation on the piano astonished every hearer. In 1793 he began his serious studies of composition under Albrechtsberger at Vienna. His exercises in harmony and counterpoint written under that master were published at Paris in 1833, in 2 vols. small folio, with protrait, &c.; and are very curious as exhibiting the perpetual conflict between Beethoven's imagination and his perseverance in the hard and dry studies prescribed to him. He began these too late in life to be able to render their forms quite subject to his will when he employed them in his compositions. Some of his instruction in vocal composition was derived from the celebrated Italian composer Salieri.

It appears that during a great part of his life he suffered from deafness, which had become almost total in his twenty-eighth year. In his will, dated 1802, his expressions of wretchedness under this infliction are very strong. He says that his deafness occasioned him such anguish of mind that he was often tempted to commit suicide, but that his art restrained him. There is something very affecting in all this, which reminds one of Milton's frequent and touching allusions to the miseries of blindness.

Beethoven tells us that his unhappy deafness, occasioned by the ignorance and mismanagement of a surgeon, was the cause of his withdrawing himself from society, and leading a solitary and miserable life. He speaks in terms of the deepest grief of the many privations to which the loss of his hearing subjected him;—his incapacity of enjoying audible music, and his inability to maintain social intercourse by means of speech. The feeling of his irreparable loss seems to have haunted him perpetually like some hideous phantom. Doubtless he often felt most deeply what Dante has so well expressed in the bitterness of his recollections:—

> ———"Nessun maggior dolore
> Che ricordarsi del tempo felice
> Nella miseria."

The spirited sketch given by Mr Russell,[1] from his own observation, of Beethoven's appearance, and manners, and musical performance, is quite consistent with what the writer of this article has heard from other persons. Mr Russell tells us (*Tour in Germany*, vol. i. p. 277), "though not an old man, he (Beethoven) is lost to society, in consequence of his extreme deafness, which has rendered him almost unsocial. The neglect of his person which he exhibits gives him a somewhat wild appearance. His features are strong and prominent; his eye is full of rude energy; his hair, which neither comb nor scissors seem to have visited for years, overshadows his broad brow in a quantity and confusion to which only the snakes round a Gorgon's head offer a parallel. His general behaviour does not ill accord with this unpromising exterior. Except when he is among his chosen friends, kindliness or affability are not his characteristics. The total loss of hearing has deprived him of all the pleasure which society can give, and perhaps soured his temper."

"He has always a small paper book with him, and what conversation takes place is carried on in writing. In this too although it is not lined, he instantly jots down any musical idea which strikes him." Mr Russell heard him play, and says that, from his deafness, "when playing very *piano*, he often does not bring out a single note, yet he hears it himself in the 'mind's ear.' While his eye and the almost imperceptible motion of his fingers show that he is following out the strain in his own soul through all its dying gradations, the instrument itself is actually as dumb as the musician is deaf."[2]

Beethoven died at Vienna on the 26th March 1827, in the fifty-seventh year of his age. His funeral took place on the 29th, and was attended by a great number of poets, literary men, and musicians, who attended as mourners, besides a vast concourse of the people of Vienna. His body was interred in the churchyard of Friedhofe, a village about two English miles from Vienna, a favourite resort of his, where he is said to have passed many solitary hours in meditation and composition. The churchyard rises gradually from the road, and Beethoven's grave is situated about half-way up, close to the wall, on the left-hand side. Against the wall was placed a marble slab, of which a print has been published, having merely the word "Beethoven" in carved gilt letters, but surmounted by the image of a lyre and a head crowned with rays, and at the top a butterfly with expanded wings, the symbol of resurrection and immortality. Twenty years afterwards a statue of this illustrious composer was erected in Bonn, his native place.

With regard to Beethoven's abilities as a pianoforte player, the opinion of Mr J. B. Cramer, one of the greatest masters of that instrument, may be sufficient. Mr Cramer described him as "by no means a *finished* or very *delicate* player, but a giant in respect of command of ideas and energy of style." "His extemporaneous playing," Mr Cramer adds, "is the most magnificent I ever heard." Signor Dragonetti concurred in this opinion.

As a composer Beethoven stands in the foremost rank. He possessed a powerful, inventive, and original mind. In respect of regularity of design, purity of harmonic combination, and skilful management of all his materials, he is, generally speaking, inferior to Haydn and Mozart. But still, all his best compositions are pervaded by an enthusiastic spirit of inspiration, a wild and masculine energy, relieved by frequent touches of tender beauty and melancholy, which stamp the superior genius of the man, and may, perhaps, be said to render his music analogous in character to the poetry of Dante. His earlier works and those of the second period of his artistic development are his best. His deafness may in a great measure account for the dry, crude, and unmelodious style of many of his later works. In vocal composition he was not in general greatly successful. Still, in his "Fidelio" there are fine things; and his *scena ed aria*, "Ah perfido! spergiuoro!" and his canzonet, "Adelaide," are truly exquisite. The latter is modelled upon Haydn's fine canzonet, "O tuneful voice!"

In 1840 A. Schindler published in Germany a life of Beethoven, containing much silly gossip and some misstatements. A true life of the great musician has yet to be written. (G. F. G.)

BEETLE, a term applied to most insects belonging to the order *Coleoptera*. See ENTOMOLOGY.

BEETLE also denotes a wooden instrument for driving piles, &c.: likewise called a *stamper*, and by pavers a *rammer*.

BEEVES (old plural of *beef*), a general name for oxen.

BEFORT, or BELFORT, a second-class fortified town of France, in the department of Upper Rhine, and capital of an arrondissement of the same name, is situated on the Savoureuse, 38 miles S.S.W. of Colmar. It contains a handsome church, a college, and a public library of 20,000 volumes; and has several iron foundries and iron-wire factories. Pop. (1851) 5274. The arrondissement of the same name

[1] Russell's *Tour in Germany*, &c. in 1820-21-22. 2 vols. 8vo. Edinb. 1824.

[2] *Ibid.* vol. i. pp. 277, 278, 299.

Bega || Behaban.

contains 9 cantons, and 192 communes. Pop. (1851) 132,591.

BEGA, CORNELIUS, a painter of landscapes, cattle, and conversazioni, was born at Haerlem in 1620, and studied painting under Adrian Ostade. Falling into a dissipated way of life, he was disinherited by his father, for which reason he changed his paternal name, which was Begeyn, and took that of Bega; hence his early pictures are marked with the former name, his subsequent works with the latter. Bega, at the age of forty-four, died of the plague, having taken the infection from his mistress, whom he attended with unceasing devotion till the last hour of her life.

BEGARELLI, ANTONIO, an eminent modeller in clay, was a native of Modena. He was born A.D. 1498, and died in 1565. Begarelli is praised by Vasari for the fine air of his heads, his beautiful drapery, exquisite proportions, and his imitations of marble. It is said that Michael Angelo on seeing the works of this artist exclaimed, "If this clay were to become marble, alas for the ancient statues!" His works at Modena and elsewhere are very numerous. (Lanzi, *Stor. Pitt.* iv. 29.)

BEGGAR. See POOR-LAWS.

BEGLERBEG, or BEGLIERBEY, (*i.e. Lord of lords,*) in the Turkish dominions is the title of a high officer, the governor of a province, and next in dignity to the grand vizier. He has under him several beys, agas, &c., and his province is called a beglerbeglik.

BEGUARDS, or BEGHARDS, religionists of the third order of St Francis in Flanders. They were established at Antwerp in the year 1228, and took St Begghe for their patroness, from whom they derived their name. On their first institution they employed themselves in making linen cloth, each supporting himself by his own labour, and were united only by the bonds of charity, without having any particular rule. But when Pope Nicholas IV. had confirmed that of the third order of St Francis in 1289, they embraced it the year following, and were greatly favoured by the dukes of Brabant, particularly John II. and John III., who exempted them from all contributions and taxes. In the year 1425 they began to live in common, and in 1467 made solemn vows, after having taken the habit of the Terciaries of Liège, religionists of the third order of St Francis; and in 1472 they became subject to the general of the congregation of Zepperen in the diocese of Liège, to which they were united by Pope Sixtus IV. But Innocent X. having, in 1650, suppressed the general of the congregation of Zepperen, all the convents of the third order of St Francis, in the dioceses of Liège, Malines, and Antwerp, were submitted to the visitation, jurisdiction, and correction of the general of Italy, and erected into a province under the title of "the province of Flanders." (See Mosheim, *De Beghardis et Beguinabus Commentatio*, Leipz. 1790.)

BEGUINES, a congregation of female religionists or nuns, founded either by St Begghe or by Lambert le Begue, who died about the end of the twelfth century. They were originally established at Liège, and afterwards at Neville. From this last settlement sprang the great number of Beguines, which spread over all Flanders, and thence passed into Germany, where some of these religionists fell into extravagant errors; persuading themselves that it was possible, in the present life, to arrive at impeccability and a clear view of God. The council of Vienna condemned these errors, and abolished the order of Beguines, permitting such of them, however, as continued in the true faith to live in chastity, either with or without vows; under cover of which permission the decree of the council was evaded, and communities of Beguines spread throughout all Flanders.

BEHABAN, a town of Persia, and capital of a mountainous district. It is pleasantly situated in the middle of a valley which is of considerable extent, highly cultivated, and watered by the rivers Zab and Jerahi. The walls are about three miles in circumference. It is said to contain about 10,000 inhabitants, and is the seat of a governor, whose palace is at the north-west corner of the town. It is 153 miles from Shiraz, from which it is separated by a mountainous country, entirely uninhabited, and infested by banditti.

Beheading || Behemoth.

BEHEADING, a capital punishment in which the head is severed from the body by the stroke of an axe, a sword, or some other instrument.

Beheading, called *decollatio*, was a military punishment among the Romans. The head of the culprit was laid on a *cippus* or block placed in a pit dug for the purpose beyond the *vallum*, and near the *porta decumana;* and preparatory to the stroke, he was tied to a stake and whipped with cords. In the early ages the blow was given with an axe, but in after times with a sword, which was thought the more reputable manner of execution. In England decapitation is a punishment reserved for the nobility, as was formerly the case in France, being reputed less derogatory to their rank than hanging, which is the punishment inflicted on ordinary criminals.

In Scotland, beheading was anciently performed by an edged instrument called the *maiden*, consisting of a vertical frame with a sharp and heavily loaded axe or knife-edged iron, which in descending chopped off the head. It was introduced into this country by the Regent Morton, who, as in several similar instances, was himself the first that suffered by it. This instrument has been preserved, and may still be seen in the museum of the Society of Scottish Antiquaries. The *guillotine*, so called from the name of its inventor M. Guillotin, a physician, who is also said to have lost his head by his own contrivance, is an instrument somewhat analogous to the *maiden*, with this exception, that the edge of the knife descends obliquely, and thus the head is severed more instantaneously. In France, beheading is an ordinary capital punishment for great crimes, and the guillotine, notwithstanding all the revolutionary horrors associated with it, is still the instrument by which decollation is performed.

BEHEM, MARTIN, a celebrated geographer and navigator, born at Nurnberg about 1436. He entered into the service of Portugal in 1479, and in 1484 sailed in the fleet of the great captain Diego Cam, which was sent to explore the western coast of Africa. In 1485 he returned to Lisbon, where, on account of his scientific services and charts, the honour of knighthood was bestowed on him by the king, with splendid ceremony. He married the daughter of Job Huester, at Fayal, in 1486. For several years after he was employed in the construction of maps and charts at Lisbon, where he is said to have met Columbus. In the year in which that celebrated navigator sailed to discover the New World, Behem visited his native city, where he resided a year, and constructed a terrestrial globe, some fortunate conjectures in which have been made the foundation of an erroneous theory as to his share in transatlantic discovery, He afterwards resided chiefly at Fayal; but died at Lisbon in 1506, leaving no monuments of his science except this globe, and various maps and charts. The utter silence of the Portuguese government as to his supposed share in the discoveries of Columbus, is sufficient evidence that Behem had no claim to that honour. (T. S. T.)

BEHEMOTH (בהמות, Job xl. 15; in Coptic, according to Jablonski, *Pehemont*) is regarded as the plural of behemah, בהמה, but commentators are by no means agreed as to its true meaning. A number of learned men, with Bochart and Calmet at their head, understand the word in the singular number as a specific name denoting the hippopotamus, seeking to prove, by somewhat forced interpretations of the beautiful poetical allusions in Job xl. 15–24, the exactness of the description when compared with the species, which, however, in some respects is more applicable to the

Behmen ‖ Behring's Strait.

elephant, while in others it is equally so to both animals. Hence the term behemoth, taken intensely (for in some places it is admitted to designate cattle in general), may be assumed to be a poetical personification of the great Pachydermata, or even Herbivora, wherein the idea of hippopotamus is predominant. This view accounts for the ascription to it of characters not truly applicable to one species.

BEHMEN, JACOB. See BOEHM.

BEHN, APHRA, an authoress of some celebrity, born of a good family in the city of Canterbury in the reign of Charles I. Her father, whose name was Johnson, having received the appointment of lieutenant-general of Surinam, proceeded to the West Indies, taking with him his whole family. Mr Johnson died on the voyage; but his family reached Surinam, and resided there for some years. Here Aphra learned the history, and acquired a personal knowledge, of the American prince Oroonoco and his beloved Imoinda, whose adventures she has related in her novel of that name, and which Southerne afterwards made use of in one of his tragedies.

On her return to London she became the wife of Mr Behn, a merchant of Dutch extraction residing in that city. The wit and abilities of Mrs Behn having brought her into high estimation at court, Charles II. employed her to transact some affairs of importance abroad during the Dutch war. For this purpose she went to Antwerp, where by her intrigues and gallantries she so far penetrated into the secrets of state as to accomplish the objects of her mission; and in the latter end of 1666, by means of the influence she had gained over one Vander Albert, she wormed out of him the design formed by De Ruyter, in conjunction with the family of the De Wits, of sailing up the Thames and burning the English ships in their harbours. This she communicated to the English court; but although the event proved her intelligence to have been well founded, it was at the time disregarded;—which circumstance, together with the disinclination shown to reward her for her services, determined the lady to drop all further thoughts of political affairs; and during the remainder of her stay at Antwerp she gave herself up entirely to the gaiety and gallantries of the place. In her voyage home to England she narrowly escaped death, the vessel in which she sailed having foundered, but fortunately within reach of aid.

From this period she devoted her life entirely to pleasure and the muses. Her works are numerous, and all of them are of a lively and amatory character. In her dramatic pieces the plots are full of action and ingenuity, and the dialogue sparkles with wit; but, in common with the licentious taste of the time, they are interlarded with the most indecent scenes and expressions. This singular woman died on the 16th of April 1689, and was interred in the cloisters of Westminster Abbey.

BEHRING'S ISLAND, the most westerly of the Aleutian group, in the North Pacific. Lat. 55. 22. N. Long. 166. E. It is rocky, desolate, and uninhabited, and is only remarkable as being the place where the navigator Behring was wrecked, and died in 1741.

BEHRING'S STRAIT, the narrow sea between the N.E. part of Asia and the N.W. part of North America, connecting the North Pacific with the Arctic Ocean. At the narrowest part, East Cape in Asia approaches within about 36 miles of Cape Prince of Wales on the American shore. The former is in N. Lat. 66. 6. W. Long. 169. 38.; and the latter in N. Lat. 65. 46. W. Long. 168. 15. North and south of these points, the coasts on either side rapidly diverge. They are steep and rocky, and considerably indented. The Asiatic coast, extending from Cape Serdtzy to Cape Tchoukotzky, a distance of about 400 miles, presents several large and commodious bays. The strait is in general from 23 to 30 fathoms in depth, and contains a few small islands. Haze and fogs greatly prevail, and the temperature is low. This strait derives its name from Vitus Behring, a German in the Russian service, who sailed from Kamtschatka and discovered it in the year 1728. It was subsequently explored and described with great accuracy by Captain Cook, in 1788. An account of this strait, in connection with the discovery of the North-west Passage by Captain M'Clure, will be found under the head POLAR SEAS.

Beilan ‖ Bejapour.

BEILAN, a town and pass of Syria, on the east of Iskanderoon, nine miles from the coast of the Mediterranean. The pass, between mounts Rhosus and Amanus, is supposed to be the *Amanides Pylæ* of Strabo. The town is picturesquely situated near the top of the pass. Pop. about 5000.

BEINASCHI, GIOVANNI BATTISTA, an eminent historical painter, born in Piedmont in 1634. He studied at Rome under Pietro del Po; and some authors affirm that he was afterwards a disciple of Lanfranc. He was a good designer; and in acknowledgment of his merit, the honour of knighthood was conferred upon him. He died in 1688.

BEIT EL FAKIH (*i.e. house of the saint*), an unwalled town situated in Arabia Yemen, on a barren sandy plain, protected against the predatory incursions of the Arabs by a castle, in which the governor resides. It carries on an extensive trade in coffee, which grows on the hills 16 miles distant, and is carried to Mocha, the shipping port, and thence exported to Egypt, the East Indies, and to Europe. The trade of Beit el Fakih is carried on solely by the caravans; and the coffee is either sold for specie or for such goods as are required for the use of the inhabitants, who number about 8000. It is 24 miles E.S.E. of Loheia, and 60 leagues N. by E. from Mocha. Long. 43. 23. E. Lat. 14. 32. N.

BEITH, a town and parish of Scotland, in the county of Ayr, and partly also in Renfrewshire. The town is in Ayrshire, on the Renfrew and Ayr Railway, and nine miles S.W. of Paisley. It carries on to a considerable extent the manufacture of bleached and coloured thread, and has several cotton manufactories. Pop. of the town in 1851, 2016.

BEJA, a city of the province of Alentejo, in Portugal, 36 miles south of Evora. It is surrounded with walls, is the see of a bishop, and contains about 5500 inhabitants, who are for the most part occupied in cultivation, and especially in breeding cattle.

BEJAPOUR, in Southern India, the ancient capital of an independent sovereignty of the same name, and once an extensive, splendid, and opulent city, but now retaining only the vestiges of its former grandeur. It is situate in a fertile plain, and is a place of great extent, consisting of three distinct localities—the citadel, the fort, and the remains of the city. The citadel, a mile in circuit, is a place of great strength, well built, of the most massy materials, and encompassed by a ditch 100 yards wide, formerly well supplied with water, but now nearly filled up with rubbish, so that its original depth cannot be discovered. It was built in 1489, by Eusof Adil Shah, the founder of the dynasty of Bejapour. The fort consists of a rampart flanked by numerous towers, a ditch, and covered way. Its defences, which are not less than six miles in circumference, were completed by Ali Adil Shah in 1566. The interior formerly contained the king's palace, the houses of the nobility, large magazines, and extensive gardens. At present, though considerable portions of the area are covered with buildings or ruins, there is room for corn-fields and extensive inclosures. Outside the fort are the remains of a vast city, now for the most part in ruins, but the innumerable tombs, mosques, caravanseras, and other edifices which have resisted the havoc of time, afford abundant evidence of the ancient splendour of the place. It is asserted by the natives that Bejapour contained, according to authentic records, 1600 mosques and nearly 1,000,000 houses. The number of houses is certainly overrated; that of the mosques, in the opinion of recent travellers, is no exaggeration. The outer wall of the city on the western side runs nearly south

and north, and is of great extent. It is built of stone, is of prodigious thickness, and about twenty feet in height, with a ditch and rampart; and at intervals of 100 yards are capacious towers, built of large hewn stones. The whole is now in a ruinous condition; the wall and the towers having in many places fallen into the ditch, and in other parts being covered with rubbish. Several mosques and mausoleums, adorned with all the embellishments of Eastern architecture, are still to be seen in Bejapour. The fort in the interior is adorned with many of these edifices, in rather better preservation than the works. Amongst these is the great mosque, which is 97 yards long by 55 broad. The wings, which are 15 yards broad, project 73 yards from the north and south ends, inclosing on three sides, with the body of the mosque, a large reservoir of water and a fountain. The mausoleum of Sultan Mahmood Shah is a plain building, 153 feet square, over which is reared a dome 117 feet in diameter at its greatest concavity, and called by the natives the grand cupola. The mosque and mausoleum of Ibrahim Adil Shah, king of Bejapour—which was probably completed about the year 1620—is said to have cost L.700,000, and to have occupied thirty-six years in its completion. It is built on a basement 130 yards in length by 52 in breadth, and raised 15 feet. On it is a plain building, 115 feet by 76, covered by an immense dome raised on arches. The mausoleum is a room 57 feet square, inclosed by two verandahs 13 feet in breadth and 22 feet in height. There are, besides, many other public buildings more or less injured by time and the violence of the Mahrattas. Almost all the buildings, the palaces in the fort excepted, are of massive stone, and in the most durable style; and at the same time the workmanship is minutely elegant. Among the curiosities of the capital is the celebrated monster gun, stated to be the largest piece of cast brass ordnance in the world. It was captured from the king of Ahmednuggur by the king of Bejapour about the middle of the seventeenth century. An inscription on the gun recording the fact was erased by Aurungzebe, who substituted the present inscription, stating that he conquered Bejapour in 1685. The city is well watered, having, besides numerous wells, several rivulets running through it.

After the dissolution of the great Bahmani dynasty of the Deccan in 1489, a race of independent sovereigns arose, who ruled over the new kingdom of Bejapour, extending from the confluence of the Beema and the Krishna on the east to the sea-coast, on the west from Goa to Bombay. Their rule endured through several generations, until at length, in 1650, Shah Jehan compelled them to become tributary to the empire; and shortly after, their monarchy was totally subverted by his successor Aurungzebe. The city and territory of Bejapour remained annexed to Delhi till 1724, when the Nizam established his independence in the Deccan, and included Bejapour within his dominions. His sway over this portion of his acquisitions was, however, of brief duration, for, being defeated by the Peishwa in 1760, he was constrained to purchase peace by its cession to the Mahrattas. Upon the fall of the Peishwa in 1818, Bejapour passed into the hands of the British, and was by them included in the territory assigned to the rajah of Sattara.

The place, as already intimated, is rich in monuments of the bygone period when Bejapour was the capital of a powerful and flourishing Mahometan kingdom. Such traces of the past it is always desirable to preserve to the greatest possible extent, as they furnish the best commentary upon the history of the times in which they were raised, and indeed constitute their history, so far as manners are concerned. It is fortunate that their value was duly appreciated by the late rajah of Sattara, who took great pains to preserve them; and that the British government, participating in the same feeling, has, since the country passed into its possession, manifested great zeal in rescuing from the ravages of time the magnificent relics which have come into their possession.

Bejapour is distant from Sattara S.E. 130 miles; from Bombay S.E. 245. Lat 16. 50. Long 75. 48. (D. B–N.) (E. T.)

BEKES, a town of Hungary, capital of a county of the same name, situated at the confluence of the White and Black Koros, 14 miles N.N.W. of Gyula. The inhabitants, principally Calvinists, amount to about 17,000, and are chiefly engaged in agriculture and the rearing of cattle. Long. 20. 41. 37. E. Lat. 46. 46. 16. N.

BEKKER, Balthazar, a distinguished Dutch divine, born in Friesland in 1634, was the author of a work entitled *Die Betooverde Wereld*, or *The World Bewitched*, in which he exposed with irresistible force of reason the errors, absurdities, and impostures which had been propagated respecting spiritual agency; and which occasioned his deposition from the office of the ministry. He died in 1698. For an account of this remarkable man, who so far outstripped the age, see Apparitions. (Vol. III. p. 313.)

BEL, or Belius, *Matthias*, an Hungarian divine and historiographer to the Emperor Charles VI. His *History of Hungary* was so greatly admired that the emperor gave him letters of nobility; and notwithstanding his being a Lutheran, the pope, in 1736, sent him his picture and several gold medals. He was a member of the Royal Society of London, and of the academies of Berlin and Petersburg. He died in 1749, aged sixty-five.

Bel, or *Belus*, the supreme god of the ancient Chaldæans or Babylonians. He was the reputed founder of the Babylonian empire, and is supposed to be the Nimrod of Scripture, as well as identical with the Phœnician Baal. The term signifies Lord, and was applied by those nations to the sun. A temple was erected to Belus in the city of Babylon, on the uppermost range of the famous tower of Babel, in which there were many statues of the god, including one of massive gold forty feet in height. This temple, with its riches, was in existence till the time of Xerxes; but the Persian monarch, on his return from his unfortunate expedition into Greece, demolished it, and carried off the immense wealth which it contained. It was the statue of this god which Nebuchadnezzar set up and dedicated in the plain of Dura, on his return from the Jewish war.

Bel and the Dragon, an apocryphal book of Scripture. This book has always been rejected by the Jewish church: it is not extant either in the Hebrew or in the Chaldaic language, nor is there any proof that it ever was; hence St Jerome calls it the Fable of Bel and the Dragon.

BELAY, in *Seamanship*, to fasten by winding a rope round a kevel, cleat, or belaying-pin.

BELBEIS, or Belbeys, a town of Egypt, on the eastern arm of the Nile. It was formerly considered the bulwark of the kingdom on that side, and was defended by strong fortifications; but these were suffered to fall into decay till 1798, when Buonaparte ordered them to be put in repair. The present population is not supposed to exceed 5000. Belbeis is 28 miles N.N.E. of Cairo.

BELEMNITE (from *βέλεμνον*, a *dart*), vulgarly called *thunder-stone*, a marine fossil, common in the chalk and lime formations. The fossil shells of this genus are of a long conical shape, the interior cone being divided into partitions connected by a siphon (as in the Nautilus), and surrounded by numerous concentric layers composed of fibres radiating from the axis. This genus, of which there are many species, belongs to the order Cephalopoda. See Mollusca.

BELENYES, a town of Hungary, in the province of Farther Theiss, on the Körös, thirty miles S.S.E. of Grosswardein. It is the chief place of a small circle of the same name, and contains two Greek churches, one Roman Catholic, and one Calvinistic. Pop. 3250. Long. 22. 13. 25. E. Lat. 46. 40. 11. N

Belerium ‖ Belfast.

BELERIUM, in *Ancient Geography*, a promontory of the Dumnonii or Damnonii, the West Britons; now called the *Land's End.* (Diodorus Siculus, v. 21.)

BELESIS, a Chaldean priest at Babylon, who, according to Ctesias, conspired against Sardanapalus, and, in conjunction with Arbaces the Mede, overthrew the Assyrian empire, B.C. 876. He afterwards obtained from Arbaces the satrapy of Babylon. (Diodorus, ii.)

BELFAST, a maritime town, a municipal and parliamentary borough, the capital of Ulster, the chief manufacturing and commercial town in Ireland, and since 1850 the county town of Antrim. It is mainly comprised in the county of Antrim; but the large suburb of Ballymacarret, separated from the town by the river Lagan, is in the county of Down. Belfast is situated in Lat. 54. 36. 8·5. N., and Long. 5. 55. 53·7. W., at the mouth of the river Lagan, which flows immediately into Belfast Lough (Carrickfergus Bay), an estuary about 12 miles in length, and 5 miles broad. The town is built upon an alluvial deposit and land reclaimed from the sea, the greater portion being not more than six feet above high-water mark. In common with all places so situate, it is exposed to occasional inundations, and somewhat to the visitations of epidemics; but independently of the lowness of its site, Belfast is in other respects advantageously placed, and generally by no means unhealthful. The environs of the town are highly agreeable and picturesque.

The etymology of the name is uncertain, and its origin so obscure, that Belfast contains not one single memorial of past times deserving the notice of an antiquary. For a lengthened period the town consisted of a few houses, a church, and the castle, which latter edifice, used as a residence by the Chichester family, remained as a solitary relic of semi-barbarous times until the year 1708, when it was carelessly destroyed by fire, three daughters of the Earl of Donegal perishing in the flames.

The original charter constituting Belfast a corporation, consisting of a sovereign, twelve burgesses, and commonalty, with the privilege of sending two members to the Irish parliament, was granted in the tenth year of James I., although it was at that time a very inconsiderable place. This charter was renewed by James II. The municipal government of the borough was altered after the passing of the Act of Union, by the addition of police and life commissioners to the former corporation; and under this arrangement the borough was governed until the passing of the Municipal Reform Act in 1841, when the present corporation, consisting of a mayor, ten aldermen, and thirty town councillors, was instituted. At the Union, and until the passing of the Reform Act, Belfast returned one member to the imperial parliament; but that act granted two members to the borough, the constituency under the 13th and 14th Vict. cap. 69, numbering in 1853, 3282.

In the early part of the seventeenth century, and in connection with the project of James I. for the plantation of Ulster, many Scotch and English settled in the town and neighbourhood, and at that era commence the first signs of the future progress of Belfast. The great influence exerted by this infusion of new blood into the district is attested at the present time by the persistency of the lowland Scotch dialect and accent, the prevalence of the Presbyterian religion, and the physical characteristics of the people, no less than by their commercial activity, industry, and enterprise. For some time, however, the growth of the town was comparatively slow, and Milton, in his reply to the *Representation of the Presbytery of Belfast*, in 1649, describes it as a "small town in Ulster," and "a barbarous nook in Ireland." At the commencement of the eighteenth century, it had become known as a place of considerable trade, and what was then considered a handsome, thriving, and well-peopled town, with many new houses and good shops. Partly from good fortune, and more, perhaps, on account of the prudence of its inhabitants, Belfast suffered less during the civil commotions which so long afflicted the country than most towns in Ireland; its history is therefore fortunately barren of those exciting scenes so plentiful in the records of other important towns. Belford.

With regard to population, Belfast has been steadily progressive from an early period. In 1758 the number of inhabitants was 8549; in 1782, 13,105; in 1798, 18,320; in 1821, 45,177; in 1831, 48,224; in 1841, 75,308; and in 1851, 100,300. The custom duties collected at the port in 1784 amounted to L.104,376, and, after various fluctuations, reached L.288,756 in 1834, L.339,989 in 1843, and L.377,329 in 1852. The great increase of shipping frequenting the port appears in the following account of the number and tonnage of vessels entered inwards at various periods:—

Years.	No. of Vessels.	Tonnage.	Years.	No. of Vessels.	Tonnage.
1786	772	34,287	1825	2,060	183,441
1795	801	52,576	1835	2,730	290,769
1805	840	69,585	1845	3,655	445,537
1815	1,134	91,371	1851	5,016	650,938

The chief export trade is carried on by the cross-channel navigation; but a considerable direct trade also exists with the United States and Canada, the West Indies, the Mediterranean, and the Baltic.

Belfast is the centre of the Irish linen manufacture, to the cultivation of which it is mainly indebted for its prosperity. In 1841 about 240,000 spindles were employed, and the increase during the last ten years has been so rapid, that about 510,000 spindles are now in operation. The total value of all products of the linen manufacture exported abroad in the ten months ended 5th November 1852 was L.4,357,874, against L.4,150,157 in 1851; and the export of linens and yarns, especially of the latter, continues on the increase. In 1851, 5,060,160 lb. of linen yarns were exported from Belfast; and in 1852, 6,779,680 lb.

Externally, Belfast is pre-eminent among manufacturing towns for its cleanliness, elegance, and agreeable environs; the main streets are wide, and regularly built, chiefly of brick; and although inferior to Dublin in its public buildings, it possesses many of no mean architectural pretensions, and presents an appearance of bustling activity not to be found elsewhere in Ireland.

The river Lagan is crossed by three bridges of modern construction, the chief of which is the Queen's Bridge, erected on the site of the "Long Bridge of Belfast," and opened for traffic in 1844. There are 11 places of worship belonging to the Established Church, 21 Presbyterian, 8 Methodist, 3 Unitarian, and 4 Roman Catholic chapels, besides those belonging to other denominations. The chief educational establishments are the Belfast academy, the Royal Academical Institution, the new Queen's College, built of brick, in the Tudor style of architecture, and opened in 1849, the government school of design, &c.; and, proportionately to its extent, no town in the kingdom is better supplied with educational appliances than Belfast. The public buildings most worthy of notice are the white and brown linen halls, the corn exchange, the commercial buildings, the Museum, the Northern Joint-Stock and Belfast Banks, the theatre, the town-hall, the range of buildings containing the offices for the customs, inland revenue, and post-office departments, and the county lunatic asylum, about a mile distant from the town. The botanic garden, adjoining the Queen's College, is extensive, well kept, and beautiful.

The harbour of Belfast, originally a creek of the river Lagan, has been much improved of late years, and now allows vessels drawing eighteen feet of water to reach the quays at spring-tides. (H. S—R.)

BELFORD, a market-town of England, in the county of Northumberland, and northern division of Bamborough

Belfort || Belgium.

ward, 14 miles S.S.E. of Berwick. It is pleasantly situated on a gradual slope, about two miles from the sea, and on the Berwick and Newcastle railway. Pop. (1851) 1226.

BELFORT. See BEFORT.

BELFRY, BELFREDUS, is used by military writers of the middle ages to denote a tower erected by besiegers to overlook the place besieged. Sentinels were placed on the belfry to watch the avenues and prevent surprise, or to give notice of fires by ringing a bell. The word belfry is compounded of the Teutonic *bell*, and *freid*, "peace." Belfry also denotes that part of a steeple in which the bells are hung; sometimes called by old writers *campanile*, *clocaria*, and *tristegum*.

Belgica Gallia || Belgium.

BELGICA GALLIA, one of the three divisions of Gaul mentioned by Cæsar, and bounded by the ocean on the north, and east by the Rhine, on the west by the ocean, and on the south by the Seine and the Marne. The *Belgæ* are described by Cæsar as the bravest of the Gauls, because untainted by the importation of foreign luxuries. The collective forces of the whole nation exceeded a million.

BELGINUM, a town of the Treviri, in Gallia Belgica; now called *Baldenau*.

BELGIUM,

As a united state, did not exist in the middle ages. The country of which that kingdom has been formed was divided into a number of fiefs, independent of and frequently at war with each other. Amongst these fiefs may be mentioned the duchies of Brabant, Limbourg, and Luxembourg; the counties of Flanders, Hainault, and Namur; the bishopric of Liège; the lordship of Malines; and the principality of Stavelot. The Belgians took part in all the expeditions of those chivalrous times, and were seen fighting in the plains of the East. But in spite of the frequent wars in which they engaged, they enriched themselves by commerce and industry. Philip the Good, Duke of Burgundy, united them under his vast power, the bishopric of Liège and the principality of Stavelot alone maintaining a separate existence for more than four centuries. Under the Burgundian dominion, the Belgians became more and more prosperous; the brilliancy of their fêtes attracted numbers of cavaliers from all parts; whilst industry and commerce grew and prospered.

But the proper history of this country does not commence till the period when it came into possession of the house of Austria, by the marriage of the Archduke Maximilian, son of the Emperor Frederick III., in 1477, with Mary of Burgundy, only daughter and heiress of Charles the Bold.

Maximilian, when his son Philip had attained his twentieth year, resigned to him the government of the states; and at his death the inheritance of the Low Countries devolved upon the Archduke Charles of Austria, afterwards Charles V. The religious movement which then agitated Europe convulsed this country, which suffered fearfully under the cruel persecutions and oppression of Charles and his more bigoted son Philip II. The attempt to establish the inquisition at length roused the people to resistance, under the leadership of Count Brederode, a descendant of the ancient counts Holland. The insurgents presented to Margaret, Duchess of Parma, to whom Philip had intrusted the administration of Belgium, a demand for a redress of their grievances and the restoration of their rights. To this document they gave the name of the *compromise*, which was signed by above five hundred of the nobles and principal men in the state. On the rejection of this, they drove back the inquisitors to Spain, and religious liberty was proclaimed. This drew down upon them the wrath of Philip, who sent the Duke of Alva, at the head of the Spanish troops, to reduce them to subjection. He devastated the country, erected scaffolds in every city, and perpetrated the most cruel atrocities upon the inhabitants. At length the confederates formed an alliance with the Prince of Orange. For many years the conflict was carried on between the states of the Netherlands, under the house of Nassau, and the house of Austria, with varying success.

The death of Charles II. of Spain in 1700 gave rise to a general war, which extended to almost every part of the world. The dying king bequeathed his dominions to the Duke of Anjou, the grandson of Louis XIV., whose ambition had roused the jealousy of the other European states. This gave rise to the Grand Alliance. The Netherlands formed a part of the territory contended for, and again became the theatre of bloody battles and protracted sieges. The peace of Utrecht, concluded in April 1713, terminated the hostilities. By this treaty the ten provinces of Belgium, which now assumed the name of the Austrian Netherlands, were assigned to the emperor of Germany.

For a considerable time after this, in consequence of the weakness of the successors of Philip II., Belgium was in such a state of exhaustion, that Holland, to guard itself, occupied the greater part of her fortresses. The emperor had to treat with the states-general, and to accord to the Dutch advantages over the Belgians which excited the murmurs and threats of the inhabitants both against the emperor and the states-general; and it was only by extreme severity and the greatest precautions that a general revolt was prevented. But the prosperity which accompanied the subsequent peace reconciled the Belgian people to the Austrian rule.

The tranquillity of the Netherlands was interrupted by the war which broke out in 1743; but the treaty of Aix-la-Chapelle in 1748 re-established Maria Theresa in her Belgian possessions. Her good sense and good feelings preserved her from overstepping the bounds of the ancient laws; and her government, which was mild and prudent, remained popular with the people. She died in 1780, and was succeeded by her son Joseph II.

Joseph was inaugurated with the ancient formalities, and commenced his reign under favourable auspices. Anxious to promote the prosperity of the country, he resolved to deliver it from the yoke of Holland, to open up the navigation of the Scheldt, and, by the introduction of liberal commercial regulations, to restore it to its ancient importance. By various edicts he announced his determination to curb the power of the priests and to resist the papal encroachments; and even ordered the suppression of some of the monasteries. These reforms, too abruptly proposed, roused the opposition of the priesthood and the superstitious inhabitants, but they were not excited to revolt till Joseph began to overturn the civil departments by a complete change of system. The assembly of the states of Brabant then offered a determined opposition to his measures. They refused to vote the supplies, and in 1789 published a manifesto declaring Joseph II. deposed from the sovereignty. During the contests that followed, which were strongly marked by religious bigotry and fanaticism, Joseph died on the 20th January 1791, and was succeeded by his brother Leopold.

Leopold manifested much sagacity and moderation in his measures for the recovery of the revolted provinces. The states-general, on the other hand, occupied themselves almost exclusively in attempts to re-establish the monkish institutions; and having dismissed their able general Van der Mersch on account of his alleged heresy, their army became disorganized, and they had the temerity to reject with scorn the moderate overtures of the new emperor. The army of the imperialists advanced into the provinces; town after town

Belgium. opened its gates, and a short campaign gave the emperor quiet possession of the whole of the provinces. He revoked the ordonnances of his predecessor which had given such offence to the clergy and bigoted inhabitants, and re-established the form of government on the footing on which it had existed under Maria Theresa. These arrangements were scarcely completed when he died, on the 1st of March 1792. His son Francis II. succeeded to the throne, and under his reign the final separation of the Belgian provinces from the imperial family took place.

The new emperor, soon after his accession, found himself involved in the war with revolutionary France, which ended in the conquest of the Netherlands by the French. See FRANCE. The Netherlands were formed by the French first into the Batavian republic, afterwards into the kingdom of Holland for Louis Buonaparte; and in 1811, on his abdication, they were annexed to the French empire.

In 1813, after the battle of Leipzig and Napoleon's evacuation of Germany, the Dutch threw off the French yoke, and recalled the Prince of Orange, who assumed the reins of government under the title of king. The Belgian provinces were soon after abandoned by the French and fell by the right of conquest into the power of the allied sovereigns.

From its position Belgium had been the battlefield of Europe in former periods; and the possession of that country by France would be of vast importance as an advanced post, from which she might easily proceed to other conquests. The house of Austria, having always found the Belgian provinces a source of trouble and annoyance, was ready to abandon its claims; trusting thereby to secure some advantages nearer the centre of its power. The Netherlands, if united under one power, might be sufficiently strengthened to become a strong barrier against France, and the means of securing the continuance of that general peace which was then so much desired, and indeed wanted. Belgium, and the other territories near it, the bishopric of Liège, and the duchy of Luxembourg, were considered merely as European objects, which were so to be disposed of as would best suit the purposes of the combined powers, particularly that of securing the tranquillity of the great community of nations. It was not, then, from any peculiar favour to Holland, or from any personal regard to King William, though his minister formed one of the assembly, that, in less than two months after the seizure of Paris, it was adopted as a principle by the representatives of all Europe, and promulgated to the world, "that Holland, placed under the sovereignty of the house of Orange, should receive an increase of territory." This declaration was made on the 30th of May, and at the time received with general approbation, although at a subsequent period it was one of the principal grievances set forth by the Belgians in their declaration of independence. The principle thus announced received its final sanction by a treaty dated the 21st of July, in virtue of which Baron Vincent was to deliver over to King William the provisional power he exercised in Belgium, upon the following conditions, viz. 1. That the two countries should form one state, governed by the constitution already established in Holland, to be modified by common consent: 2. That there should be no alteration in that part which assured to all religious sects an equal admissibility to public offices: 3. That the states should assemble in alternate years in a city of Holland and in one of Belgium: 4. That all the inhabitants of both parts should be alike in all commercial matters, without any restriction being imposed on one for the benefit of the other: 5. That the provinces and cities of Belgium should be admitted to the full enjoyment of commerce with the colonies: 6. That all expenses should be in common, and the debts of the two parts should be assumed by the treasury of the kingdom: 7. That the expense of maintaining and strengthening the fortresses Belgium. should be defrayed from the common treasury: and, 8. That the cost of supporting the dikes should be furnished by the districts more immediately interested in them; but in case of any great disaster, succours were to be supplied by the general government, in the same manner as had formerly been practised in Holland. The king of England, by a separate treaty, on the 13th of August, agreed to give up to the newly-created king of the Netherlands all the conquests made from the Dutch during the war, with the exception of the Cape of Good Hope, and the settlements of Demerara, Essequibo, and Berbice, on the continent of South America.

By the treaty of the 21st of July, the government of the Netherlands accepted, on the conditions therein stated, that sovereignty over the Belgian provinces which the allied powers had offered, not from any peculiar feeling of regard to the interests of King William or of Holland, but as a European benefit, "de pourvoir à l'établissement d'un état d'équilibre en Europe, et en vertu de leur droit de conquête sur la Belgique." The duchy of Luxembourg was not a portion of Belgium, but a part of Germany; and that division was given up to the king of the Low Countries, by the German confederation, of which he was a member, not in his regal capacity, but in consequence of his transferring to Prussia the sovereignties, hereditary in his family, of Nassau-Dittenburg, Siegen, Hademar, and Dietz.

After the union of the two countries had been settled by treaty, and the whole delivered up to the government of William, it was thought necessary to submit, not the union itself, but the fundamental law or constitution, to the acceptance of the people. That constitution had already been accepted by an almost unanimous vote in the northern division, but it was deemed necessary to submit it also to the southern division. An assembly of Notables was accordingly convened in Belgium, on the same plan as had before been pursued in Holland. The number of the members of this assembly was 1600, but not more than 1325 attended. Upon the vote being taken, there appeared to be 529 in favour of accepting the constitution, and 796 against it; and thus, as far as that assembly was concerned, the acceptance of the proposed constitution was negatived. The government, however, took a different view of the subject, founded upon the assumption, that the union being adopted must be considered as a fact not to be questioned; and that this was a question for the united kingdom, which must be determined by a majority of the whole. For this purpose, the statistical view given of the kingdom was thus represented.

The inhabitants of the northern division, or what was before Holland, were	2,071,181
Those of the south part, or Belgium	3,411,082
In all	5,482,263
The votes in favour of the acceptance were stated to be the whole of the northern part	2,071,181
Two fifths of the southern part, who voted by their 529 delegates	1,364,432
	3,435,613
The majority of the Belgian representatives, who voted for three fifths of that part, amounted to	2,046,650
Thus giving in favour of the constitution, or fundamental law, a majority of	1,388,963

We have given an account of this proceeding, because it was subsequently made one of the grievances complained of. The assembly had been chosen fairly, and consequently under clerical influence, which was decidedly op-

Belgium. posed to the toleration of any other party than the Catholic religion. This was proved by a kind of protest, issued under the title of "Jugement Doctrinal des Evêques du Royaume des Pays-Bas, sur le serment préscrit par la Nouvelle Constitution." In an authoritative style it condemns the liberty given to appoint persons of any religious creed to offices of power and trust; and it reprobates the enactment that the Catholic church was to be submissive to the law of the state, that the other religious sects were to be protected in their worship, that the government was to have the power to regulate all the seminaries of the kingdom, and that the liberty of the press was recognised. It concluded with these words: "Mais dès qu'une loi humaine est intrinsèquement mauvaise, et opposée à la loi divine et aux lois de l'église, on ne peut, sous aucun prétexte, s'engager d'y obéir." This declaration was signed by all the prelates, viz. the Archbishop of Malines, and the Bishops of Ghent and of Tournay, and the vicar-general of the chapter of Liège. It is natural to suppose that such a declaration must have had great influence with people so ignorant and superstitious as the lower classes of the Belgian population are universally allowed to be, and averse as they had ever been to a connection with the Dutch, who were represented to them as a combination of heretics. The nobles are also said to have been more attached to the ancient Austrian government; but the middle classes were supposed to have more sympathy with the French than with the German nation, and to be peculiarly jealous of the Dutch.

Whatever may have been the common sentiment, of which it is always difficult to judge, not the least appearance of discontent was displayed at the promulgation of the constitution, or the public entry made by the king and his family into Brussels. His first efforts there, as they had been in Holland, were directed to the means of defence; and all due exertions were employed for the purpose of raising an effective and numerous army. In this much progress had been made when the intelligence arrived that Bonaparte had escaped from Elba, advanced in a sort of triumphal procession through France, and again assumed the imperial title, and all the power connected with it.

The alarm and terror created by this event had the effect of, in a great measure, disarming the power of the ecclesiastical fulminations, and uniting all classes with the new government in preparing for the contest which was evidently about to take place on the frontiers of the kingdom. The time spent by Bonaparte in Paris in organizing his recovered army, and in conciliating the several parties in his capital, was most actively employed by the king in strengthening his means of defence; and a great advance had been made in his military affairs, when it became evident that the first inroad of the French would be on the side of Belgium.

An army composed of Dutchmen and Belgians, but chiefly officered by the former, was collected and led towards the frontiers by the Prince of Orange. When the French entered Belgium, these troops formed the advance of the allied army. It encountered the French at Quatre-Bras, and, aided by the British, resisted during the whole day (the 16th of June) the attacks of the left division of the French army, commanded by Marshal Ney. The loss of lives on both sides was great; but that action had a powerful influence on the issue of the battle of the 18th, as it gave time to bring up the whole of the allied forces, and place them on the field of Waterloo, where the decisive conflict took place which decided the fate of the French empire, and gave a long peace to Europe. During the whole of that day the troops of the Netherlands sustained the character for courage which past centuries had established. There were probably a few instances of overpowering terror, and some solitary examples of disaffection, arising from past associations with the French; but the great principle of public duty pervaded the Netherlands army, as was proved by the loss which they sustained in the battle. The victory was cemented by the blood of the Prince of Orange, who stood at the head of his troops throughout the whole of that arduous day, encouraging them by his cool and determined conduct. On one occasion he made a desperate charge on the enemy, and advanced so far that he was actually in the midst of the French, and in the greatest danger, when a Belgian battalion rushed forward, repulsed the enemy, [illegible] a desperate struggle, disengaged the prince. From the [illegible] his gratitude, and his admiration of the bravery displayed, he tore from his breast one of the decorations gained by his conduct in some preceding action, and flung it amongst the battalion, calling out, "Take it, my lads; you have all earned it." This decoration was eagerly grappled for, and tied to the regimental standard amidst loud shouts of "Long live the Prince," and vows to defend the trophy, in the utterance of which many a brave man received the stroke of death. A short time afterwards, towards the close of the battle, the prince was hit by a musket-ball on the left shoulder. He was carried from the field, and conveyed to Brussels the same evening in a cart, accompanied by two of his aides-de-camp, one of whom, like himself, was badly wounded; displaying to those near him as much indifference to pain as he had previously shown contempt of danger. Belgium.

The battle of Waterloo appeared at the moment to have consolidated the establishment of the kingdom of the Netherlands. It seemed to have attached the military part of the Belgians to the prince who had been wounded at their head, and who had led them to that victory which they so mainly ascribed to their own exertions, as almost to forget that the troops of any other nation had contributed to it. Advantage was taken of this feeling to commence the working of the new constitution, which had been accepted, as before noticed, by a majority of the whole kingdom, though rejected by a majority of the Belgian portion. The solemn inauguration was held a few weeks after the battle, and much interest was excited by the appearance of the Prince of Orange, on the occasion, still wearing his wounded arm in a scarf, and with the pallid countenance of an invalid.

The constitution was then declared to have been accepted by the people, and no allusion was made to the irregularity of the decision, as the objections once urged had arisen from repugnance to religious toleration; those who had urged them being sensible that any allusions to the subject would have been unavailing amidst the prevailing military enthusiasm. None was made, but such were certainly nourished, to be brought forward at some moment more favourable for making the desired impression. No murmurs were heard, and Belgium became, or appeared to have become, reconciled to the arrangement which had been made by the allied powers.

The speedy concentration of the two divisions was a spectacle viewed with astonishment, whilst a thousand channels were opened for the egress of national industry, capital, and enterprise. Every obstacle seemed to have vanished, asperities were softened down or concealed, faction seemed dead or paralysed, and a quiet enjoyment of the present formed the only public manifestation. The people of Belgium appropriated to themselves the glorious victory of which their country had been the theatre. The king, by his love of peace, and by his activity in whatever could improve the institutions and the condition of the country, at first gained a high opinion amongst those Belgians who were able to endure the religious toleration he established; and amongst others his personal virtues, his

Belgium. domestic habits, and his unwearied industry, as favourable a view was taken of his character as could be formed of one who had the misfortune to be a heretic. This last party was soothed, if not reconciled, by the exertions which he made to recover and restore to their churches those pictures and other objects of value which had been pillaged by the French and carried to Paris.

The naval transaction of the following year, when a squadron of Netherlands ships joined the fleet under Lord Exmouth in the attack on Algiers, was another circumstance favourable to the consolidation of the new kingdom; for although the battle was gallantly fought by Dutchmen, yet the Belgians took care, in the exercise of their vanity, not to allude to the Hollanders; and as they had forgotten the English at Waterloo, so they now gladly assumed to themselves the glory of the united victory. The prosperity of Belgium made it the chosen residence of many respectable foreigners, as well as the place of refuge of others of the most opposite descriptions. The king busied himself less in projects to secure popularity, than in efforts to benefit the country; and it may here be proper to notice the institutions which were either established or ameliorated, and the beneficial consequences they produced.

Under the rule of France, Belgium, like the other parts of the Continent, had suffered severely from the operation of the conscription laws, which had deprived the country of those active labourers who were necessary to cultivate the fields. Although peace could not restore the great numbers who had perished, yet it stopped the farther progress of the evil in the Netherlands, by the establishment of a voluntary enrolment for a small regular army, and of a militia, whose service was required only for one month in the year. The mines felt the benefit of this regulation. The minerals of Belgium consist of coal, iron, and calamine. As soon as the union had been formed, and labourers became less scarce, a great impetus was communicated to this branch of industry; and companies were formed, who were most liberally repaid by the profit of their investments in this branch of industry, which was augmented from year to year as long as Belgium and Holland constituted one kingdom. By the excitement communicated to mining, the provinces of Liège and Hainault, and a part of Namur, were greatly enriched; and a company formed to explore the mines of Luxembourg were amply rewarded in their labours and their profits, till interrupted by internal commotions. The various branches of manufacturing industry received a similar impulse, though at first they were checked by the peace. The continental system of Bonaparte had given a factitious encouragement to some articles of manufacture, which ceased with the return of peace; and, till the formation of the kingdom of the Netherlands, many branches were depressed by the rivalry of foreign goods in the markets to which they had access. But as soon as the junction was completed, a stimulus was given to the manufacturers, by opening to their goods the markets of the East and West Indies, and those of all countries with which the Hollanders had traded. The iron manufactures of Liège advanced rapidly in prosperity; the woollen manufactures of Verviers felt most powerfully a similar impulsion; and many large establishments were formed at Ghent and other places, where cotton goods were fabricated which rivalled those of England, and so far surpassed those of France, that much of the goods were sold by the contraband trade in that kingdom. The opening of the Scheldt was the necessary effect of the formation of the united kingdom. Merchants from various countries formed establishments with large capitals at Antwerp; its docks became crowded with ships from all countries; its warehouses were loaded with colonial and other produce; and it advanced rapidly to a rivalry with Amsterdam, Rotterdam, and Hamburg, in the transit trade to the interior of Germany. The king directed his best efforts to the state of the roads, the greater part of which had suffered dilapidation, whilst the cross roads, so important in a country chiefly agricultural, were in many places scarcely passable. The management of the former was under the general government, whilst that of the latter was superintended by the local authorities; but in the first few years of the union the whole were repaired and placed in the most excellent state. The interests of internal navigation were sedulously watched over by the king. The old canals were repaired, the shallow parts of the rivers were deepened, and new and important water communications were formed. The chief of these, the Canal Guillaume, which extends from Maestricht to Bois-le-Duc, was an expensive but highly beneficial work; whilst that of Antoing in Hainault, that of Charleroy in the province of Namur, and that of Ternuse in Flanders, have been found in a very high degree beneficial. Though no longer of any importance to Belgium, it may not be quite out of place to remark, that the spirit of improvement which spread throughout the whole kingdom was to be seen in Holland in the Grand Canal of North Holland, which opens to Amsterdam a way for ships of the largest size to the ocean by way of the Helder, without incurring the risks arising from the shoals of the Zuyder Zee. Belgium.

Some other plans of this kind had been decided on, when the disturbances broke out which ended in this disjunction of Belgium from Holland. One of these was to make the river Sambre navigable; the other was to form a canal from the Meuse to the Moselle, by means of which the prosperity of the duchy of Luxembourg would have been greatly advanced.

The state of education, from the schools for primary instruction up to the universities, was in a wretched state when the king ascended the throne. In Holland it had ever been an object of the greatest consideration; and it had received from Louis Bonaparte, during his short reign, a degree of perfection which fitted it for reception in Belgium. Normal schools for the instruction of teachers were early founded; and as soon as any were found qualified, they were fixed with moderate stipends in the rural districts where they could be most beneficially placed. To such an extent was this plan of organizing primary schools carried during the first ten years of the reign of William, that their number in 1826 was 3329, in which the pupils were taught reading, writing, arithmetic, and the system of weights and measures. The numbers of pupils in the several schools of Belgium were 156,075 boys and 116,761 girls; in Luxembourg the numbers were 19,925 boys and 14,819 girls.

The schools for higher instruction were improved, and the number of students in them yearly increased. In ten years they had risen from 3400 to 7048. These were in general the institutions in which the youth were prepared for the universities. The king founded a new university at Liège, in addition to the two previously existing at Louvain and at Ghent. Great care was taken to procure the most able men in every branch of science; and as the country was rather deficient in such as possessed eminent qualifications, it was found necessary to repair to foreign lands for help. Several were invited from Germany, and others from France and Italy. No one establishment for education in Europe could boast of more distinguished names than those of the individuals who filled some of the professors' chairs, both in Liège and Ghent.

Whilst in the united kingdom the surface appeared smooth, and the vessel of the state seemed to be making a rapid progress, an under-current was perceived to be making its way in a direction not favourable to permanent tranquillity. At first William gained the highest applause from his Belgian subjects. The whole kingdom exhibited a show of bustling activity, if not of prosperity. Amongst the re-

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fugees from other countries, the king and people were spoken of as models of public and domestic happiness; the diplomatists joined in the flattery, and prided themselves on the skill with which they had accomplished the tranquillity of Europe, by founding the kingdom of the Netherlands; and all united in the assertion that the king was much too good for his Belgian subjects.

For several years this favourable or flattering state of affairs continued, though thoughtful people soon discerned, from events unnoticed by superficial observers, the prognostics of future disunion. At the earliest meeting of the representative house, the different languages spoken by the members caused some difficulties; a Belgian in the discussions speaking in French, and a Hollander replying in Dutch. Too many of the questions brought forward might be of a local nature; and in these, as the whole of the Hollanders voted on one side, and the whole of the Belgians on the other, the decision was often dependent on the accidental absence of an individual on the one side or the other. The equality of numbers between the Dutch and Belgians made it difficult to come to a settlement on such subjects as affected the interests of the two countries in a different or opposite way. This was first exhibited on the subject of a free trade in corn. The Dutch provinces had never produced sufficient corn for their consumption, but a free trade in it had always furnished them with a sufficient supply. The Belgian provinces grew more corn than they consumed. As in the other parts of Europe during the last years of the war, the prices of corn had risen to an enormous rate, and the Belgian proprietors of land had increased their rents in due proportion. With the return of tranquillity the prices of grain and the rents of land were much reduced; and the Belgian members of the assembly desired to impose restrictions on the importation of grain. This was naturally opposed by the Dutch members, whose interest was engaged in favour of low prices, both as regarded the subsistence of the inhabitants, and the trade of the distilleries. The question was finally decided in favour of the freedom of the trade; but the contest gave rise to the formation of two parties, so equally balanced as to make the decision of many legislative questions dependent on accident.

As the royal authority had been established in Holland the greater part of a year before the union with Belgium, it had been organized without reference to that event. Holland had been a shorter period under French power; and during the prevalence of that influence when King Louis filled the throne, its government had been carried on upon the principle of nationality; the fittest men filled the offices in the different departments, and many of them remained unchanged when Holland became a French department. It was natural that King William should continue such men in their offices, and that in selecting officers for the new branches which were to be created, a preference should be given to natives, of whom there were numbers whose education, habits, and patriotism had well fitted them for the public service. At the union of Belgium and Holland the whole administration was in the hands of French functionaries, who speedily disappeared. Few men in Belgium had been brought up in such a way as to form them for official duties, and those who had sufficient information and capacity had been nominated to employments in the distant provinces of France. Under these circumstances, the greater number of officers was necessarily appointed from the northern division of the kingdom. Another cause of many offices in Belgium being filled by Dutchmen was, that some of those Belgians to whom offers were made declined to serve, on account of the influence of the priests, which prevented them from taking the oath to a constitution, one of the first stipulations of which was an equal freedom to all religions.

A complaint was brought forward, that in the appointment of officers in the army an undue preference had been shown in favour of the natives of Holland; and as Mr Northomb, an opponent of the house of Orange, in his work entitled *Essai Historique et Politique sur la Révolution Belge*, has placed the numbers in a statistical point of view, this matter is entitled to examination. According to his statement, in 1830 the officers of the army of the kingdom of the Netherlands is thus shown:

Belgium.

Rank.	Whole Number of Officers.	Belgians.	Belgians settled in Holland.
Generals	5	0	0
Lieutenant-generals.	21	2	1
Major-generals.	50	5	2
Colonels	48	8	1
Lieutenant-colonels.	48	9	1
Majors	137	19	0
Captains	211	38	3
Lieutenants	808	115	2
Sub-lieutenants	639	82	0
	1967	278	10

This great disproportion is in some measure lessened, from the circumstance that many of the officers were Germans, some were Swiss, and some were natives of other countries. With this allowance, the exact number of which is unascertained, the contrast between the whole and the Belgians is very striking. Baron de Keverburg, a partisan of King William, gives a different account, making the whole number of Belgians in the army to be 536 instead of 278. In his work entitled *Du Royaume des Pays Bas*, he asserts of his catalogue that it is " d'après des renseignemens puisés à des sources authentiques;" but, even on this showing, the more numerous population supplied but one fourth of the officers. This is accounted for, if not justified, by the baron, on various grounds.

When Louis Bonaparte became king of Holland, he sedulously attended to the formation of his army; and when he abandoned the throne the armed force was so well trained, equipped, and officered, that, on the annexation of Holland to France in 1810, it formed a military body equal to any other of the empire in its adaptation to the purposes of war. When that army was transferred to France, the different grades of officers retained their Dutch rank, and their former course of promotion. But when the people of Holland rose against France, and raised William to the throne, the Dutch resigned their posts in the French service, and repaired to their own country, where they were gladly received, and reinstated in the rank which they had attained during their service in France. It will be seen by the list of Mr Northomb that all the generals were Dutchmen; but that rank had been acquired in the French service, where, by their military talents, they had gained high reputation, and had been honoured and trusted by the French emperor. The names of the Dutch officers thus appointed generals by William are well known. Tindal had been raised by Bonaparte to the rank of general, and commanded a regiment of his body guard. Jansens had been distinguished as governor of Batavia, and in the army of the French emperor on the Ardennes frontier. Daendels was one of those Dutchmen who had been always placed in posts of the greatest danger, and had displayed the highest skill and valour. Dumonceau, though a Belgian by birth, had by his long service in the northern provinces become a Dutchman, and was highly esteemed in the French army. Chassé, an old officer of

Belgium. Holland when he was transferred to the French service, became known by the familiar title of *Général Baionnette*, and afterwards distinguished himself by his gallant defence of the citadel of Antwerp.

When men like these returned to their liberated country, and at a moment when their services were wanted, there were no rivals to compete with them in Holland, and they were necessarily placed at the head of their profession. Those of the successive ranks who also returned, as almost the whole did, were retained in those ranks in the army, formed first in Holland, and afterwards strengthened by the addition of Belgians. The Belgian officers serving in the French army had not been kept apart, but mixed up with the Frenchmen. They had formed a part of the general conscription; few had raised themselves to the rank of officers; and of these only three had attained the grade of colonel, no one having risen higher. Being thus insulated, they had nourished little or no national feeling; some few tardily returned to their native country after the occupation of Paris; but many of them remained in the service, and fought against their country at Waterloo.

The king, in the hasty organization of an army, naturally availed himself of the materials within his reach, and adapted them to the emergency. When after the battle of Waterloo peace was established, it would have been highly unjust to the brave men who had assisted there not to have confirmed them in their ranks, or to have placed others over them merely because they were born in Belgium. But for these, and even for such as had fought against their country, and repaired to it after the victory, the provision made was the best that could be effected at the time; and they were subsequently placed in new corps, retaining their former rank and seniority.

The utmost economy was practised respecting the army; and from the number of good officers in the highest classes, and their seniority, there was no prospect of rapid promotion. Thus the gentry of Belgium had but little inducement to enter the military service, so that, without attributing to the king any great partiality, the facts here stated sufficiently account for the greater number of officers belonging to one division of the kingdom.

The other charge of partiality on the part of the king, which ultimately became one of the grievances, was, that, in the legislative body, the number of deputies was as great from the northern as from the southern division of the kingdom, although the number of inhabitants in the latter was so much greater. The foundation of this settlement of the relative numbers was based upon the principle of giving legislative power according to the rate of revenue to be extracted from each division, rather than according to the number of the population. The proportion of revenue raised in Holland was nearly equal to that raised in Belgium; indeed it was shown, at a subsequent period, to be as fifteen to sixteen. The rate of revenue per head in Holland was sixteen florins, and in Belgium ten florins. Whether the rate of revenue or the number of inhabitants be the proper scale for regulating the proportion of legislators, is not a subject to be discussed in this place.

In the distribution of the higher civil offices of the government, complaints were urged and magnified into weighty grievances by the Belgians. On this subject the statements of Baron de Keverburg, when confirmed by the official part of *L'Almanach Royal*, are as follow:

The cabinet consisted of six members. It was formed before the union of the two countries, and was composed wholly of Hollanders; but after the junction of Belgium, two of the members withdrew, and two Belgians were admitted in their stead. The first chamber of the states-general, similar to our House of Peers, but nominated by the king for life, contained fifty-six members, of whom thirty were Belgians, and twenty-six Hollanders. The Belgium. *Conseil d'Etat*, or privy council, was composed of twelve Dutch and eleven Belgian members. The Prince of Orange and his brother Prince Frederick presided over the two divisions into which it was formed; one for the direction of the army, the other for that of the naval force. The *Chambre des Comptes*, or treasury, consisted of sixteen persons, taken equally from the two divisions of the kingdom. The judicial authority of the provinces and communes was in general intrusted to persons chosen in the division in which they were to execute their duties. There were a few exceptions to this rule, for two Dutchmen exercised these functions in Belgium; but two also, natives of Belgium, filled the same offices in Holland. Thus far there was an equality; but in North Brabant the judicial office was filled by a Belgian, which gave a trifling superiority to the southern division.

It may fairly be presumed, that in the appointment of officers in the several civil departments, the king had been mainly influenced by his view of the capacity of the persons selected to discharge the necessary duties; for at a subsequent period, when the most scrutinizing activity was exercised to discover grounds of complaint, no accusations were made of any other fault in the appointments than that which related to the portion of the kingdom to which the functionaries belonged. The king himself was active and regular; and being in a great degree his own prime minister, he must have been peculiarly anxious that the persons under him should be adapted to their several stations, and certainly under no government was more industry exercised or more regularity preserved.

Many of the important institutions of the country had, by the constitution, been left to the will of the king as to their local establishment. The seat of the states general had been fixed by that law to be alternately in Belgium and in Holland, but not the place for the king's residence or the council of state; yet these also, though with some personal and political inconvenience, were made changeable, business being transacted six months of each year at Brussels and six months at the Hague. But the supreme court of justice, the court of appeal from all the inferior tribunals of the kingdom, was permanently fixed at the Hague, to the great disadvantage of the more numerous suitors in the southern part of the kingdom. This formed a material, and apparently a just cause of complaint; and nothing has been stated by the Dutch which has disproved the inconvenience, though attempts have been made to represent the practical injury arising from it as very trifling and insignificant. Several other establishments were also made permanent in Holland, such as the state archives, the diplomatic offices, the council of the nobles, the coinage of money, the military and naval boards, the academies for the instruction of naval, artillery, and engineering officers, and the principal naval and military arsenals. This arrangement was justified upon public grounds by the partisans of the king. The kingdom, they affirmed, had been established as an European object, and to form a barrier for the defence of all the powers against the ambition of France. In any display of that ambition, Belgium would, as heretofore, become the first theatre of war, and, in spite of the range of fortresses about to be erected, might be occupied by an invading army. If the means of carrying on the war fell into the enemy's power, the effect might be fatal; but by having the establishments farther from the frontiers, and where they could be guarded by natural defences, the war might be kept up effectively behind the rivers and canals of Holland, so as to render the advance of the enemy a dangerous or a ruinous step.

There are in Belgium a variety of languages spoken, and the attempt of King William to introduce one uniform tongue created much discontent, and was by a great and

Belgium. influential part of the inhabitants considered as a serious grievance. The far greater portion of both the northern and southern inhabitants are of German origin, and their vernacular language is chiefly composed of Teutonic words. It is divided into several idioms, namely, the Dutch, the Flemish, and the Brabant. These three are so nearly similar, that those who use them understand each other better than the English and Scotch peasantry do. The Dutch language has been more polished than either of the others, having been the tongue of some of the most learned men that Europe has produced. It contains books of art, science, literature, law, theology, and history of the greatest merit, and which have been the means of spreading knowledge of all kinds to a great extent. The care bestowed on education has produced a greater number of readers and writers than are to be found in any other country of the same limited population. The Flemish and Brabant dialects have been little cultivated; few books have been written in it, except those of devotion, the lives of saints of the Catholic church, almanacs, and spelling-books. The numbers who read them are very small in comparison of the whole population, but with the rural inhabitants this dialect is the general medium of intercourse.

During the French dominion great pains were taken to extend the use of their language, and with much success as far as regarded those who had enjoyed the advantage of even the commonest education. This has extended the use of that language amongst those above the lowest classes; and it is said that even in Holland there are more persons acquainted with the French tongue than in those parts of Belgium where the other dialects of Teutonic origin are used. The Walloon language, a corrupted dialect of the French, is commonly used in the provinces of Hainault, Liège, and Namur; and the German language is most prevalent in Luxembourg.

Baron de Keverburg, assuming the population of 1829, gives the statistics of languages as follows.

The divisions in which the German is used, and their population:—

In Holland	2,329,974
In Belgium, the provinces of Antwerp, Limbourg, and the two Flanders	1,971,056
The largest part of Brabant	380,177
One half of Luxembourg	151,317
	4,832,524

The divisions in which the French and Walloon are used, with their population:—

The provinces of Hainault, Liège, and Namur	1,124,595
The arrondissement of Nivelles, in the province of South Brabant	126,733
One half of Luxembourg	151,317
	1,402,645

In this view the Dutch language is used by two fifths of the population, the other languages of German origin by two fifths, and the French and Walloon by one fifth. From the most remote periods all public affairs in Belgium were transacted in one or other of the Teutonic idioms. The *Joyeuse Entrée*, he Magna Charta of the country, was originally drawn up in the Teutonic dialect, and was only translated into French at a recent period, when the princes, no longer residing in the provinces, began to give a decided preference to that language; but all the proceedings of the states of Brabant were conducted in it till the conquest of the country by France. From that moment all public deeds were written in French, and the subdued people supported with pain the loss of their native tongue; but they dared not utter a complaint. This attachment of the Belgians to their native language was shown to have been little weakened by their subjugation to France; for when the allies had freed them from that yoke, and Baron Vincent was appointed governor *ad interim* by the house of Austria, a petition was presented to him by the ancient representatives of the city of Brussels, who resumed their former titles under the name of *Syndics des neuf nations, et des cent quarante-trois doyens*, complaining of the compulsory use of the French tongue. The petitions were favourably received, and an arrêt issued on the 18th of July, authorizing the use of the Flemish language, not, indeed, in all public writings, but in all notarial writings. Belgium.

When this provisional government ceased by the accession of King William to the throne of the Netherlands, he proposed to redress what was then deemed one of the grievances of the country, by a decree of the 1st October 1814, which stated as a fact. "that, in consequence of the union with France, the national languages of the provinces had been almost suppressed, to give place to the French tongue;" and then added, "that if it was necessary on one side still to tolerate the use of the latter language in some parts where the Flemish is not used, it is but just, on the other side, that the Flemish, which is the natural language of the country, should be re-established in all the parts in which it is used and understood." The king was certainly desirous of restoring the national language, and of restraining the use of the French; and for a time, whilst it was gratifying to the great body of the people, it occasioned very little complaint upon the part of those who alone spoke or understood French. Gradual enactments were made to induce practitioners to study the national languages; and three years were allowed to acquire them, at the end of which time those who did not understand them were to be removed to other stations, where they could practise their official duties in the tongue they were most familiar with. At the expiration of the prescribed time, 1st of January 1823, a decree fixed the following arrangement on the subject of languages:—1. The use of the French language shall be preserved in the Walloon provinces of Liège, Hainault, and Namur. 2. The use of the Dutch language shall continue to be maintained in Holland. 3. The use of the Flemish language, in its several idioms, shall be re-established in the Flemish provinces. 4. The German language shall be used in the German part of the grand duchy of Luxembourg. In short, it was provided that the official language in each of the provinces should be that which was used and understood by the mass of the people who inhabited them.

The profession of the law in Belgium forms a body which, next to the clergy, is the most formidable body of any. They had been trained by the study of French eloquence, and the young advocates, when called upon to plead in the language of the country, were often mortified by the ridicule of the audience. They did not wish to incur the displeasure of the Belgians by degrading their language, and therefore directed their attacks on the Dutch language, which, for that purpose, they confounded with the Flemish. In these attacks they were joined by the writers of many pamphlets, and also those of the public journals. The attacks were very violent. From those on the Dutch language they passed on to attacks on their literature, on their manners, and their morals. The Dutch writers, irritated by these attacks, replied and defended themselves; and thus arose, from mere literary disputes, a powerful and enduring animosity between the two countries.

The subject of religion was one which, above all others, served to produce discontent. A set of writers who neither had, nor pretended to have, any religious principles, encouraged the government at first in measures of toleration, according to the fundamental law, and were, or affected to be, vehement against the Jesuits, who opposed it. William was no bigot in religion, but it was his desire to raise the character of the Catholic clergy, by imparting

Belgium. to them a more extensive and better education than had previously been necessary before entering on their office. With this view he framed regulations which offended the clergy and the ignorant party who submitted to them, and who were at length joined by those who distinguished themselves as liberals, as soon as they saw that some advantages could be drawn from that union to forward their own republican views.

The Catholic clergy in Belgium had submitted to the regulation of their affairs which French subjugation had imposed. The vicar of the diocese of Ghent has indeed been unwilling to allow this; but Baron de Keverburg, himself a Catholic, and under the French regime governor of West Flanders, asserts most positively that the imperial institutions were observed in Belgium as elsewhere; that the catechism of the empire was taught to almost every one; and that the four articles of the clergy of France formed a part of the religious instruction in all the Belgian departments. As soon as the kingdom was established, they brought forward claims to power which they dared not even to whisper under Napoleon, and even carried those claims to an extent beyond what they had been urged for the last three or four centuries, and beyond what are acknowledged in the Catholic kingdoms of Europe.

The vicar-general of Ghent had required, as essential to the establishment of the kingdom of the Netherlands, " le rétablissement de tous les articles des anciens pactes inauguraux, constitutions, chartes, *et cetera*, en ce que concerne, non seulement le libre exercise de religion Catholique, mais aussi les droits, privilèges, exemptions, et prérogatives des évêques, prélats, des maisons-dieu, et des autres institutions religieuses quelconques." A single exception was indeed admitted to this exercise of power. The church would indulge the monarch so far as " accorder au prince et à sa cour des chapelles, bien entendu seulement dans l'enceinte des palais royaux." Thus these old powers, which the French had destroyed twenty years before, were to be restored; and then the prelates would allow, but only to the king and his family, the toleration of his own worship in secret. According to the principle of the prelates, the chief and sole duty of the temporal power was, in its relation to the Catholic church and its clergy, limited to " protéger la religion et ses ministres, à faire exécuter les lois de l'église, à faire punir les actes extérieurs nuisibles à la société religieuse."

This extraordinary claim of the church to a power independent of, and in fact governing the state, would not, on its own account, have deserved the notice here taken of it. It was at least quieted by the prudent conduct of the king, who suffered the Count Mean, one of the prelates, upon his nomination to a seat in the council of state, to swear to the tolerating constitution under a protest, that if the pope should declare the oath to be contrary to the rights of the church, it should thereby cease to be binding. The king, whilst he adhered to the constitutional principle of tolerating other sects, extended his liberality to the Catholic clergy, by increasing the stipends of the inferior orders; by making provision for those who, from age or infirmity, were incapable of performing their duty; and by contributing liberally to the erection or repairs of churches where the communal funds were inadequate to the purpose. The opposition of the clergy was for a time dormant; but it was again roused, when, at a subsequent period, the leaders of the church formed a junction with the leaders of the French party, and thus placed the lower classes, who could not read their effusions, but were under the influence of the priests who spoke to them in Flemish, in a state of hostile excitement towards the government. The hostility of the clergy was much aggravated by the attempts made to improve the education of the priests. The king had determined that no priest should be inducted who had not passed two years in the study of the *literæ humaniores* before his ordination, and appropriated a college at Louvain for that purpose, to which was given the unfortunate name of the *philosophical* college, a name with good Catholics almost equivalent to infidel or heretic. The prelates, to counteract this, established seminaries connected with the cathedrals, in which the pupils were instructed in their humanities. These contravened the design of the king, and were forcibly shut up. It was an objection to the philosophical college that the professors of history were not priests, but laymen, and some Protestants. This may not seem a solid ground of declining to attend lectures on history; but it was so with the Catholics; for, as their doctrines rest quite as much on tradition as on the Holy Scriptures, it was of vast importance that history should be taught by those alone who were orthodox in their opinions. In truth, the critical spirit of some of the German professors would make sad work with many parts of the traditions held sacred by the Catholic church. The prelates, in the discussions on this subject, indulged in language of a violent kind, and were prosecuted. A law enacted by Napoleon was made the instrument of condemning one or two of them to banishment, and excited no small degree of hatred amongst their adherents, who, if not the most enlightened, were the most numerous, portion of the inhabitants. These mortifications were increased by circumstances of inferior importance. Some of the religious festivals were curtailed, certainly with no views inimical to religion, but to benefit the morals of the people, by lessening the number of days that were devoted to idleness and drunkenness. The architecture of the national schools was similar to that of the reformed places of worship, and the youth of the country were forbidden to be educated out of the kingdom. These trifles were magnified into matters of plain evidence of a regular system to proselytise the whole of the Netherlands. Whilst these controversies respecting religion and education were carried on, the conduct of the king was applauded and encouraged by the active party of the liberals, who represented them as proper steps to secure the people from the insidious attempts made by the Jesuits to blind and cajole them. There was no evidence of any plan of the kind on the part of the Jesuits, and it was only affectation in the liberals to insinuate it. It served their turn for the time, but was soon forgotten, when it appeared advantageous for their party purposes to join with the most bigoted of the Catholics against the government of the house of Orange.

Another subject was at times brought forward, and must be added to the causes of the internal disunion between the two parts of the kingdom. The number of members of the representative body had been fixed at the time of the union, and made equal for Holland and for Belgium. The subject was then investigated with the greatest deliberation, and all parties were content. It had been suggested that Belgium brought, to form the kingdom, a more numerous population than Holland, and therefore ought to have a greater proportion of members in the assembly. But, upon the other hand, it was shown that the colonies which Holland brought to the common stock contained, in Asia, Africa, and America, as many persons as rendered them equal in number, and, in regard to common advantage, much superior to Belgium; and, besides this, it was urged, that the Dutch contributed to the common cause a powerful fleet and an army, with the stores belonging to both services. This point was, however, settled with perfect cordiality, and remained at rest during several years. But at length it was thought necessary to extend to Belgium the Dutch system of taxation on the grinding of corn. This was severely felt, and gave rise to renewed agitation as to the inequality of representation in reference to the numbers of inhabitants. It became a more prominent

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During the whole of the period from 1815 to 1829 the popularity of the monarch was very variable. After the uttering of some loud complaints, as alleged grievances arose, they seemed to die away and be forgotten; and, till some new cause supervened, the king was as much respected as his best friends could wish. At no time, indeed, was his personal character assailed; and the general feeling in Belgium was, that he always meant well, but gave too ready an acquiescence to what they tauntingly called the schemes of their *Dutch cousins*.

The king, attacked by two parties, by the priests and their bigoted followers on one side, and by the republicans on the other, avowed his intention to act with indifference to all parties in the pursuit of what he deemed for the general advantage. In conformity with this disposition a *concordat* was in 1827 entered into with the pope, by which the right of nomination to the bishoprics was settled. It was provided that each should be selected by the pope out of three individuals to be nominated by the king, and that the education of the priests should be under the control of the prelates; but that in the seminaries professors should be appointed to teach the sciences, as well as what related to ecclesiastical matters. This arrangement was highly satisfactory to the cool and thinking part of the community, but was far from pleasing to the extravagant partisans. The clergy thought that too little had been granted to them, and the liberals that too much power was conferred on their order. Conciliatory as this measure was intended to be, it thus proved nugatory; and several nominations of Belgians to offices before filled by Dutchmen had no better effect.

Brussels at this time contained a most heterogeneous foreign population, consisting of the intriguing and discontented subjects of almost every country of Europe. There were of Frenchmen, regicide conventionalists, exiled Napoleonists, and proscribed constitutionalists, besides Italian carbonari, expatriated Poles, Spanish liberals, disgraced Russians, English and Irish radicals, and visionary students from the various parts of Germany. As the greater part of these had but insecure means of subsistence, and for the most part understood the French language, the press groaned with libels, not more against the Belgian than against all other governments, and thus contributed towards the production of a high state of political excitement. The press of the capital also furnished cheap editions of such works as, either from their irreligious, immoral, or democratic tendency, were prohibited in France; and thus became a nuisance to the regular governments of Europe. The great mass of the population could not be inflamed by these fire-brands; few of them could read, and fewer still could read French. They were, however, acted upon by other means. The Flemish preachers, schoolmasters, and confessors, in their several spheres, were ready to join in any movement, and were sure to be supported by the idle, the dissolute, and the indigent, with which the cities and large towns abounded. To bring the whole body of discontent to bear upon the same point, it was found advisable to form the two parties into one; and this was achieved by the liberals affecting a zeal for the Catholic faith, which they had before treated with contempt and ribaldry. The union was thus formed, meetings of the parties were held, the junction was openly announced, and threatenings were promulgated tending to give confidence to the confederacy, as well as to excite apprehension in the king and his ministers.

This system of agitation was carried to an extent which no government could behold with indifference, however confident in the rectitude of its measures. It was attempted to oppose the calumniating writers by employing others to counteract their influence; but the attempt was far from successful, as in that kind of warfare the assailants have almost always the advantage on their side. The avowed object of the liberal writers was to urge the clerical party to make such extravagant demands of extensive power as they knew, if granted, would be the ruin of the royal authority, and if refused, would increase the agitation they had already created. Although the whole of the Dutch members of the representative assembly, and several of the most respectable of the Belgian members, gave a majority in favour of the royal party, yet many of the latter adopted most inflammatory language, and, as far as the rules of debate allowed, seconded the views of the united party of the liberals and bigots. Belgium.

As the union openly flung defiance at the government, it appeared necessary to bring before the courts of law the most notorious of the inflammatory writers; and two were selected as subjects for prosecution before the court of assizes of South Brabant. These individuals are thus described by the Baron de Keverburg. Of the first, Louis de Potter, he says, " Il s'était fait remarquer longtemps avant les troubles de la Belgique par dés écrits qui, aux yeux de l'église, étaient reputés fort impies, et, aux yeux des hommes doués, d'un peu de délicatesse, de très-mauvais gout. Ce que j'ai de dire sur le second est moins honorable encore. M. François Tielemans, avant l'époque pre-indiqué, n'était connu que par les bienfaits qu'il avait reçus et qu'il continuait de recevoir du roi, et plus tard il le fut par son ingratitude envers son bienfaiteur."

These men, with two others, likewise editors of journals, were sent to the tribunal in which Van Maanen filled the office of presiding judge. The prosecution terminated in a sentence of banishment from the kingdom for the period of eight years; a sentence which brought on the judge the execrations of the libellous journals, and elevated the prisoners to the rank of martyrs. The sentence was put in force by sending the culprits to the frontiers, where they were detained, as neither of the neighbouring states would admit them. The revolution of July occurred in Paris whilst they were in this state; and the party which prevailed in that city allowed them to enter France, and they were received in the capital with great applause by the propagandists.

The popular mind in Brussels was highly agitated by these trials, which did not operate to restrain the indignant language of the journals, nor the distribution of the most vehement placards, many of them in the Flemish tongue, in which the minister Van Maanen, and the editor of a royalist journal entitled the *National*, were held up to the public indignation, and threatened with vengeance. In this state of the public feeling, the news of the success of the Parisian mob in overturning the throne was received with enthusiasm. Numbers of the young propagandists from Paris reached Brussels. Assuming to themselves the character of heroes of the revolution, and with feelings of disappointment at the tranquil issue at which it had so soon arrived, these young men displayed the three-coloured cockade in the streets and public places; talked loudly in the theatres and coffee-houses; sang the Marseillaise and Parisienne hymns in chorus with impassioned groups; and dwelt with enthusiasm on the glories of the republic and the empire, and the future destinies of their " young France." Some of the more active of the Belgians repaired to Paris, and are said to have sounded the new government on the subject of the re-union of their country to France, in the event of the dissolution of the monarchy of the Netherlands. These last were, however, mere adventurers, who had little or no power over, or intercourse with, those who were destined to influence the fate of Belgium.

Belgium. to them a more extensive and better education than had previously been necessary before entering on their office. With this view he framed regulations which offended the clergy and the ignorant party who submitted to them, and who were at length joined by those who distinguished themselves as liberals, as soon as they saw that some advantages could be drawn from that union to forward their own republican views.

The Catholic clergy in Belgium had submitted to the regulation of their affairs which French subjugation had imposed. The vicar of the diocese of Ghent has indeed been unwilling to allow this; but Baron de Keverburg, himself a Catholic, and under the French regime governor of West Flanders, asserts most positively that the imperial institutions were observed in Belgium as elsewhere; that the catechism of the empire was taught to almost every one; and that the four articles of the clergy of France formed a part of the religious instruction in all the Belgian departments. As soon as the kingdom was established, they brought forward claims to power which they dared not even to whisper under Napoleon, and even carried those claims to an extent beyond what they had been urged for the last three or four centuries, and beyond what are acknowledged in the Catholic kingdoms of Europe.

The vicar-general of Ghent had required, as essential to the establishment of the kingdom of the Netherlands, "le rétablissement de tous les articles des anciens pactes inauguraux, constitutions, chartes, *et cetera*, en ce que concerne, non seulement le libre exercise de religion Catholique, mais aussi les droits, privilèges, exemptions, et prérogatives des évêques, prélats, des maisons-dieu, et des autres institutions religieuses quelconques." A single exception was indeed admitted to this exercise of power. The church would indulge the monarch so far as "accorder au prince et à sa cour des chapelles, bien entendu seulement dans l'enceinte des palais royaux." Thus these old powers, which the French had destroyed twenty years before, were to be restored; and then the prelates would allow, but only to the king and his family, the toleration of his own worship in secret. According to the principle of the prelates, the chief and sole duty of the temporal power was, in its relation to the Catholic church and its clergy, limited to "protéger la religion et ses ministres, à faire exécuter les lois de l'église, à faire punir les actes extérieurs nuisibles à la société religieuse."

This extraordinary claim of the church to a power independent of, and in fact governing the state, would not, on its own account, have deserved the notice here taken of it. It was at least quieted by the prudent conduct of the king, who suffered the Count Mean, one of the prelates, upon his nomination to a seat in the council of state, to swear to the tolerating constitution under a protest, that if the pope should declare the oath to be contrary to the rights of the church, it should thereby cease to be binding. The king, whilst he adhered to the constitutional principle of tolerating other sects, extended his liberality to the Catholic clergy, by increasing the stipends of the inferior orders; by making provision for those who, from age or infirmity, were incapable of performing their duty; and by contributing liberally to the erection or repairs of churches where the communal funds were inadequate to the purpose. The opposition of the clergy was for a time dormant; but it was again roused, when, at a subsequent period, the leaders of the church formed a junction with the leaders of the French party, and thus placed the lower classes, who could not read their effusions, but were under the influence of the priests who spoke to them in Flemish, in a state of hostile excitement towards the government. The hostility of the clergy was much aggravated by the attempts made to improve the education of the priests. The king had determined that no priest should be inducted who had not passed two years in the study of the *literæ humaniores* before his ordination, and appropriated a college at Louvain for that purpose, to which was given the unfortunate name of the *philosophical* college, a name with good Catholics almost equivalent to infidel or heretic. The prelates, to counteract this, established seminaries connected with the cathedrals, in which the pupils were instructed in their humanities. These contravened the design of the king, and were forcibly shut up. It was an objection to the philosophical college that the professors of history were not priests, but laymen, and some Protestants. This may not seem a solid ground of declining to attend lectures on history; but it was so with the Catholics; for, as their doctrines rest quite as much on tradition as on the Holy Scriptures, it was of vast importance that history should be taught by those alone who were orthodox in their opinions. In truth, the critical spirit of some of the German professors would make sad work with many parts of the traditions held sacred by the Catholic church. The prelates, in the discussions on this subject, indulged in language of a violent kind, and were prosecuted. A law enacted by Napoleon was made the instrument of condemning one or two of them to banishment, and excited no small degree of hatred amongst their adherents, who, if not the most enlightened, were the most numerous, portion of the inhabitants. These mortifications were increased by circumstances of inferior importance. Some of the religious festivals were curtailed, certainly with no views inimical to religion, but to benefit the morals of the people, by lessening the number of days that were devoted to idleness and drunkenness. The architecture of the national schools was similar to that of the reformed places of worship, and the youth of the country were forbidden to be educated out of the kingdom. These trifles were magnified into matters of plain evidence of a regular system to proselytise the whole of the Netherlands. Whilst these controversies respecting religion and education were carried on, the conduct of the king was applauded and encouraged by the active party of the liberals, who represented them as proper steps to secure the people from the insidious attempts made by the Jesuits to blind and cajole them. There was no evidence of any plan of the kind on the part of the Jesuits, and it was only affectation in the liberals to insinuate it. It served their turn for the time, but was soon forgotten, when it appeared advantageous for their party purposes to join with the most bigoted of the Catholics against the government of the house of Orange.

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The popular mind in Brussels was highly agitated by these trials, which did not operate to restrain the indignant language of the journals, nor the distribution of the most vehement placards, many of them in the Flemish tongue, in which the minister Van Maanen, and the editor of a royalist journal entitled the *National*, were held up to the public indignation, and threatened with vengeance. In this state of the public feeling, the news of the success of the Parisian mob in overturning the throne was received with enthusiasm. Numbers of the young propagandists from Paris reached Brussels. Assuming to themselves the character of heroes of the revolution, and with feelings of disappointment at the tranquil issue at which it had so soon arrived, these young men displayed the three-coloured cockade in the streets and public places; talked loudly in the theatres and coffee-houses; sang the Marseillaise and Parisienne hymns in chorus with impassioned groups; and dwelt with enthusiasm on the glories of the republic and the empire, and the future destinies of their " young France." Some of the more active of the Belgians repaired to Paris, and are said to have sounded the new government on the subject of the re-union of their country to France, in the event of the dissolution of the monarchy of the Netherlands. These last were, however, mere adventurers, who had little or no power over, or intercourse with, those who were destined to influence the fate of Belgium.

Belgium. The disturbances which followed at first may be easily concluded to have been the result of mere popular excitation, such as is often seen in large cities. The first symptom of outrage was presented by the audience of the theatre, on the 25th of August 1830, after the representation of a piece, the *Muette de Portici*, which abounded with passages well calculated to kindle a flame amongst materials well charged with inflammable particles. When the curtain fell, the excited audience rushed into the street, exclaiming, "To the office of the National." They ran thither, soon forced in the doors and windows, and began the work of destruction. They then rushed into the dwelling of the editor, which was speedily demolished, though the obnoxious individual, whose life was threatened, made his escape unhurt. The house of Van Maanen was that next assailed. It was plundered, and then set on fire, and the populace stopped the fire-engine from playing till every thing in it was consumed. The police-office was then attacked; the books, furniture, pictures, and plate of the chief magistrate were brought out and burnt in the street; and the hotel of the provincial governor shared the same fate; whilst some private houses and several manufactories were pillaged, and otherwise much damaged. Fury, confusion, or terror were visible in every countenance, before the civil and military powers made any attempts to stop these disorders; and those which were made showed a want either of the courage or the coolness necessary to act with decision. "From this conduct," says an eye-witness, "before ten o'clock on the morning of the 26th, the guards and posts in the centre of the city had been overcome, or had tranquilly surrendered; and the troops who had been drawn out either retreated to their barracks, or were withdrawn to the upper part of the city, where they piled their arms in front of the king's palace, and renounced all attempts at suppressing the tumult."

By the operations of these two days, the multitude had in fact gained the mastery of the city, and every one in it felt himself exposed to whatever private malice, political fury, or the love of plunder, might induce the populace to inflict. This moved a few of the more influential inhabitants to take up arms, and to enrol themselves into a burgher guard, for the protection of their lives and property. Within three days, not less than as many thousand persons, chiefly heads of families, had enrolled themselves in this corps, and, under chiefs of their own selection, paraded the streets; so that, if they did not put a stop to plunder and destruction, they at least contributed in some degree to contract the extent of the mischief. In such circumstances, the actual power within the city devolved on those who obtained the direction of these hastily organized and scarcely armed citizens. They determined on resisting the troops, which were advancing; and the general who commanded them having no precise orders from the king to act, readily agreed to suspend the march, and entered into a kind of treaty of neutrality with the burghers, till they could receive directions from the Hague, where the king and his family had that year their residence. The intelligence of these events in the capital soon spread throughout the provinces, and in all the large towns, excepting Antwerp and Ghent, similar scenes were exhibited, commencing with plunder and outrages by mobs, and settling down into an uneasy but rather more secure state by the institution of burgher guards.

The intelligence from Brussels was quickly communicated to the Hague, but the royal councils were divided in opinion. The only positive demand in Brussels was the dismission of the minister Van Maanen; and he offered to resign his post. The king is said to have refused accepting his resignation, whilst the Prince of Orange urged the acceptance of it, and the adoption of some other measures of a conciliatory kind. The result of the decision can only be known by the events which followed: and they show Belgium. that neither the adoption of concessions, nor the positive use of force, was resolved upon, but a course was pursued which, being some undefined medium between the two different paths, ended, as was natural, in converting a mere popular riot into a confirmed revolution. It was determined by the council that the Prince of Orange should proceed to Brussels on a peaceful commission; whilst the command of the army was conferred on his brother, and the troops advanced with alacrity from the various parts of Holland, where they were quartered, and where the most astonishing zeal was displayed in support of the royal authority.

The prince, however, departed for Brussels, but only furnished with such limited powers as, in the actual circumstances, were utterly ineffective. On his arrival at Vilvorde, near the city, he was waited on by a deputation from the city, composed of some of the most respectable inhabitants, who had been nominated at a public meeting of the householders. After some preliminary discussions, the prince courageously resolved on entering the city with no other suite than a few officers of his staff. His passage through the streets, crowded with the irregular burgher guard, and a ferocious mob, was attended with imminent risk; but at length he reached his own palace, and commenced a conference. Discussions were continued for several days between the prince on one side, and respectable citizens on the other, which were conducted with firmness and in a conciliatory spirit by both parties. The substance was not a rejection of the royal authority, or of the reigning dynasty, on the part of the citizens, but a separation of the administration of Belgium from that of Holland. They all declared that no wish prevailed for any union with France, but only for such a kind of independence for both countries as had been fixed between Sweden and Norway, with which both countries were satisfied and benefited. It was more than intimated to the prince that the wishes of all Belgium would be fulfilled if he were elevated to the throne; but in answer to such suggestions he firmly asked of one of the most influential men both at that and the present time, "What opinion would you entertain of me were I to sacrifice the interests of my father to my own? What confidence could you repose in a man who could cast off his allegiance to his king, and that king his father, merely to gratify his own ambition? I also am a father," added the prince with deep emotion, "and am bound to show a proper example to my children. Posterity shall not revert to my name, and revile me as that disloyal Nassau who tore the diadem from his father's brow to place it on his own."

At a final meeting held on the 3d of September, when many members of the states-general attended, it was so fully obvious to the prince that nothing but a separate administration of the two countries would restore tranquillity, that he resolved to use his influence with his father to accomplish that object; and he received the fullest assurance from the persons present, that they would unite in the most efficacious measures to assure the dynasty of the house of Orange, and to protect the territory of Belgium against any attempts to subject it to France, or any other foreign power. The prince expressed his determination to use his most powerful arguments with his father to obtain his assent to this proposal; but expressed his apprehension that he should be unable to succeed in his endeavours. The prince then quitted the city, carrying with him the respect of all those with whom he had communicated, for the courage he had displayed, for the knowledge of public affairs which he discovered, for the cool judgment which he exercised, and, above all, for the sense of parental duty which he had manifested. Whilst these transactions were passing in Brussels, the whole country was in a flame; in every town the populace were triumphant, and indulged unre-

Belgium. strained in plunder, to which, especially in the important city of Liège, was added the conflagration of several valuable manufacturing establishments. The officers of the army, with no definite orders how to act, were paralyzed in some places, in others gave up their arms, and in others engaged to be neutral.

The king, amidst the general disorder in Belgium, and the most fanatical attachment to the royal cause in Holland, had summoned the states-general from both divisions to assemble at the Hague. The members from Belgium, with some slight hesitation, resolved to repair thither, and the assembly was opened on the 13th of September, by a speech from the king, which was firm and temperate, but by no means definite. The proceedings of this body were dilatory; the Belgium members were treated with indignity and insult by the populace; and the language of some of the Dutch members expressed vengeance rather than conciliation. The accounts received at Brussels from the Hague, and the warlike demonstrations made by the troops, rekindled and accelerated the preparations for defence, and induced some approaches to organization. The burgher guards had become tired of military duty, and being mostly tradesmen living on their business, which had now been ruined, they were anxious for the return of the tranquillity upon which their existence depended. The leaders of the opposition, however, drew fresh recruits of a more determined and more reckless description from the rude population of the Walloon provinces, from the men employed in the coal and iron mines, and from the iron forges and other works which had been destroyed or shut up in and around Liège. These were, in a great measure, old and hardy soldiers, who had served in the ranks of Bonaparte's army, and fought in Germany, in Russia, or in Spain. Their arrival in the capital spread terror amongst the peaceable inhabitants, and kindled alarms lest they should be again exposed to the outrages which had marked the first days of the explosion. The defenders were thus divided into two parties; but, as usual, the most violent soon prevailed; and the council of the rabble soon dispersed that of the burghers (for both had their separate assemblies), seized the arms of the latter, and added to them others which had been collected in different parts of the country.

Although the states were still sitting at the Hague, the king's army was gradually drawn around Brussels. It consisted of 14,000 well appointed troops, under the command of Prince Frederick. But the motions of this powerful body were so dilatory, and its whole operations so unmilitary, that they are difficult to be accounted for, unless on the supposition that the conduct of the king was too conciliatory when force should have been applied, and too hostile when conciliation would have been of most advantage to his cause. On the 20th of September the council resolved to take possession of Brussels, and orders were sent to Prince Frederick to that effect. This resolution was taken at the Hague in consequence of the information of numerous emissaries from Brussels, who represented the inhabitants as eager to receive the troops, and to assist in putting an end to the anarchy and oppression which the mob were exercising. The most respectable names in the city were appended to these representations, which were doubtless sincere, but came from such as were more prepared to enjoy the return of peace and good government than to contribute any share of their personal services to secure these blessings.

On the 25th, the troops advanced towards the city, and with little opposition occupied the upper portion or court part of it, which is situated on a hill, by which the whole of the rest of the town is commanded. The opponents in the lower part of the city were dispirited and disunited, and most of the more violent leaders had fled. But the commanders of the army seem to have been seized with a panic, or to have dreaded doing too much mischief to the houses and property of the more wealthy inhabitants. In the square, where the troops had been drawn up, they were exposed to a galling fire from an invisible enemy, who, from the roofs of the houses, and from the cellars, picked off the officers and men without being much exposed to any return from the troops. Instead of destroying the houses and buildings which concealed the assailants, the prince had recourse to unavailing negotiations, and, after three days of most harassing service, determined to withdraw his troops. He had the means of stopping all supplies from entering the city, and thus of effecting a surrender by starvation; or, by a bombardment, he might have easily enforced submission. Why neither of these means were adopted cannot be certainly known; but the friends of the royal party attribute it to humanity alone. The loss of lives was not very great on the side of the king's troops, considering their exposed situation, and the number engaged. It is stated in the returns as 138 killed, and 650 wounded; whilst of the defenders of the city, though far inferior in numbers, the casualties were acknowledged by themselves to be 450 killed, and 1250 wounded. This disparity must be considered as one of the many extraordinary circumstances of the transactions, and renders the result utterly incomprehensible. The incredible intelligence of this repulse was rapidly conveyed to the provinces, with great exaggerations; and disaffection, anarchy, and demoralisation were spread everywhere. The army retreated towards Antwerp, which, in spite of the force near it, soon became involved in confusion. Ghent, Bruges, Ostend, and the other towns in that direction, immediately became a prey to the revolutionary party, and experienced the horrors of anarchy in the destruction of some of their most extensive manufacturing establishments. The universal rejoicing of the Belgians did not prevent some measures from being adopted to restrain outrages. In a few days, some individuals, with the general acquiescence, formed themselves into a provisional government. They were for the most part men of character and property; but amongst them was De Potter, who had returned as soon as the danger was over, and had been placed by the popular feeling at the head of the body. His power was but of short duration, and he soon fell into utter insignificance, if not contempt, as did others of the original leaders of the insurrection. When those of the representatives who had assembled at the Hague returned home, and their conduct was reviewed in a dispassionate manner, the weight of their character gave them an influence which proved favourable to the return of order. Some of them were added to the body forming the provisional government, and they exercised their influence with prudence, firmness, and integrity. Belgium.

In the provisional government the state of parties was singular, from the variety of opinions. De Potter, who looked forward to the dignity of president, advocated a republican form of government; Gendebeer, a decided advocate of democracy, preferred a union with France; whilst Van de Weyer wished for an independent government, on a monarchical basis, with the Prince of Orange at the head, if he would consent to withdraw altogether from his Dutch obligations, and become exclusively the sovereign of Belgium. The plan of Van de Weyer was known to be favoured by all the kings of Europe; and even France, at that moment under the pilotage of Lafayette, was averse to the entire exclusion of the Nassau dynasty, and sent an agent to Brussels to forward his views. Gendebeer had visited Paris, and there found little or no disposition amongst the leading people to agree to a union with the Belgians, which, they were aware, would involve them in a war with all those powers that had founded the kingdom of the

Belgium. Netherlands in 1815, solely as a European object and a barrier against France.

It soon became evident in Belgium itself that republicanism had made little or no progress. The prevailing opinion was strong in favour of the Catholic religion, with all its ancient powers and observances, but stronger still in favour of a nationality independent of all foreign control. This latter spirit contributed to increase the number of those who had taken up arms; and by such persons the repulse of the Dutch at Brussels was vainly considered as an evidence of the military power of the people. Many of the privates, and a few Belgians of distinction, had been in the army of Prince Frederick; but they soon left his colours, and entered the ranks of their countrymen. The Belgian colours waved on every tower in the country, except those of Antwerp and Maestricht; when the Dutch army, greatly reduced in numbers as regarded subalterns and privates, but with the artillery in complete order, withdrew into their own territory.

The council of the king at the Hague resolved on the separation of the two governments into different administrations; but it was then too late to produce reconciliation; and an attempt made by the Prince of Orange to procure for himself the supremacy of Belgium had no other effect than to beget contempt in that country, and to draw upon himself the temporary suspicion of double dealing towards his father and his countrymen in Holland.

The transactions which took place at Antwerp in October had the further effect of rendering the Belgians still more adverse to the Orange dynasty than they had before been. That city was invested by a Belgian force, whilst within, notwithstanding the resistance of the armed burghers, the populace became masters of the place; and the citadel was occupied by a garrison of 8000 good troops, commanded by the bravest of the Dutch officers, General Chassé. A truce had been concluded between the adverse parties, and a white flag hoisted from the fort; but the Belgian officers were unable to maintain it, the populace having begun an attack on the citadel, though with no other arms than muskets. This was not returned, but a cannon was brought forward by the populace, and a fire opened on the gates of the citadel, which, as the Belgian officers assert, was without their approbation or knowledge. On this infraction of the truce, Chassé ordered two or three guns to be fired from the bastion facing the arsenal. This being found ineffectual, the white flag was taken down; a signal was made to the fleet, consisting of eight vessels of war, in the Scheldt, close to the town; and a cannonade and bombardment commenced. It was more terrific than injurious, the fire being chiefly directed against the arsenal and the entrepôt, where all the military and naval stores in the former were destroyed; whilst in the latter large quantities of sugar, coffee, hides, cloths, silks, and spices, were burned and buried in the ruins of the storehouses. The firing had continued some hours when a deputation from the city made their way to the citadel, and proposed a suspension of hostilities, which was instantly agreed to, and the firing ceased. Never, perhaps, was exaggeration or misrepresentation carried farther than on this occasion, in the reports printed and circulated through Belgium; and the effect which they produced destroyed the last hope of those who wished well to the Orange dynasty. Since that event, official accounts made out by the Belgian custom-house show, that the whole loss of goods in the stores amounted to 1,888,000 florins, or L.157,200; whilst the damage done to private buildings, and the furniture in them, amounted to 679,466 florins, or L.59,450. In this the loss of the public buildings was not included. The number of the killed was only sixty-eight, of whom seventeen were military men, and the others those of the populace who had caused the calamity. The Dutch asserted that the fire was confined almost wholly to the spot where the munitions of war were stored, and that the rest Belgium. of the city was designedly spared.

As all hope of conciliation was thus destroyed, the court of the Hague made pressing solicitations to the four powers who by treaty had formed the kingdom of the Netherlands, to fulfil the obligations imposed upon them by the treaty of Vienna of 1815. But it was soon seen by the answer of Lord Aberdeen, the British secretary of state, and by those of the ministers of the other powers in succession, that none of them was disposed to make use of any other than pacific measures. This proceeding gave rise to negotiations between the allied powers, which were chiefly carried on in London, out of which proceeded numerous protocols, which had no decisive influence on the course of events. The public affairs of Europe favoured the independence of Belgium. All the powers were in alarm at the recent events in France, and all feared, not that the scarcely seated king would willingly commence a war of aggression, but that the democratic party might become sufficiently powerful to compel him to associate himself with the Belgians, and to bring that country under the power of France. The obvious interest of the four great powers was tranquillity, and the securing of the Continent against Flanders becoming the base of military operations towards the centre of Europe. If these could be obtained, it mattered little whether they arose from the junction or the separation of the two portions which had formed the kingdom of the Netherlands. The first meeting of the ministers of the great powers showed that they merely considered themselves as arbitrators between the northern and southern divisions of the newly-dissolved kingdom; and their first measures were addressed to the object of a suspension of hostilities, which was to a limited extent acquiesced in by both parties.

To settle the internal government now became the first object of the Belgians, who considered their independence as firmly assured. A national congress was accordingly assembled at Brussels, consisting of two hundred deputies, chosen in the several provinces, from all tax-paying persons above twenty-five years of age, without exception as to religion. The qualification for the electors and the elected was the paying of taxes, which varied in the several provinces according to their estimated wealth. Thus, in Luxembourg, the poorest province, the qualification was the payment of taxes annually to the amount of twenty-one shillings and sixpence; but from this the required rate was gradually raised, till, in Flanders, the richest of the provinces, the tax paid required to be six pounds five shillings. The assembly was a fair representation of the people of Belgium; for scarcely any proprietor was excluded from voting, whilst in the larger towns and cities the mere populace, from the qualification being higher, had not the means of introducing their favourites. As soon as the assembly met, the demagogues, who had contributed to the revolution, became insignificant. De Potter, Thielman, and the others who had been martyrs and heroes with the mob, sunk into insignificance.

The assembly proceeded to business in a regular manner. Three important propositions were presented to the congress. The first was the declaration of independence, which was voted unanimously; the second, proposed on the 22d of November, decided against a republic, and in favour of a constitutional hereditary monarchy, by a majority of 174 against thirteen votes, but it did not fix on the title of the future chief of the state; the third proposition, brought forward on the 23d, was for the perpetual exclusion of the Orange Nassau family. This was debated during two days, and at the close was agreed to by a majority of 161 against twenty-eight. The object of the minority was to delay the proposition till a more cool and distant period, and till it could be known whether the revolution which had taken place would lead to a war against Belgium. Mr Van de Weyer had, however, returned from a mission to London,

Belgium. and it was commonly believed he had ascertained that the sentiments of Lord Grey and the new ministers were as averse to any warlike interference as those which had been previously expressed by the Duke of Wellington and Lord Aberdeen.

It seems probable, that at the period in question the governments of England and France were co-operating in endeavours to place the Prince of Orange on the throne of Belgium; even if it could be accomplished in defiance of the positive declaration of the king his father, who did not scruple to assert, "that he would rather see De Potter placed on the throne than the Prince of Orange." But if such was the desire of the two kingdoms, it was soon discovered to be utterly impracticable, though much time was spent under the impression of its feasibility, and much suspicion excited amongst the Belgians against the sincerity of France.

Whilst the plenipotentiaries were settling the most equitable plan for separating the two countries, and had given their view with respect to the boundaries of each, they also adjusted what portion of the debt of the Netherlands should be assigned to Belgium, and what to Holland, fixing the former at $\frac{16}{31}$ parts, and the latter at $\frac{15}{31}$ parts. These discussions led to others: and it soon became known, that however independent Belgium might become as regarded Holland, it was too dependent on the superior power of the European kingdoms to be permitted the spontaneous nomination of the individual who was to become its sovereign. At that time a large, perhaps a predominant, party in the assembly would have preferred one of the Bonaparte family; but this, it soon appeared, would not be permitted by France. Another party were inclined to select a son of Louis Philip, the king of the French; but intimations had been communicated to that prince, that England would consider an acquiescence in the project as a sufficient cause of war; and he agreed to the exclusion of his son, but so privately that it was only known to a few individuals beyond the diplomatic circles. The partisans of the house of Orange took no open and avowed part in these discussions.

The inefficiency of this representative assembly to the real purposes of a government was speedily shown in the long and bombastical speeches of the members; in the absolute confusion in every department, whether civil, military, or judicial; and in the mobbing and plundering which prevailed in all the provinces. The necessity for an executive power was so strongly felt by the more reflecting members of the assembly, that after several days' preparatory debate, it was resolved, on the 19th of January 1831, to proceed to the election of a chief on the 28th of that month. The election of a sovereign, or rather of a dynasty, was enough to kindle agitation and intrigue; but perhaps less of these than might have been expected was discoverable, from the great number of the candidates whose pretensions were urged. On the day before the election, petitions were presented to the assembly in favour of Lafayette, Fabvier, Chateaubriand, the Prince of Carignan, the Archduke Charles; Surlet de Chokier, Charles Rogier, and Felix de Merode, private Belgians; Prince Otho of Bavaria, John duke of Saxony, a Prince of Salm, the Pope, the Duke of Nemours, second son of Louis Philip, and the Duke of Leuchtenburg. Besides these, the Duke of Lucca, the Duke of Reichstadt, the son of Napoleon, and the Prince of Capua, brother of the king of the Two Sicilies, were suggested. The choice of the last was seriously contemplated by the French, through Talleyrand; but the Belgians showed no predilection for him, although he was not objectionable to any of the four powers. Had the Belgians showed any decided eagerness for Prince Otho of Bavaria, it was known that he would have been recognised by England, France, and Prussia; and that he would then have obtained the hand of the Princess Mary, third daughter of the king of the French. But his age, for he was only fifteen, formed an objection with the Belgians. The popular press, decidedly democratic, was most united in favour of the Duke of Leuchtenburg; but its power had been used till it was exhausted; and, besides, the choice was in better hands than those who are influenced by its inflammatory declamations. It is remarkable, that amongst the long list of candidates the name of Prince Leopold was never once mentioned. It has been suggested that England had not even then abandoned the hope of fixing the Prince of Orange on the throne. This would have been approved of by Russia, Prussia, and Austria, and by the nobles and wealthier part of the Belgians, but not by France, as Louis Philip was disposed to fear that the example of enthroning the son of the deposed monarch might hereafter have been taken as a precedent in favour of the Duke of Bordeaux against his son in France. Belgium.

At the eve of the election, however, by some strange caprice of circumstances, all the names were withdrawn excepting the two, who, all intelligent persons knew, could not be allowed to rule. It was remarked of them by Northomb, one of the most respectable of the democratic members, that "the Duke of Leuchtenburg was essentially anti-French, without being European, whilst the Duke of Nemours was so exclusively French as to be directly anti-European." It is singular that both these personages had been declared inadmissible by the conference of the representatives of the great powers. The name of the Archduke Charles of Austria was then brought forward; but he could only be considered as a cloak for the partisans of the Prince of Orange, and for other members, who knew he would not accept the dignity, for the purpose of reducing that absolute majority of the whole voters which was necessary to the choice. The votes were taken by ballot, and the following result appeared when the names were drawn from the urn:—The total number of voters was 191, and consequently the required absolute majority was ninety-six. Nine members being absent, there appeared for the Duke of Nemours eighty-nine, for the Duke of Leuchtenburg sixty-seven, and for the Archduke Charles thirty-five, so that, in fact, there was no election. A new voting then became necessary, and the second scrutiny gave a definite result. Another member had entered, making 192, and consequently the absolute majority required was ninety seven. The state of the voting then appeared to be, for Nemours ninety-seven, for Leuchtenburg seventy-four, and for the archduke twenty-one. This annunciation was received with acclamation by the populace, and with expressions of joy by the partisans of the successful candidate, who well knew his father would not permit him to accept the offered crown. A deputation was despatched to Paris to announce the choice. But the throne was refused, and the deputies returned after paying and receiving some unmeaning compliments.

The moment was seized by the partisans of the Prince of Orange in order to raise a commotion in his favour. It was a wild project, confined to Ghent, Bruges, and Antwerp, where his adherents were numerous, especially amongst the lower class, who had been thrown out of employment by the cessation of commerce and manufactures. The attack on Ghent was speedily quelled, and the leader fled; but he was seized on his way to France, and on his person were found letters from the Prince of Orange, then in London, encouraging the project. This unsuccessful effort, and the evidence of the prince's participation in it, proved very injurious to his cause; and even sober men who had favoured him, were disgusted with what appeared to them to be an attempt to involve the country in a civil war.

On the refusal of France, the assembly, still feeling the

Belgium. want of an executive power, passed an act that the throne was vacant, thereby establishing the monarchical principle, and then proceeded to the election of a regent as a temporary measure. The choice fell upon Baron Surlet de Chokier, a worthy, well-meaning man, of no great abilities, who showed little solicitude for the dignity; and on the 25th of February he was installed with some parade. Plots and conspiracies were forming around him in every direction, and the demon of civil war was urging on the people to mutual destruction. The feeble government of the regent could produce neither obedience nor tranquillity within the country; and it was threatened by the Dutch, who adhered to their king and his purposes with equal union and ardour. It was reported, during the regency, that schemes for the dismemberment of Belgium were contemplated by some of the continental powers. According to this project, two thirds of Flanders, the province of Antwerp, and the northern half of Limburg and Brabant, including Brussels, would have fallen to Holland; the eastern part of Luxembourg, with Liège and other territories upon the left bank of the Meuse and the Moselle, would have been transferred to Prussia; and Namur, Hainault, and the west part of Flanders, would have been ceded to France. If this project was seriously entertained, it received such discouragement from the British government, that it was speedily abandoned. About the same period, that is, about a month after the instalment of the regent, extensive plans were formed for a general rising amongst the Orange party, in connection with some of the chief officers of the army and the most influential leaders of the burgher guards of Brussels. But this came to nothing, having, it is said, been discountenanced by the British minister at Brussels, who saw no other effect that could arise from it but a general European war. It is said that after some discussion respecting Luxembourg, and checking the petty hostilities on the frontier, the British government in April gave up all hope of establishing the Prince of Orange on the Belgic throne. On the 12th of that month a kind of proposition was made by some of the influential members of the assembly, and privately communicated to Sir Edward Cust, one of the equerries of Prince Leopold, with the design of ascertaining whether the prince, if chosen, would accept the crown. Leopold answered in the affirmative, but strictly abstained from giving any authority to make exertions in his favour. He was however convinced, before the election, that a vast majority of the electors would vote in his favour; and that he should have all the aid of the clergy and the high Catholic nobility, with no opposition but from the French and movement party, and the few Orangeists that had seats in the assembly. A deputation of four members repaired to Claremont, and had an interview with the prince. They explained their object, and the conditions upon which they were authorized to offer the crown, and awaited his reply. It manifested a noble, simple, and frank disposition, and concluded thus: "All my ambition is to contribute to the happiness of my fellow-creatures. When yet young, I found myself in so many difficult and singular situations, that I have learned to consider power only with a philosophic eye. I never coveted it but for the sake of doing good, durable good. Had not certain political differences arisen, which appeared to me essentially opposed to the independence of Greece, I should now be in that country; and yet I never attempted to conceal from myself the difficulties of my position. I am aware how desirable it is that Belgium should have a sovereign as soon as possible. The peace of Europe is deeply interested in it."

The deputation returned, and many stormy discussions ensued. Attempts were made to defer the election till all differences with Holland were settled; but these were overcome by the votes of 137 to 48. The election took place on the 4th of June, when 152 votes out of 196, four only being absent, determined that Prince Leopold should be proclaimed king of the Belgians. under the express condition, that he "would accept the constitution, and swear to maintain the national independence and territorial integrity." Belgium.

This choice, though not expressly unanimous, was such in reality; for of the minority of forty-three, nineteen voted on the ground that the election was premature, fourteen voted for Baron Surlet de Chokier, solely on account of private friendship, and thus the real opposition to Leopold consisted only of ten. Though the voting was by ballot, yet the vote of every man was known; and all who dared, gave reasons for it, except the ten, who were well known as terrorists.

Leopold lost no time in repairing to the post to which he was appointed, and, with only one aide-de-camp and a few domestics, landed at Ostend on the 17th of June, and proceeded directly through Ghent to the palace of Lacken, near Brussels. He made his public entry into that city on the 21st, and was received with cordiality by the higher classes, and by the populace with loud acclamations. The king took the oath to the constitution; the regent delivered up his power; and the congress was dissolved, to make way for the election of the members who were to form the two legislative chambers, as prescribed by the fundamental laws.

The first chamber, or the senate, was to consist of fifty members, chosen for eight years, but one half of them was to be renewed at the end of four years. The qualifications were to be, having attained the age of forty years, and paying direct taxes to the amount of 1000 florins, or L.84 yearly. The second chamber was to consist of 101 members, being at the rate of one for 40,000 inhabitants. They were to be of the age of twenty-five years, to pay annual direct taxes to the amount of L.8, and to be paid at the rate of 200 florins, or L.16, each month during the session. They were to be renewed by one half retiring at the end of two years, but they might be again elected.

After a few formalities, and appointing the ministers to compose the cabinet, on the choice of which much judgment was exercised, the king left the capital to visit Antwerp, Liège, and the other parts of the new kingdom, and was everywhere received with demonstrations of respect and of loyalty. But whilst the proceedings just narrated were passing in Belgium, a storm was gathering on the side of Holland, which had not been anticipated, and to meet which no adequate preparations had been made. The Belgians relied on the armistice which the conference of the ambassadors had established, and the few measures which were taken by them discovered only the confusion and disorder inseparable from all popular movements. In Holland, every thing betokened tranquillity, order, and loyalty. The different orders of the government and the people were more eager for punishing what they denominated the rebellion, than even the king and his family. A powerful army was quickly assembled. It was well disciplined, officered, and appointed, and furnished with an ample train of artillery; and yet all was done with so much secrecy, that till that army was ready to advance beyond the frontiers, no preparation was made to resist it.

Much dispute has arisen relative to the right of Holland to commence hostilities without due notice of the cessation of the armistice; but, on the other hand, Holland maintained that due notice had been given. The whole turned on the precise sense of the words "ses moyens militaires," in a note delivered by the Dutch ministers to the conference of ambassadors. The king was certainly encouraged in the enterprise by the stormy scenes exhibited in the Belgian assembly between the period of Leopold's election and the time of his arrival. By the noxious influence of the press, such angry passions had been kindled in every

Belgium. division of society, as seemed to threaten internal war; but happily a most powerful speech of Mr Lebau in favour of union, and urging the importance of rallying round their new monarch, had the effect of producing feelings of tranquillity; though no language had power to produce order or infuse energy, when the time approached for the exhibition of the one and the exercise of the other.

The Prince of Orange having assumed the command of the Dutch army at Breda, on the 1st of August, the order to advance was instantly given; and the march of the several divisions commenced the next day. This was a complete surprise to the Belgians, who were unprepared at every point to resist a disposable army of more than 40,000 men. It is not necessary here to describe the position and the movements of the various corps on both sides. It was, however, remarked by military men, that the Prince of Orange advanced more deliberately than the occasion required. Leopold collected his forces, such as they were, near Louvain, in order to cover his capital. In this position the Dutch army, having seized the road which led to Brussels on the 9th of August, advanced to attack him. The Belgian troops could not stand for a moment against their opponents, but instantly fled, throwing away their arms, and escaping in disorder; and a neglect of the Dutch, who thoughtlessly left open a road behind Louvain, alone prevented Leopold and his whole staff from becoming prisoners of war. He, however, made good his retreat to the capital, upon which all hostilities ceased. As soon as the movements of the Dutch were known, Leopold appealed to France for assistance. A French army was cantoned on the frontiers, which, by telegraphic communications, was instantly set in motion; and intelligence of their advance was formally announced to the Prince of Orange by Lord William Russell, coupled with an intimation, from the French marshal Gérard, of the determination of the two powers to enforce the abandonment of all military operations. As the French army rapidly entered the country, the Prince of Orange soon saw the necessity of retreating; and a convention was concluded between him and the French general, in consequence of which he returned to Holland, and the French repassed the frontier; so that by the 1st of September both armies had left the Belgian territory.

The cowardly disgraceful conduct of the Belgic troops was of great benefit to the new government. It showed the reflecting part of the community the folly of trusting the defence of their country to a host of popular partisans, too ready to destroy or to plunder, but too much inflated by the flattery they bestowed on themselves to become efficient defenders when steadily opposed. All saw the necessity of confiding in their chief, and became convinced that a regular army must be formed, in which the men should be compelled to obey their officers. The formation of an army was therefore determined on; but Belgium could not furnish officers. Most of those appointed had been placed in stations of which they were unworthy, because they had been what was called distinguished patriots, that is, leaders of the revolutionary movements; but those active disorganizers were found worse than useless when energy against an enemy required order, discipline, and obedience. By the interference to protect Belgium against Holland, this farther advantage was gained, that the protecting powers were placed in a position to obtain more weight in the negotiations carried on in the conferences of the ambassadors, and both parties were more disposed to leave the contested points respecting boundaries to their arbitration.

In forming an army, Leopold was assisted by the French, who, as far as could be done, furnished it with able officers; a want which Belgium could by no means supply from the natives of that country. The partisans of the Orange family, on this occasion, justified the conduct of King William previous to the revolution, in having selected few of his officers from the Belgians. The selection of Frenchmen, they contended, proved that William was right in not trusting to officers taken from that division of his kingdom. Belgium.

After the Dutch irruption, Leopold proceeded with coolness and vigour to restore order and gain confidence. He kept on the best of terms with the most important party, the Catholic clergy and the Catholic nobility, and avoided any nearer contact with the French party than politeness and civility required. He knew who were the real friends of monarchical government, and his best supporters. His marriage with a daughter of the king of the French, who was a Catholic, and the contract that the children of the marriage should be educated in the Catholic faith, were powerful means of attaching to his throne all those of his subjects who were under the influence of the clergy. The Belgian army, under the French officers, soon attained considerable advancement in organization and discipline. The undisciplined free troops were disbanded, and the best of the men incorporated in the regiment of chasseurs. Some superior officers were superseded, and many of the subalterns dismissed. A military school was established, and a corps of sappers and miners with a pontoon brigade raised.

The civil list was arranged with economy and order, and the other branches of the public service reformed, and others newly arranged. The talents and the integrity of Leopold, and his benevolent disposition, made a very favourable impression on all that approached him.

Whilst affairs were thus proceeding within, the great work of general pacification was attended to by the members of the conference in London. A final decision was come to on the 15th of November, expressed in twenty-four articles. These settled the great point of boundaries, and placed the question of Luxembourg in a way the most favourable, as was thought, for future pacific arrangement; but, above all, it expressed a determination "to oppose, by every means in their power, the renewal of hostilities between the two countries." This arrangement was ratified by the Belgian and French sovereigns on the 20th and 24th of November, by the British on the 6th of December, by Austria and Prussia on the 18th of April 1832, and by Russia on the 4th of May.

By these articles, the division of the joint debt was fixed on the scale before arranged, viz. $\frac{1}{31}$ for Belgium, and $\frac{5}{31}$ for Holland; but as the latter had discharged the whole interest as it became due from the first disturbances, she was to be paid the share of the advances, with interest on them at the rate of five per cent. Another point arose out of the settlement of the limits of the two countries Holland was to have Maestricht, and was in actual possession of that place and its citadel; but Antwerp, which was allotted to Belgium, and was in possession of the Belgians, was commanded by the citadel, which was garrisoned by a Dutch army under the command of General Chassé, a distinguished officer, who, after the annexation of Holland to France, had served in the army of the Emperor Napoleon. The Belgians had given only a conditional ratification of the articles of the 15th of November, upon the express stipulation that the whole of them, in which the possession of the citadel of Antwerp was certainly included, should be fulfilled. They were precluded by that instrument from exercising hostilities, and therefore claimed from the parties to it the performance of its conditions.

It was important to the allied powers that the throne which they had established in the person of Leopold should be strengthened in the views of his subjects, who had sometimes manifested dispositions to democracy, and at others strong inclinations for a union with France, neither of which were deemed compatible with the interests of the European commonwealth. But it could not retain respect if the con-

Belgium. ditions framed by the founders were to be impugned by the Dutch holding the citadel of Antwerp, whilst they were still in possession of Maestricht. These considerations had their due effect on the conference, who, on the 1st of October, unanimously resolved that forcible means were necessary. They differed in regard to the means, the northern courts wishing to adopt pecuniary coercion, by deducting from the debt due from Belgium to Holland a sum weekly till the fortress was delivered up; but to this France and England objected, as leading only to future and tedious negotiations, during which Rotterdam and Amsterdam might enjoy those exclusive commercial advantages which Antwerp was entitled to share with them.

Belgium, being wearied with these entangled negotiations, and having now created an army of more than 100,000, gave notice that, unless their territory was evacuated before the 3d of November, they would use force to compel it. But this would have created a war, which all the powers were anxious to prevent. On the 22d of October, a convention was therefore entered into between England and France, which was forthwith communicated to the three other powers, of whose passive adhesion they were assured.

By this convention it was determined, that if the places assigned by the former resolutions to the respective parties were not given up before the 12th of November, France and England would enforce the delivery of these places. This determination was communicated to both nations. Belgium was ready to give up Venloo, which she held; but Holland positively declined surrendering the citadel of Antwerp. The result was, that a combined fleet of English and French proceeded to blockade the ports of Holland, and detain the merchant-ships, whilst France prepared an army to besiege the citadel, without allowing the Belgians in any way to interfere in the military operation. The siege of Antwerp by the French, as a fine practical exemplification of science, became an object of great interest to the military amateurs of all Europe, who repaired thither as spectators. But this is not the place for recording the history of that warlike spectacle. It was vigorously and skilfully attacked; and the defence, which was altogether passive, exhibited a conspicuous example of fortitude and endurance. The first works of the besiegers were opened on the 30th of November, and on the 24th of December the citadel capitulated, when the garrison marched out, and the French took possession of the battered fortress, which, on the 1st of January, they delivered up to the Belgians. The city of Antwerp was not in the least injured, as the approaches were carried on upon the opposite side. The French army shortly afterwards withdrew from Belgium to its own territory. The Dutch garrison was marched into France as prisoners, on the ground that two forts on the river Scheldt, those of Lillo and Liefenschoeck, were still retained by the Dutch. This led to long and complicated diplomatic negotiations, which were at length adjusted, when the captured garrison returned to their own country. On the 16th of May 1833 an indefinite armistice was agreed upon, and on the 21st a provisional convention was signed, which preserved the liberty of the Scheldt, regulated the tolls of the Meuse by the tariffs of Mayence, maintained the existing territorial arrangement, including therein Luxembourg, raised the embargo on the Dutch ships, and set at liberty all the Dutch prisoners kept in France since the siege of Antwerp. Nevertheless, the house of Orange still numbered many partizans among the people, and when the government sequestrated its possessions in Belgium murmurs were heard in many towns, chiefly at Ghent, Liège, Antwerp, and Brussels. The people thus irritated became violent; at Brussels they pillaged the houses of the principal Orangists, and were appeased with difficulty. All the attention of the government of King Leopold was given to the encouragement of Belgian commerce, which the revolution had almost annihilated. In 1838 a financial crisis endangered the bank, which was constrained to suspend its payments. The government, however, came to its aid, and soon restored public confidence. Belgium.

On the 14th of March of the same year, Holland signified readiness to accept the treaty of the twenty-four articles. This announcement produced an extraordinary movement in the kingdom, for since the year 1830 Luxembourg and Limbourg were identified with Belgium, and sent representatives to both chambers; addresses were sent to the government from all parts of the country, the Brabant colours were hoisted, and the people were roused by protestations of the most energetic kind. Leopold was in the meanwhile obliged to yield to the representations of Prussia and Austria, and in 1839 the Belgians had to abandon more than one-third of the provinces of Luxembourg and Limbourg. A subsequent treaty was formed on the 19th of October 1842, which had for its object the settlement of the debts chargeable against Holland and Belgium. By this it was agreed that Belgium should only be liable for an annual payment of five millions of florins, instead of eight millions four hundred thousand florins, which had been imposed upon it by the treaty of November 15. 1831.

In the same year was discovered a conspiracy to place the Prince of Orange upon the throne. The generals Vandermeer and Vandersmissen were at the head of this movement. They were tried before the tribunals, and condemned to death, but the king commuted their punishment to twenty years' imprisonment. Vandersmissen effected his escape, and Vandermeer was afterwards pardoned on condition of retiring to America.

During the revolutions and insurrections of 1848, Belgium was one of the few European kingdoms in which tranquillity was maintained, for which it was mainly indebted to its constitutional government and the wisdom and liberality of its sovereign. On the 11th October 1850 the queen Louise died, leaving two sons and a daughter.

Situation and extent. Belgium extends from Lat. 49. 27. to 51. 30. N. and from Long. 2. 34. to 6. 4. E. On the N. it is bounded by Holland; E. by Dutch Limbourg and Luxembourg, and Rhenish Prussia; S. by France; and on the W. by the North Sea. It is somewhat of a triangular form, of which the longest side is that adjoining France, being 366 miles in length. The eastern boundary is 233 miles, and the northern and western are together 279 miles in length. Its greatest length from N.W. to S.E. (from Ostend to Arlon) is 56 leagues of 5000 metres, or 174 English miles, and its greatest breadth from N. to S. is 105 miles. It has an area of 2,945,593 hectares, equal to 7,278,968 English acres, or 11,373 square miles; being about one-eighth of the area of Great Britain. This country is divided into nine provinces—Antwerp in the N.; West and East Flanders and Hainault in the W.; Namur in the S.; Luxembourg in the S.E.; Liège and Limbourg in the E.; and Brabant in the centre.

Physical description. Belgium is in general a very flat country with few elevations, and these rarely exceeding 2000 feet in height. They are principally to be found in the E. and S.E., while the N. and N.W. parts of the country bear a considerable resemblance to Holland. The elevations of Belgium take their rise in France, and extend generally in a N.E. direction. A chain proceeding from the neighbourhood of the sources of the Saone separates the waters of the Meuse from those of the Moselle, passes Arlon and Neufchateau, then extends in a north-eastern direction towards Bastogne, and finally enters Prussia. A branch of this chain goes off at Neufchateau, proceeds northward towards Liège, passes St Hubert, and separates the Ourthe from the Meuse. A part of the Ardennes also extends into Belgium, and separates the basin of the Meuse from that of the Scheldt. It pro-

Belgium. ceeds in a north-eastern direction, passing Fontaine l'Eveque, Gembloux, Ramillies, and Tongres, then, gradually decreasing in height, it turns northward to Asch, and afterwards N.W. to Hechtal, Lommel, and Turnhout. A series of heights on the frontier of France, near Chimay, extend in a N.W. direction towards Namur, and separate the Meuse from the Sambre.

The provinces of Liège, Luxembourg, and Namur present the greatest irregularities of surface. This part of the country is intersected by numerous ravines and streams with steep and rocky banks, by deep valleys, and by ridges of hills, with frequently precipitous and rocky escarpments. The vegetation here is of a very poor and languid character. The greater part of this region is covered with dense forests, marshy and uncultivated plateaux, or wretched pasture land, and corn is very rarely cultivated. The inhabitants are a primitive and pastoral race, principally engaged in the tending of flocks, which constitute their chief riches. Descending towards the coast the forests become less frequent and extensive, and rye, oats, and potatoes take the place of the pasture land. In the western and north-western provinces are extensive and well-watered plains which, from their great fertility and the high state of their cultivation, are the boast of the Belgians and the admiration of strangers. Even here, however, are to be seen occasional patches of waste land and uncultivated heaths, particularly in the provinces of Antwerp and Limbourg. From the improvements which have been going on lately, it is expected that at no distant period these shall have all disappeared.

Polders. In the provinces bordering on the sea, the land is in some places so low as to require to be protected from inundation by dikes. Those places are called *polders*. Numerous places along the banks of the rivers are also protected by embankments; these are called *interior polders*. About a sixtieth part of the kingdom is thus artificially gained from the sea and rivers, being 50,000 hectares, or 193 square miles.

The coast of Belgium is said to be undergoing a change similar to that of Scandinavia,—in some parts a gradual elevation, and in others a gradual depression. Nieuport is said to be the axis of this change, from which, northward to the mouth of the Scheldt, the sea is continually gaining upon the land, while southward to Pas de Calais it is losing.

Rivers. This country is watered by the rivers Scheldt, Meuse, and Yzer, with their tributaries. The Scheldt is navigable during its entire course through Belgium, and has a general direction from S.W. to N.E., passing through the province of Hainault, along the eastern boundary of West Flanders, traversing East Flanders, and finally forming the boundary between the provinces of East Flanders and Antwerp. Its entire length through Belgium is 108 miles. The Meuse has a course nearly parallel to that of the Scheldt, traversing the provinces of Namur, Liège, and Limbourg. It is 115 miles in length, during the whole of which it is navigable. The small river of Yzer, which enters the sea at Nieuport, is navigable for about 26 miles. The navigable rivers connected with the Scheldt are,—the Dyle, which after receiving the Nethe at the village of Rumpst, takes the name of Ruppel, and joins the Scheldt nearly opposite to Ruppelsmonde; the Great and Little Nethe, which after their junction take the name of Nethe and fall into the Dyle; the Demer, also an affluent of the Dyle; the Dender, which enters the Scheldt at Dendermonde; the Durme, which joins it near Thielrode; and the Lys at Ghent. The entire navigable length of these streams is 230 English miles. The navigable rivers of the Meuse are: the Amblere and the Vesdre, affluents of the Ourthe; the Ourthe, which joins the Meuse at Liège; and the Sambre, which joins it at Namur. The navigable length of these is 142 miles. The small river of Yperlee, which joins the Yzer, is navigable for about nine miles. The principal other rivers are the Senne, Belgium. the Haine, the Semoy, and the Lesse.

Canals. Besides these navigable rivers, Belgium has a number of canals for inland navigation, some of which are used also for irrigation. They are 29 in number, and their entire length is 605,440 metres, or 376 English miles. The principal of these are,—the canal from Bruges to Ostend, that from Brussels to Charleroy, from Bocholt to Herenthal, from Brussels to Willebroeck, from Ghent to Bruges, from Liège to Maestricht, from Maestricht to Bois-le-Duc, from Pommeroeul to Antoing, from Plasschendaele to Nieuport, the Louvain canal, the Lieve, and the Moevaert. Each of these canals is upwards of 12 miles in length, and the longest, that from Brussels to Charleroy, upwards of 46 miles. The entire length of the river and canal navigation of Belgium is therefore 1006 English miles.

Mineral springs. Belgium possesses a number of mineral springs, the principal of which are the hot springs of Chaudfontaine, situated about five miles from Liège, and the mineral spring of Tongres See LIÈGE and TONGRES. But the most celebrated waters are those of Spa, of which an account is given under that head. See SPA. The ferruginous springs of Huy were formerly in considerable repute, but are now little used.

Climate. The climate of Belgium is considered as very similar to that of England, and is more temperate and salubrious than that of Holland. In the south-eastern parts the atmosphere is more pure and bracing than in the lower parts towards the N.W., where it is frequently damp and hazy. Frost rarely appears before the middle of October or after the middle of April. From observations made at Brussels for the eighteen years preceding 1851, the mean annual temperature was found to be 50°·3 Fahr.; the maximum mean being 55°·8, and the minimum 43°·5 Fahr. During that period there were no frosts in the five months from April to October, and only twice snow in May and three times in October. The average number of foggy days annually was 58·1, and with thunder 13·2. The annual average of rainy days was 191·4; the quantity being 27·9 inches. The average annual fall at Greenwich during the last 37 years was 27·1 inches.

Civil state. Since the formation of Belgium into an independent state, the government has taken a laudable interest in all that concerns the happiness and improvement of the people; and not being trammelled by a respect for old laws or useless customs, they have adopted as far as possible the most improved systems of other countries. The whole system of government is based upon the broadest principles of rational freedom and liberality; all power emanates from the people, and can only be exercised according to law. The people are upon a strict equality in the eye of the law, personal liberty is guaranteed to all, as well as entire freedom in opinion and in religious worship. All the religious sects are endowed by the state, and large grants are also given annually for educational and charitable purposes. Home is inviolable, nor can any one be deprived of his property unless for the good of the state and for a suitable indemnity. Justice is open to all, as well as the means of education, and the benefits of the public charities. The press is free, and civil death is abolished. Any one may address petitions to the public authorities, signed by one or more persons. Trial by jury is established for all criminal and political charges, and for offences of the press. The contents of letters are inviolable, and the post-office is responsible for all letters committed to it.

Government. The government is a constitutional representative and hereditary monarchy. The legislative power is vested in the king, the chamber of representatives, and the senate. The judicial power is exercised by fixed tribunals, freed from all authoritative influences, judging publicly and assigning reasons for their decisions. The provincial and communal affairs are managed by local councils chosen by the people.

King. The royal succession is in the direct male line in the order

Belgium. of primogeniture, to the exclusion of females and their descendants. The king's person is declared sacred; and his ministers are held responsible for the acts of the government. No act of the king can have effect unless countersigned by one of his ministers, who thus becomes the responsible party. The king convokes, prorogues, and dissolves the chambers, and makes rules and orders necessary for the execution of the laws; but has no power to suspend or dispense with the execution of the laws themselves. He nominates to civil and military offices, and commands the sea and land forces. He declares war, and concludes treaties of peace, of alliance, and of commerce, communicating the same to the chambers as far as may be consistent with the interest and safety of the state. Those treaties which may be injurious to the state or to the individual interests of the people can only have effect after obtaining the sanction of the chambers. No surrender, exchange, or addition of territory can be made except when authorized by a law passed by the chambers. In no case can the secret articles of a treaty be destructive or contrary to the patent ones. The king sanctions and promulgates the laws. He has the power of remitting or reducing the punishments pronounced by the judges, except in the case of his ministers, to whom he can extend pardon only at the request of one of the chambers. He has the power of coining money according to law, and also of conferring titles of nobility, but without the power of attaching to them any privileges. In default of male heirs the king may nominate his successor with the consent of the chambers. On the death of the king the chambers assemble without convocation at latest on the tenth day after the decease. From the date of the king's death to the administering of the oath to his successor or to the regent, the constitutional powers of the king are exercised in the name of the people, by the ministers assembled in council, and on their own responsibility. The regency can only be conferred upon one person, and no change in the constitution can be made during the regency. The successor to the throne, or the regent, can only enter upon his duties after having taken an oath, in presence of the assembled chambers, to observe the constitution and the laws, to maintain the independence of the nation and the integrity of its territory. If the successor be under eighteen years of age (which is declared to be the age of majority), the two chambers meet together for the purpose of nominating a regent during the minority. In the case of a vacancy of the throne, the two chambers, deliberating together, nominate provisionally to the regency. They are then dissolved, and within two months the new chambers must assemble, which then provide definitively to the vacancy.

Chambers. The people are represented in the legislature by the Chamber of Representatives and the Senate, the members of which are chosen by the people. The sittings are public; but by the decision of the majority either chamber may form itself into a private committee. No one can at the same time be a member of both chambers, and no member can retain his seat after obtaining a salaried office under the government except on being re-elected. No member can be called in question for any votes or opinions he may have given in the performance of his duties. No member can be prosecuted or arrested during the session, without the consent of the chamber of which he is a member, except in the case of flagrant offence. Each chamber determines the manner of exercising its own powers, and every session nominates its president and vice-presidents, and forms its *bureau*. No petition can be presented personally; and every resolution is adopted by the absolute majority, except in some special cases, when two-thirds of the votes of the members are required to be favourable; in the case of an equality of votes the proposition is thrown out. The chambers meet annually in the month of November, and ought to sit for at least forty days; but the king has the power of convoking them on extraordinary occasions, and of dissolving them either simultaneously or separately. In the latter case a new election must take place within forty days, and a meeting of the chambers within two months. An adjournment cannot be made for a period exceeding one month without the consent of the chambers. Belgium.

Chamber of Representatives. The Chamber of Representatives is composed of deputies chosen directly by the people paying a certain amount of direct taxes. The number of deputies is fixed according to the population, and cannot exceed one member for every 40,000 inhabitants; at present they amount to 108. The members represent the nation generally, and not merely the province or division by which they are nominated. To be eligible for a member it is necessary to be a Belgian by birth, or to have received the grand naturalization; to be in the possession of the civil and political rights of the kingdom; to have attained the age of twenty-five years; and to be resident in Belgium. The members not residing in the town where the chamber sits receive during the session an indemnity of 200 florins (L.16, 13s. 4d.) each per month. The members are elected for four years, one-half going out every two years, except in the case of a dissolution, when a general election takes place. This chamber has the parliamentary initiative and the preliminary vote in all cases relating to the receipts and expenses of the state, and to the contingent of the army.

Senate. The electors of the Chamber of Representatives have also the nomination of the members of the Senate. To be eligible as a senator it is necessary to be a Belgian by birth, or to have received the grand naturalization; to be in the enjoyment of civil and political rights; to be domiciled in Belgium; to be forty years of age; and to pay at least 1000 florins (L.84) of direct taxes. In those provinces where the number of those paying 1000 florins of taxes does not amount to one in every 6000 inhabitants, this proportion is made up by those paying the highest amount below that sum. The permanent deputation of the provincial councils annually prepare a list of those who are eligible to the senate. In 1850 the number of these was 726, of whom 405 were paying the prescribed amount of taxes, and 321 were supplementary. At the age of eighteen the heir-presumptive to the throne has a seat in the senate, but has no voice in its deliberations till he attain the age of twenty-five. The senators receive no indemnity. They are elected for eight years, one-half going out every four years, except in the case of a dissolution. The senate is composed of half as many members as the chamber of representatives, the number at present being 54.

Electors. The amount of direct taxes paid in order to qualify one to be an elector is fixed by the electoral law. The standard varies in different localities, but can never be below 20 florins (33s. 4d.), nor above 100 florins. At the last general election which took place in 1848, the number of electors, voters, &c., in each of the provinces was as follows:—

Provinces.	Electors.	Voters.	Representatives.	Senate.	Electors p. 1000 Inhabitants.
Antwerp, ...	8,229	5,298	10	5	20·25
Brabant, ...	15,333	10,067	17	9	22·21
West Flanders,	10,359	7,554	16	8	16·12
East Flanders,	15,088	9,669	20	10	19·06
Hainault, ...	12,412	8,074	18	9	17·34
Liège, ...	8,090	5,200	11	6	17·90
Limbourg, ...	2,918	2,275	5	2	15·70
Luxembourg,	2,722	2,011	5	2	16·62
Namur, ...	3,925	2,797	6	3	14·90
	79,076	52,955	108	54	18·24

A partial election of representatives took place in 1850, viz., for the provinces of Antwerp, Brabant, West Flanders, Luxembourg, and Namur. The number of electors, &c., was:—

Provinces.	Electors.	Voters.	Representatives.
Antwerp, ...	8,525	7,060	10
Brabant,.....	15,030	10,264	17
West Flanders,	10,162	7,746	16
Luxembourg,...	2,711	1,921	5
Namur, ...	4,007	3,159	6
	40,435	30,150	54

Ministers. The king appoints and dismisses his ministers at pleasure. No member of the royal family can be a minister, nor any but a Belgian, or one who has received the grand naturalization. Ministers have a right of admission to the chambers and to demand a hearing; but have no voice in the deliberations unless they are members. The chambers can at any time demand the presence of the ministers. No act or writing by the king can free a minister from responsibility. The chamber of representatives has the power of accusing the ministers, and of bringing them before the court of cassation, which alone has the right of judging them, in all cases of offences committed in the exercise of their functions. There are six ministers, viz., a minister of foreign affairs, of the interior, of justice, of finance, of war, and of public works.

Divisions. For civil purposes the provinces are divided into 26 arrondissements, 203 justice-of-peace cantons, and 2528 communes; and for military purposes, into 4 arrondissements, 268 military cantons, and 2198 communes. The following table gives the civil divisions of each province:—

Provinces.	Arrondissements.	Cantons.	Communes.
Antwerp, ...	Antwerp,	7	57
	Malines,	6	39
	Turnhout,	6	50
Brabant.....	Brussels,	10	120
	Louvain,	7	111
	Nivelles,	5	107
West Flanders	Bruges,	10	77
	Courtray,	11	67
	Turnes,	4	58
	Ypres,	7	47
East Flanders	Oudenarde,	8	113
	Ghent,	14	105
	Termonde,	10	75
Hainault	Charleroy,	9	147
	Mons,	9	140
	Tournay,	11	140
Liège.....	Huy,	7	131
	Liège,	8	144
	Verviers,	6	56
Limbourg	Hasselt,	6	76
	Tongres,	7	127
Luxembourg.....	Arlon,	6	60
	Marche,	7	67
	Neufchateau,	7	68
Namur	Dinaut,	9	222
	Namur,	6	124
	Total	303	2528

In each province is a governor named directly by the king for the purpose of superintending and securing the due execution of the laws, and a provincial council, the members of which are chosen directly by electors having the same qualifications as the electors to the legislative chambers.

Provincial councils. The councils are composed of Belgic citizens at least twenty-five years of age, residing in the province, and in the enjoyment of civil and political rights. Members of the chambers, governors, and persons in the employment of the state or province, are excepted. They have an annual session of not more than four weeks; but the king can convoke them on extraordinary occasions. Those not residing in the provincial capital receive an indemnity during the session.

In 1836 the number of councillors for each province was fixed according to the population, as follows: for the provinces of Brabant, West Flanders, East Flanders, and Hainault, one to each 10,000 inhabitants; for Antwerp, Liège, Limbourg, and Luxembourg, one to each 7500; and for the province of Namur one to each 5000 inhabitants. It was, however, agreed that every canton should have at least one councillor, whatever might be its population, and that the same scale should be applicable to it as to the province in which it was situated. The treaty of 1839 having reduced Luxembourg and Limbourg, the proportion for these was fixed at one to each 5000. The number of councillors in 1850 was 461, as follows: Antwerp 46, Brabant 57, West Flanders 64, East Flanders 73, Hainault 61, Liège 50, Limbourg 33, Luxembourg 34, and Namur 43. The number of electors in each electoral section cannot exceed 600 nor be below 200. The number of ordinary electors was 78,228, and of supplementary 5003.

Belgium.

These councils are of the highest importance to the country. They watch over the interests of their various provinces, prepare the budgets, direct the taxation, and superintend public works. They give a healthy impulse to agriculture, trade, and commerce; direct the construction of roads, canals, and bridges; and extend the benefits of education and religion throughout the country. The communes have the power of appeal to the king if they consider themselves aggrieved by any of the acts of the provincial council, or of the permanent deputation. In the ten years preceding 1851 only two appeals had been made against the provincial council, and thirty against the permanent deputation; and in only two of these had the decisions been altered.

Permanent deputation. Each provincial council appoints a permanent deputation for conducting business in the interval between the sessions, particularly in matters requiring immediate attention. It is composed of six members chosen for four years, one-half going out every two years.

Communal councils. Matters exclusively communal are managed by communal councils. The councillors are Belgic citizens in the full enjoyment of civil and political rights, and, except in some special cases, resident in the commune. They are elected for six years, one-half going out every three years. The number of the councillors varies from 7 to 31, in proportion to the population of the commune, varying from under 1000 to upwards of 70,000 inhabitants. All citizens paying taxes varying from 15 francs (nearly 12s.) to 42 francs 32 cents (L.1, 13s. 6d.), according to the population, have a vote in the election of communal councillors. Of the 4,338,447 inhabitants in 1848, 194,413 were electors, and 20,849 councillors were elected, of whom $\frac{7}{10}$ths had been previously elected. Communes with less than 20,000 inhabitants have two aldermen, and those having more than that number have four. There is also in each commune a burgomaster, who, as well as the aldermen, is chosen by the king from among the members of the communal council.

Judicial system. The judicial system of Belgium consists of courts and tribunals of various kinds, as the court of cassation, the courts of appeal, of assize, tribunals of primary instance, of commerce, &c.

For all criminal and political cases, as well as offences of the press, trial by jury is established. The jury is composed of twelve persons chosen by lot from a leet of thirty, partly by the public minister and partly by the accused.

Justices of the peace and judges of the tribunals are chosen directly by the king. The councillors of each court of appeal, and the presidents and vice-presidents of the tribunals of primary instance in its district, are chosen by the king from two double lists of candidates, the one presented by the court of appeal, and the other by the provincial council. The councillors of the court of cassation are named by the king from two double lists, the one presented by the senate, and the other by the court of cassation. The judges are appointed for life, and cannot be suspended or deposed but by a judgment. They cannot hold any salaried office under the government, or at least must perform the duties of it gratuitously. The duties of public minister at the court

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of cassation are exercised by a procurator-general and two advocates-general; and by a royal procurator with substitutes before each of the tribunals of primary instance and courts of assize and appeal.

Court of Cassation.

The Court of Cassation or annulment sits at Brussels, and is divided into two chambers, the one for civil and the other for criminal matters. It is composed of a president-general, a president of each chamber, and fifteen councillors. It decides upon appeals against judgments pronounced in the other courts and tribunals in contravention of legal forms.

Appeal courts.

There are three courts of appeal: one at Brussels, for the provinces of Antwerp, Brabant, and Hainault; another at Ghent, for the two Flanders; and a third at Liège, for Liège, Limbourg, Luxembourg, and Namur. These decide upon appeals from the decisions of the tribunals of primary instance in civil matters, and affairs of commerce and correctional police.

Courts of assize.

In the capital of each province is a court of assize, composed of a councillor deputed from one of the courts of appeal, who presides, and of two judges chosen from among the presidents and judges of the primary tribunal where the court is held. Crimes, graver misdemeanours, political offences, and abuses of the press, are judged by the courts of assize.

Primary tribunals.

In each judiciary arrondissement is a tribunal of primary instance, judging in misdemeanours belonging to the correctional police, in civil matters, and in commercial affairs where there is no commercial tribunal, but in cases above 2000 francs (L.79) its decision may be brought before the courts of appeal. The number of judges varies from three to ten in each tribunal, amounting in all to 148.

Tribunals of commerce.

Tribunals of commerce are established by law in several principal towns. They judge definitively in civil matters of not more than 2000 francs, but above that sum their decisions are subject to appeal, as in the tribunals of primary instance. Each is composed of a president, from two to eight judges, and substitutes. The members of the tribunal are chosen by the leading commercial men, amounting in 1850 to 1759. There are thirteen tribunals of commerce, established in the towns of Antwerp, Brussels, Louvain, Mons, Tournay, Bruges, Ostend, Courtray, Ghent, St Nicolas, Liège, Verniers, and Namur.

Councils of prud' hommes.

In several of the manufacturing towns are councils of *prud'hommes*, composed of master tradesmen and workmen chosen for three years, a part going out annually. The number of members varies from five to nine in each council, except in that of Brussels, which has fifteen members. They decide in all questions and disputes arising between masters and workmen. A special board of two members first attempts to effect a reconciliation between the parties, and if unsuccessful the matter is then brought before the council for decision. Previous to 1843 there were only two of these councils, one at Ghent and the other at Bruges. Since then government has been authorized to establish twenty additional ones, and of these thirteen are now in operation.

Justice of peace.

In each canton is a justice of the peace, with a registrar and two substitutes. These constitute tribunals of simple police for the trial of offences involving a fine of not more than 200 francs (nearly L.8), or imprisonment for not more than eight days. The commissary of police performs the duties of public minister.

Councils of war.

Councils of war are held in the chief place of each province, with the exception of Limbourg, which is joined to Liège, and of Luxembourg, which is united with Namur. They decide in crimes and misdemeanours committed in their provinces by the military of a rank not higher than captain. They are composed of seven members, including the president, who ought all to be of the grade of officers.

Military court.

The military court for the whole of Belgium has its seat at Brussels. It is composed of five members, one of whom is a councillor of the appeal court of Brussels, delegated annually to preside; the rest are general or superior officers chosen by lot every month. It decides on appeals from the courts of war. All officers of a grade superior to that of captain are amenable to this court.

Belgium.

Police.

Besides the several bodies of ordinary police, there are commissaries of police, royal procurators, *juges d'instruction*, &c. The commissaries of police, and, in the communes where these are wanting, the burgomasters or delegated aldermen, are specially charged with searching out and proving all contraventions of the police laws. The royal procurators are charged with discovering and prosecuting for all offences coming within the jurisdiction of the courts of assize or the correctional tribunals of police. There is at least one *juge d'instruction* or examining judge in each arrondissement (in Brussels there are three). They are chosen by the king from among the judges of the tribunal, and continue in office for three years. They are specially charged with the collection of evidence, and with bringing the culprit before the tribunal. There is a council-chamber composed of at least three judges, including the *juge d'instruction*, for the preliminary examination of culprits.

Prisons.

The prisons are of three classes:—1. Houses of municipal police; 2. Houses of arrest and justice; and, 3. Central houses of punishment. Of the first class there are 168, containing, in 1850, 10,373 prisoners. In the capital of each province the seat of a court of assize is a house of justice; and in the capital of each arrondissement the seat of a court of primary instance is a house of arrest. In connection with many of these, schools, workshops, and circulating libraries have been established. There are eight central houses of punishment:—1. At Ghent, for compulsory labour; 2. At Vilvorde, for seclusion; 3. At St Bernard (near Antwerp), for correctional imprisonment: 4. Military house of detention at Alost; 5. Female penitentiary at Namur, for those condemned to imprisonment, seclusion, or compulsory labour; 6. Penitentiary of St Hubert (Luxembourg), for young male delinquents condemned to at least six months' imprisonment, and for children acquitted as having acted without discernment; 7. A penitentiary at Liège for young females, similar to the preceding; 8. The citadel of Huy, for persons convicted of political offences. Each prison is under the direction of a committee of management, whose services are gratuitous. The superior board of control has the general superintendence of the prisons, and an inspector-general and two comptrollers are charged with their inspection and direction. In each central prison are schools, at which attendance is obligatory on all prisoners under forty, and optional for those above that age. The number attending these schools in 1850 was 3578, or about 68 per cent. of the prisoners.

The prisoners are employed in various kinds of work. Those condemned to compulsory labour receive no remuneration, but those condemned to seclusion or correctional imprisonment receive a part of the produce of their labour, and which, in the case of the latter is frequently applied in mitigation of their punishment. Premiums are also given for good conduct, zeal, and progress in their labours. The total expense of the prison establishments for 1849 was 4,133,703 francs.

Population.

The population of Belgium in 1831 was 3,785,814; in 1840, 4,073,162; and in 1850, 4,426,202; distributed as follows:—

	1831.	1840.	1850.
Antwerp	349,942	371,157	420,556
Brabant	561,828	621,072	734,617
West Flanders	608,226	646,054	631,137
East Flanders	742,973	779,466	783,450
Hainault	613,179	661,701	733,740
Liège	375,030	410,171	467,843
Limbourg	160,090	169,960	188,198
Luxembourg	160,762	174,719	192,588
Namur	213,784	238,862	274,073
	3,785,814	4,073,162	4,426,202

Belgium.

The increase for the first period was 7·60 per cent., and for the second 8·67 per cent. At the date of the general census in 1846 Belgium contained 86 towns, 2436 rural communes, and 4,337,196 inhabitants. The first-class towns were—Brussels, 123,874 inhabitants; Ghent, 102,977; Antwerp, 88,487; Liège, 75,961. The second-class were—Bruges, 49,308; Louvain, 30,278; Tournay, 30,125; Malines, 29,693. Those having from 20,000 to 25,000 inhabitants were Mons, Verviers, Namur, Courtray, and St Nicolas; from 15,000 to 20,000, Alost, Ypres, and Lokeren; and from 10,000 to 15,000, Turnhout, Ostend, Lierre, Renaix, Thielt, St Troud, Roulers, Poperinge, and Tirlemont.

According to that census the density of the population averaged 147·24 inhabitants per 100 hectares, or 247 acres. The density, however, varied considerably in the different provinces, as will be seen from the following table:—

	Population.	Extent in Hectares.	Proportion of the Average to the Kingdom.
East Flanders	793,264	299,787	1·797
Brabant	691,357	328,323	1·457
West Flanders	643,004	323,448	1·350
Hainault	714,708	372,205	1·304
Liège	452,828	289,319	1·063
Antwerp	406,354	283,311	0·974
Limbourg	185,913	241,315	0·523
Namur	263,503	366,181	0·489
Luxembourg	186,265	441,704	0·287

The proportion falls below the general average in the provinces of Antwerp, Limbourg, Namur, and Luxembourg, and exceeds it in the other five.

The number of dwelling-houses was 799,848; of which 625,498 were of one story, 146,464 of two stories, and 127,886 of three or more stories; 160,471 were insured, the amount of capital insured being 1,093,030,336 francs. The number of families was 890,566; of which 154,454 inhabited only one apartment, 282,785 two apartments, and 453,327 three or more apartments. The number of married persons in 1846 was 1,322,588; of unmarried, 2,771,975; and of widows, widowers, and divorced, 242,633;—4,242,380 were born in Belgium, 34,600 in France, 12,859 in Germany, 3828 in England, 38,910 in Holland (including Dutch Luxembourg and Limbourg), and 4624 in other countries.

Languages.

The principal languages spoken in Belgium are French, or Walloon (a dialect of the ancient French), and Flemish or Dutch. French is the language of the upper and educated classes, and is generally understood even in the Flemish parts of the kingdom. In 1846 those speaking French or Walloon amounted to 1,827,141; Flemish or Dutch, 2,471,248; German, 34,060; English, 3824; other languages, 923. The French or Walloon is the prevailing language in the provinces of Hainault, Liège, Luxembourg, and Namur; the Flemish or Dutch in Antwerp, Brabant, the two Flanders, and Limbourg.

Registers.

Registers of the movement of the population in each commune are kept by the burgomaster or an alderman. The commissioners of the arrondissement inspect annually the various communal registers within their districts, and give notice of any irregularities or inaccuracies, to the permanent deputation of the provincial council; and the royal procurators are specially intrusted with the verification of the acts and registers. These contain the name, age, profession, and place of birth, of each inhabitant of the commune. The births, deaths, and other changes among families, as well as the names of those who enter or leave the commune, are daily registered. A new entry can be made only on the production of a certificate from the administration of the last domicile, or, in the case of a foreigner, on the production of his passport. Each commune is bound to remit monthly to the governor of the province a list of all persons who have settled in or left the commune during the month. The provincial registers are annually sent to the central committee of statistics. Since 1851 valuable improvements have been introduced, so that the register of deaths now indicates not only the age, sex, profession, &c., of the deceased, but also the disease or accident that occasioned death, whether medical treatment had been received, &c.

Belgium.

Since 1840 the bureau of general statistics has annually published a report of the movement of the population, made up from the yearly communal reports. The total number of births during the ten years preceding 1851 was 1,299,681, the annual average being 129,968; of which 66,648 males and 63,320 females. The annual average of legitimate births during that period was 120,303. In 1850 the number is somewhat, and in 1846–7–8 considerably, below the average; and in the other years exceeds it. The illegitimate births during that period were 96,652, averaging one for every 12·45 legitimate births. In the province of Luxembourg they are only one in 38·52; and in that of Brabant one in 6·83. In comparing the results of these years, the proportion of illegitimate births to legitimate has been annually increasing from 7·16 per cent. in 1841, to 9·11 in 1849, and 9·42 in 1850. The proportion of male to female births is 102·5 males to 100 females. The greatest number of births is in the months of February and March, and in the six months from November to April; the least in July and August. The still-born are as one to every 23·87 births; of males one in 21, and of females one in 27.

Births.

The deaths in that decennial period were 1,040,497; of these 314,313 were unmarried males, and 304,465 unmarried females; 136,492 married males, and 119,555 married females; 66,205 widowers, and 99,467 widows. The year 1849 presents the greatest number of deaths in this period, arising from the cholera, which alone carried off 23,027 victims. In the years 1846–7–8, the deaths are also considerable, from epidemic diseases which were then prevalent in the country; in 1847, indeed, the deaths were to the births as 101·75 to 100, while in the years 1841–44–50, the births exceeded the deaths by 30 per cent. The average number of deaths to 100 births during the ten years was 80. In the provinces of West and East Flanders the deaths are above the average, being in the former 97·6, and in the latter 91·5; the others are below the average, except Limbourg, which is equal to it, Namur, the lowest, being 60·7. The great mortality in the Flanders is ascribed to the greater prevalence there of the above-mentioned epidemics; the excess of deaths was 26·626 over the 100 births. The greatest number of deaths are in the half-year from November to April, mostly in January, February, March, and April; the least in August, September, October, and November. Of the deaths during this period, 6·46 per cent. were not more than one month old, 18·77 not exceeding one year, 26·16 not more than two years, and 48·98 not exceeding 25. Between 25 and 50 the deaths were only 16·83 per cent.; from 50 to 60 only 7·53; from 60 to 70, 10·10; from 70 to 80, 10·68; from 80 to 90, 5·23; and from 90 upwards, 0·65. To the end of the second year, the deaths in males exceed those in females as 18·52 to 15; from that age to 45, the females exceed the males as 17·27 to 15; from 45 to 55, the males exceed the females as 2·14 to 2; and from 55 upwards, the females exceed the males as 12·08 to 10. The number of suicides in the ten years was 2428.

Deaths.

The proportion of marriages to legitimate births is one to 4·15. The number of marriages during the above decennial period was 289,676.

Marriages.

Naturalization is of two kinds, the one conferring on the foreigner all the civil and political rights belonging to a Belgian, with certain exceptions specified by law, such as eligibility for a seat in the legislative chambers: to obtain these the *grand naturalization* is requisite. The registration fee for the former is 500 francs; for the latter, 1000.

Naturalization.

In order to arrive at a somewhat correct notion of the

Crime.

Belgium. state of crime in the country, we shall take the annual average of the number of persons brought before the various courts of assize for several periods. For the five years preceding 1831, the annual average of persons accused was 766; being 200 crimes against person, and 566 against property. From 1831 to 1839 the average was 577; being 184 against person, and 393 against property; showing, notwithstanding the increase of the population, a considerable decrease in the amount of crime. From 1839 to 1845 the average was 438; being 117 against person, and 321 against property. The decrease in this case is more apparent than real, arising principally from the lighter offences being remitted to the tribunals of correction; as also from the annexation of part of the provinces of Limbourg and Luxembourg to Holland, in terms of the treaty of 1839. In the next three years there was a deficiency of the crops and of employment, occasioning a state of distress such as had not been known for a long time previously in the kingdom. Under these circumstances the offences against property considerably increased. The average during that period was 575, being 101 against person, and 474 against property. Happily this increase of crime ceased with the producing cause, so that the number of accused in 1849 little exceeds the average of the period preceding that crisis, being 451, —113 against person, and 338 against property. Of these, 104 were acquitted, 41 condemned to death, and 34 to compulsory labour for life.

For the ten years preceding 1850 the number accused of crimes was 4570; of these 1332 were acquitted, 311 condemned to death, 377 to compulsory labour for life, 904 to compulsory labour for a period, 1068 to seclusion, and the rest to correctional punishments. The propriety of capital punishments is here a much contested point, and the royal clemency is exerted in all except the most aggravated cases. Of the 311 persons capitally condemned, only 23 were executed. Of the 4570 accused, 3802 were males and 768 females; 1343 were under 25 years of age, 1970 between 25 and 40, and 1249 of 40 and upwards: 64 per cent. had received no education, and only 3 per cent. any education beyond mere reading and writing. Comparing the number of the accused with the population, after deducting children under 10 years of age, we find the proportion among males to be one in 4272, and among females one in 21,430.

In 1849 the accused before the correctional tribunals amounted to 32,509; of these 17,383 were misdemeanours, 1107 minor crimes, and 14,019 contraventions of police or special laws;—5018 were acquitted, 15,336 sentenced to imprisonment, and 12,148 fined: 2096 had been previously convicted. The number brought before the tribunals of police was 38,081; of these 4489 were acquitted, 257 remitted to a higher tribunal, 25,818 fined, and 7517 imprisoned.

A criminal appearing a second time before a court is condemned to the punishment immediately above that fixed by law for his crime; and if guilty of a misdemeanour punishable correctionally, he is condemned to the maximum punishment allowed by law for that offence. The number of those brought before the courts of assize for the ten years preceding 1850, and who had been previously condemned, was 1434, or about 31 per cent. of the accused for that period.

Religion. Full liberty is guaranteed to all in the exercise of the public or private rites of their worship; nor does the state interfere in any way in matters of religion, except where the public safety may be concerned or the laws infringed. The population of Belgium in 1846 was 4,337,196; of these 4,326,873 were Roman Catholics, 6578 Protestants, 1336 Jews, and 790 belonged to the Anglican Church. The incomes of the ministers of each of these sects are derived from the public treasury. The amount thus paid by the state in 1850 was, to the Catholics, 3,628,130 francs (L.143,636), to the Protestants, 45,099 francs (L.1785), to the Jews, 9500 francs (L.376), and to the Anglicans, 10,300 francs (L.407). Belgium

Catholic. The Roman Catholic religion embraces upwards of 99 per cent. of the entire population. The kingdom is divided into six dioceses, the archbishopric of Malines, and the bishoprics of Bruges, Ghent, Liège, Namur, and Tournay. The archbishopric has three vicars-general, and a chapter of twelve canons; and each of the bishoprics, two vicars-general, and a chapter of eight canons. In each diocese is an ecclesiastical seminary. There was formerly one rectory in each justice of peace canton, but the number of the latter having been reduced, the rectories now outnumber the cantons by 25, and amount in all to 229, being 86 of the first class and 143 of the second. Chapels of ease are established throughout the country where necessary: these amounted in 1851 to 2640. The number of public chapels established as secondary chapels of ease, &c., at first unendowed, but of which the chaplains are now placed on the same footing as vicars, was 148, and of vicariates 1555. The salaries of each of the several kinds of ecclesiastics are as follows:— Of the archbishop, 21,000 francs (L.831); of the bishops, 14,700 francs (L.582); vicars-general of the archbishop, 3600 francs (L.142), of the bishops, 3200 francs (L.126); canons of the archbishop, 2400 francs (L.95), of the bishops, 2000 francs (L.79), rectors of the first class, 2047 francs (L.81), of the second class, 1365 francs (L.54); officiates in the chapels of ease, 787 francs (L.31); chaplains and vicars, 500 francs (L.20). These incomes, however, may be augmented by the church or communes. The amount contributed for that purpose by the communes in 1849 was 520,845 francs (L.20,617). This, however, includes the sum given by the urban communes to the support of the ecclesiastical edifices; the sum given by the rural communes for that purpose is mentioned afterwards. These do not include the chaplains of prisons nor of the army. Those of the army are divided into three classes, the first receiving a salary of from 2000 to 3000 francs, the second from 800 to 1000 francs, and the third from 400 to 600 francs.

The temporal affairs of the churches are managed by a vestry-board composed of a council, and a board of wardens. In parishes having 5000 inhabitants and upwards, the council is composed of nine members, and in other cases of five. It is renewed every six years, a part going out every three years. The new members are chosen by the remaining councillors. The ecclesiastical officiate in the church and the burgomaster of the commune are entitled to a seat. The council holds four ordinary assemblies annually. The board of wardens is composed of three members of the council and the officiating clergyman. One of the members goes out annually. This board acts under the council, and meets once a month.

The total number of students attending the diocesan seminaries in 1846 was 740. Scholarships of 423 francs (L.16, 14s.), and half scholarships of 211 francs (L.8, 7s.), are annually given by the state to certain of the students upon the presentation of the chief of the diocese. There are 66 of these scholarships, and 217 half scholarships. The state also contributes to the salaries of the professors by an annual grant of 8000 francs (L.317) to each of the seminaries, except that of Liège, the grant to which has been withdrawn since 1849, as it has sufficient funds otherwise. The provinces are bound to provide and maintain suitable buildings for these seminaries.

The amount contributed to the support of religious edifices by the provinces in 1849 was 253,193 francs (L.10,022), and by the rural communes, 155,252 francs (L.6145). Numerous donations and legacies have been given by private individuals for ecclesiastical purposes, amounting, for the twenty years preceding 1851, to 6066, and comprehending houses, lands, money, &c. The acceptance of these, if above 3000 francs in value, requires to be sanctioned by the

Belgium. government, and by the permanent council if not exceeding that sum. The total value of these, including two of the value of 100,000 francs (L.3958) to the Protestant church, was 16,306,481 francs (L.645,465).

There are a number of religious houses in Belgium for males and females whose lives are spent in pious contemplation, teaching, and visiting the sick. The number of these houses in 1846 was, for males, 137, and for females, 642; the number of persons in the former was 2051, and 9917 in the latter.

Protestant. The Protestant-evangelical church is under a synod composed of the clergymen of the body, and a representative from each of the churches. It sits in Brussels once a-year, when each member is required to be present, or to delegate his powers to another member. Included in the sum of L.1785 already mentioned as given by the state to Protestant pastors, are certain sums granted to the families of such clergymen. Each child is allowed the sum of 25 florins (L.2) till attaining the age of twenty-one years. A bursary of 25 florins is given to each child attending a Latin school, or receiving private lessons in that language; one of 50 florins to each attending a university or athenæum; and one of 200 florins to each studying theology. In 1850 twenty-three children were receiving the first-mentioned allowance, one a school, and one an academy bursary.

Anglican. The Anglican church has six pastors and as many chapels, in Belgium,—two in Brussels and one in each of the towns of Antwerp, Bruges, Ostend, and Spa.

Jewish. The Jews have a central synagogue at Brussels, three branch synagogues of the first class at Antwerp, Ghent, and Liège, and one of the second class at Arlon. The civil and religious affairs are conducted by a consistory of nine members, six of whom are appointed by the central, and one by each of the three first-class synagogues. The grand Rabbi, who is at the head of this body in Belgium, is *ex officio* a member of the consistory. They meet once a month, and two of the members go out annually.

Education. The Belgian government has shown itself thoroughly alive to the great importance of a general diffusion of education among the people. Numerous public schools and literary and scientific institutions are established throughout the country, supported out of the communal, provincial, or government funds. Different classes of inspectors are appointed to visit and report upon the state of education in their various districts. Prizes, scholarships, and other rewards are bestowed upon those that distinguish themselves most in the prosecution of their studies. Religious and moral instruction is under the direction of the sect to which the majority of the pupils belong; but those connected with other sects may be exempted from attendance on this course. Normal schools have also been established for the purpose of securing trained and efficient teachers. Meetings of the teachers and inspectors are frequently held for conversing upon the various methods of teaching, and other matters connected with education. *Caisses de prevoyance* are also established to afford aid to aged or infirm teachers, and their widows and families. The schools are open to all, and gratuitous instruction is provided for those who may not otherwise have the means of acquiring it. Yet, with all these advantages, it cannot be denied that there are still many among the lower classes growing up in ignorance and crime. Indeed, it seems undeniable that the providing of the means of instruction is not alone sufficient to secure an educated population. In the industrial localities the parents are generally anxious to get their children admitted as soon as possible into workshops and manufactories, and in rural districts they are engaged in the tending of cattle or in field labour. In some localities efforts have been made to counteract this evil,—the people have been addressed from the pulpit on the advantages of education; the parents have been conversed with upon the same subject, and, in some cases, the participation in public charities has been made subservient to sending their children to school. Some idea of the state of education in the country may be gathered from the annual draughts for the militia. In 1850 the number drawn was 38,328: of 21 of these the state of education was unknown; 13,965 had received no education; 2945 could read only; 9295 could only read and write, and 12,102 had received a more advanced education. Contrasting the period from 1843 to 1847, with the years 1849 and 1850, we find that in the former 41 per cent. were without instruction, 8 could read only, 27 could read and write only, and 24 were more advanced. In the latter period there is a considerable improvement; 38 per cent. were without instruction, 7 could read only, 25 could read and write only, and 30 were more advanced. In entering rather fully into the state of education in this country, we do so both from the great importance of the subject in itself, and from a conviction of the beneficial results that must eventually follow from it.

Belgium.

The educational institutions may be divided into four classes, viz., primary, middle, superior, and special. In 1846, the number of children receiving primary instruction at the schools was 441,172, and at home 5632; the number of those receiving middle or superior instruction at the athenæums, colleges, universities, &c., was 24,636, and at home 1050, showing a total of 472,490 receiving instruction at that period, or one in every 9·18 of the population. Since that time the number has been much increased.

Schools.

The primary schools are under the surveillance of the communal authorities and government inspectors; the imparting of moral and religious instruction is superintended by delegates from the religious bodies. Each province has a general inspector of the primary schools, who is appointed by the king, and inspects at least once a-year all the communal schools in his district, on which he makes an annual report. Under him are the cantonal inspectors, who are bound to visit the schools in their districts at least twice a-year. They are appointed by the state on the advice of the provincial government, and continue in office for three years. The provincial inspectors assemble annually in a central commission under the presidency of the minister of the interior. The bishops and consistories of the religions supported by the state may be represented by delegates at this commission, but these have only a deliberative voice in the proceedings. Ministers of religion and delegates of church dignitaries have the right of, at any time, inspecting the primary schools. The diocesans and consistories annually communicate to the minister of the interior a detailed account of the state of moral and religious instruction in the schools under their care. For the schools connected with the Roman Catholic communion there are two classes of inspectors; the diocesan inspectors, of whom there is one for each province, and the ecclesiastical cantonal inspectors. The Protestant schools are inspected by a delegate of the consistories, having the title of inspector-general. The Jewish schools have also an inspector-general delegated by the consistory.

Primary schools; inspectors.

The cantonal inspector calls a meeting of the teachers in his district at least once every three months, to discuss the merits of the different modes of teaching employed, the state of primary education, and the best means of advancing it. Educational libraries have recently been formed in connection with each of these districts.

A law passed in 1842 enacted that there should be at least one primary school in every commune, except in certain cases where primary education is already sufficiently provided for by private schools, or where one school may serve for several neighbouring communes. The communes may also adopt one or more private schools possessing the legal qualifications, to occupy the place of the communal school. The total number of primary schools, public and private, in the end of 1848, was 5747, of which 1008 were exclusively for boys, 1202 exclusively for girls, and 3537 for both sexes. Of these 2626 were communal schools, 913 private adopted schools, 58 private schools under inspection, and 294 boarding schools. The scholars receiving primary instruction at that time were 462,606, and in the end of 1849 were 493,773; being an increase of more than 200,000 since the end of 1830; and in the proportion of 11·2 per cent. of the population.

The branches taught in the primary schools are reading, writing, and the elements of arithmetic; the rudiments of the language spoken in the locality,—French, Flemish or German; moral and religious instruction; and the legal system of weights and measures, in most schools taught practically. In many of the schools gymnastics, music, and the elements of drawing, the outlines of history and geography, and the rudiments of the natural sciences, are also taught. Competitions take place annually, under the direction of the permanent deputation, between the scholars in the superior division of a certain number of the primary schools. The number of scholars from each school is fixed by the deputation, one-half chosen by the teacher and the other half by lot. The jury of examiners is presided over by the inspector of the district or his substitute.

The communes are obliged to afford gratuitous instruction to all the children within their bounds whose parents are in poor circumstances, and may not otherwise have the means of educating them. For that purpose there is a register in each province, open annually during the month of July, to receive the names of all the children claiming gratuitous instruction for the next scholastic year, which extends from the beginning of October to the end of August. This register is submitted to the communal council, which decides what children are entitled to gratuitous instruction, and this decision is then communicated to the permanent deputation of the provincial council. Claimants for gratuitous instruction are required to be between seven and fourteen years of age, and to have been vaccinated, or had the smallpox. The number of children receiving gratuitous instruction at the end of 1848 was 219,731.

Schoolmasters.

The schoolmaster is appointed by the communal council, which has also the power of suspending him for a period not exceeding three months,—the government decrees as to his reinstatement or dismissal. He ought to have attended, for at least two years, the classes of a normal school. This condition may, however, be dispensed with, if assented to by the government. In the case of a vacancy, the communal council is bound to fill it up within forty days, except in cases where the government may sanction a longer delay. On the expiration of that period, the nomination is proceeded with by the government. The male and female teachers in the communal schools in 1848 were 2786, besides 296 assistants.

Income.

The minimum salary of a teacher, as fixed by law, is 200 francs, or nearly L.8. Besides this, they have generally an allowance for the gratuitous instruction of poor children, a free house with, particularly in the rural districts, a garden, and in many cases the school fees. The fees vary considerably, according to the locality and other circumstances; they are in all cases fixed by the communal council. The average income of the teachers exceeds 600 francs. Some teachers considerably augment their incomes by the performance of other duties unconnected with their office, as those of communal secretary, &c. Rewards are bestowed on those who distinguish themselves most in the performance of their duties. These are of three kinds,—a gratuity of 50 francs, *a gift*, and *honourable mention*.

Caisses de prevoyance.

In each province is a *caisse de prevoyance* for the purpose of affording pecuniary aid to aged and infirm teachers, their widows, and children. All teachers and assistants in the communal primary schools are obliged to become members of this institution. The widow of a teacher who has been engaged for twelve years is entitled to a pension, and also the children of such teacher till the completion of their sixteenth year. These *caisses* are under the direction of the governor of the province, the members of the permanent deputation of the provincial council, provincial treasurer, and the provincial inspector of primary schools, whose services are gratuitous. They are supported by an annual payment of three per cent. upon the income of each member, by grants from the province and the state, and by particular donations and legacies. Besides these primary schools properly so called, there are in many localities other establishments where primary instruction is communicated, as the infant, adult, manufacturing schools, &c.

Infant schools.

The infant schools are for children between two and six years of age. There were 516 of these in 1848, 204 being communal or adopted, and 312 private. The scholars amounted to 28,593, of whom 13,183 were males, 15,410 females; of these 16,926 were admitted gratuitously. Some of these institutions are reported as being in a high state of efficiency, but in most of them there is much room for improvement, arising from the want of funds, and from the teachers in many cases possessing neither the knowledge nor the talents necessary for their duties. The expense of those schools for 1846, 1847, and 1848, was 243.927 francs (L.9655), of which 65,636 francs were derived from charities, 96,109 from the communes, 10,530 from the provinces, 38,787 from the state, and 32,865 from the fees.

Adult schools.

The adult schools in 1848 amounted to 1110, of which 41 were day schools, 336 evening schools, and 733 Sunday schools; 442 were under inspection. The number of scholars was 184,348, of whom 111,213 were receiving gratuitous instruction. The branches taught in these are generally the same with those in the communal primary schools. The inspected adult schools are supported in the same way as the infant schools, the expenses for 1848 being 44,582 francs (L.1765).

There are primary schools annexed to prisons, hospitals, and depôts of mendicants; and reform schools. The scholars attending these at 31st December 1848 amounted to 6086. The manufacturing schools in their present state can scarcely be viewed as educational institutions. Although the means of education are provided, little time is devoted to that object, being almost entirely taken up in manual labour.

Considerable sums are given by government for providing food, clothing, and other necessaries to the poor children attending the primary and infant schools;—for the four years preceding 1849 these amounted to 72,400 francs (L.2850).

Expense of education.

The expenses of public primary education fall in the first instance on the commune; and in case of insufficiency of funds, the province, and finally the state, come to its assistance. Each commune, however, must contribute a sum at least equal to two per cent. upon its direct taxation before being entitled to claim any assistance from the province or state. The total expenditure for public primary education was, in 1846, 3,837,197 francs; in 1847, 4,137,220; and in 1848, 4,376,675 francs, or L.173,243. Of this last 304,500 francs were public or private donations; 783,830 school fees; 1,586,918 contributed by the communes; 512,370 by the provinces; and 1,189,057 by the state. The expenditure for that year was as follows:—

	Francs.
The central commission and provincial inspection...	101,420
Cantonal inspection	78,181
Conferences of the teachers	15,737
Ordinary expenses of instruction.....	2,756,892
Construction and repairing of school-houses	614,097
Grants to *caisses de prevoyance* scholarships, &c.	156,790
Infant, adult, and manufacturing schools, &c.	349,817
Normal and superior primary schools.....	303,741
	4,376,675

The last item of this list does not properly belong to what are now considered as primary schools, the normal schools being placed among the special schools, and the superior primary schools having since that time been classed with the middle schools. Comparing the amount expended in primary education with the population, we find that in 1846 it was 0·884 francs for each inhabitant, in 1847 it was 0·953, and in 1848, 1·005.

Middle schools.

The middle schools are divided into two classes, those supported by the government, and those maintained by the province or commune. The former are of two kinds, the royal athenæums, called also the middle superior schools, and the middle inferior schools, or the middle schools properly so called, including the former superior primary as well as the government industrial and commercial schools.

The superior primary schools have only very recently been classed among the middle schools, and are included in the general statistics of primary education, already given as at that time belonging to that branch. These schools, 22 in number, were established in the principal towns, and in 1849 had 2978 pupils. The branches taught included land-measuring and other branches of practical geometry, the rudiments of the natural sciences, the elements of history and geography, drawing, music, and gymnastics, with in some cases the German and English languages, and book-keeping. The educational staff consisted of a rector, with one or more teachers and assistants; the first nominated by the king, and the last two by the minister of the interior.

The government has the general management of the state middle schools, in which it is assisted by a local board of administration for each school, composed of the burgomaster and

aldermen, and of from four to six members nominated by the government from a list of candidates presented for that purpose by the communal council, with a secretary. The services of the board are gratuitous;—an election takes places every three years, but the same members may be re-elected. They have the general direction of the institution, the preparation of the budgets, making up the annual reports, and presiding at the distribution of the prizes, &c. Members of the board may at any time visit and examine the classes.

Inspection. These, like the primary schools, are also subjected to a regular system of inspection. The literary and scientific branches are under the superintendence of two inspectors and an inspector-general, nominated by the king. To one of the inspectors is especially confided the mathematical and natural sciences, and to the other the humanities; the other branches, as history, geography, and the commercial sciences, may be committed to either of the inspectors or to the inspector-general. Once a-year, at least, each of the athenæums are visited by the inspector-general and both the other inspectors, and the other establishments by one of them. The time and duration of each tour of inspection is fixed by the minister of the interior, who also gives special instructions concerning it, on the advice of the *conseil de prefectionnement*. The inspector has to examine and report upon the state and discipline of each establishment, the methods employed in teaching, the progress made by the pupils, and the merit and zeal of the teachers. These reports are annually sent by the inspector-general to the minister.

Conseil de prefectionnement. The *conseil de prefectionnement* of middle instruction is composed of from eight to ten members, presided over by the minister of the interior or his deputy, and meets at least four times a-year. It advises upon the programmes of the studies, examines the books used in teaching or given as prizes, proposes directions to be given to the inspectors and examines their reports, and deliberates on subjects connected with the advancement of middle instruction.

Competition. A general competition takes place annually between the scholars of the athenæums and colleges receiving grants from government; in which, however, scholars from other establishments may be admitted to take a part on a request being presented to the minister of the interior to that effect. They are examined by a jury, nominated by the minister of the interior, and divided into two sections, the one for the humanities and the other for the mathematical sciences. The examinations are both written and oral; and the rewards are of three kinds, prizes, *accessits*, and honourable mention.

Educational staff. The educational staff consists of a prefect of studies in the athenæums and a rector in the middle schools, professors, regents, and masters. Since 1st June 1853, no one can be appointed a professor or prefect in the athenæums or communal colleges without having the diploma of a professor *agregé* of superior middle instruction. The rectors and regents of the middle schools ought to have a diploma of a professor *agregé* of middle instruction. A master or superintendent must have a certificate of having attended a university, or the diploma of a primary teacher. These conditions are not required of professors of living languages, of writing, music, or gymnastics. Doctors in philosophy, science, and some others are excepted; government may also grant exceptions in particular cases. The prefects, professors, rectors, and regents are nominated by the king, and the masters and teachers by the minister of the interior. The diploma of a professor *agregé* of either degree is bestowed by a special jury after a searching examination. It is given without regard to the place where the candidate has studied. The prefects and rectors reside on the premises, and have the general direction and management of the institutions over which they are placed, the maintenance of order and discipline, and the superintendence of the professors and teachers. Each has to report annually to the minister as to the state and condition of the institution under his care; to register the conduct and progress of the scholars, both from his own observations and from the monthly reports of the professors or teachers, as well as the talents and proficiency of the professors, and the method of teaching followed. They alone can correspond with or report to the board of administration. Every three years a report upon the state of middle education is presented by the government to the legislature.

The salaries of the prefects, rectors, professors, and regents are partly fixed and partly fluctuating; the former being fixed by the government, and the latter arising from the division of the fees, after defraying some necessary expenses, among them in certain proportions. All are obliged to become members of the central *caisse de prevoyance* who are not already members of a similar institution. The annual payment for those whose income does not exceed 1500 francs is 3 per cent., from 1500 to 3000 it is 3½ per cent., and 4 per cent. for all above 3000 francs. Ministers of religion are invited to give or superintend the religious instruction, and to communicate their observations to the *conseil de prefectionnement*.

Athenæums. There are ten royal athenæums in Belgium, two in Hainault, and one in each of the other provinces, viz., in the towns of Antwerp, Brussels, Bruges, Ghent, Mons, Tournay, Liège, Hasselt, Arlon, and Namur. In each of these there are two courses, the one for the humanities and the other for a professional education. The humanity course includes religion, principles of rhetoric and poetry, the Greek, Latin, French, Flemish, German, and English languages, elementary mathematics and physics, geography, and history, with the constitution of the country, drawing, vocal music, and gymnastics. The professional course includes religion, rhetoric, the French, Flemish, German, and English languages; mathematics, including analytical and descriptive geometry, and spherical trigonometry, and as applicable to arts, manufactures, and commerce: the elements of physics, mechanics, chemistry, natural history, and astronomy; book-keeping, the rudiments of commercial law and political economy; geography and history, particularly of Belgium; drawing, vocal music, and gymnastics. This course is divided into two sections, the lower and upper. The lower division, independently of a preparatory class, comprehends three classes, each extending over one year. The upper division has three sections, the commercial, industrial, and scientific, each divided into two classes, and extending over two years. To be admitted into the preparatory classes, the pupil must be at least ten years of age, and at least eleven for the regular classes. The entrance examination for the former comprehends reading, writing correctly to dictation, the legal system of weights and measures, the first four rules of arithmetic, and the elements of the French language; and for the latter are added grammatical and logical analysis and fractions. They also undergo examinations in passing from one class to another.

The government annually allocates the sum of 300,000 francs to the athenæums, in sums varying from 25,000 to 35,000 to each; and 200,000 to the middle schools according to their necessities, the minimum being 2000 francs. The town or commune in which the athenæums or middle schools are situated, has to provide and maintain suitable buildings and furniture, and in the case of athenæums to contribute annually to the extent of one-third of its expenditure. The commune may also in case of necessity be called upon to contribute to the middle school, but not to an extent exceeding one-third of the expense. The fees are fixed by the government on the advice of the board of administration, as well as the conditions of gratuitous or reduced admission.

Middle schools. In the middle schools the branches taught are the French language, with the Flemish or German in the localities where these are used, arithmetic, the elements of algebra and geometry, with land-measuring, and other branches of practical geometry, writing, book-keeping, and the elements of commercial law, the rudiments of the natural sciences, geography, history, drawing, vocal music, and gymnastics. These courses are arranged so as not to occupy more than two years, or three at the most. To some is annexed a preparatory section.

Provincial colleges, &c. The provincial or communal establishments take the name of colleges, or provincial or communal middle schools. Some of these receive government grants, and others are supported entirely by the province or commune. They ought to be based upon the same principles, and teach the same branches as the royal athenæums and middle schools. The administration is in the hands of the province or commune by which the institution has been founded, as well as the nomination of the professors and the other employees. Subsidies by government to these institutions are given, subject to the following conditions, that the programme of studies, the books used, the rules, budgets, and accounts be submitted to the approval of government.

In the end of 1848 there were 8 athenæums, 16 communal colleges, and 12 commercial and industrial schools endowed by the state. Most of these have libraries, museums of natural history, and chemical laboratories. The athenæums and colleges

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had then 4438 scholars, of whom 2595 were attending the humanity courses, 163 had bursaries, and 396 were receiving gratuitous instruction. There were 51 unendowed colleges; of these 28 were Episcopal colleges and seminaries, and two exclusively communal. Since then two additional athenæums have been established, and a number of government middle schools, so that there are at present (1853) 10 of the former and 47 of the latter.

Superior instruction.

The superior instruction establishments are the four universities, two belonging to the state, at Ghent and Liège, the Catholic university at Louvain, and the free university at Brussels.

Each of the state universities has faculties of philosophy and literature, science, law, and medicine, including archæology, modern and oriental literature, anthropology, æsthetics, statistics, physical and ethnographical geography, political economy, the higher mathematics, astronomy, mechanics, physics, mineralogy, geology, zoology, botany, &c. The professors are ordinary or extraordinary, the former having a fixed salary of 6000 francs, and the latter of 4000 francs. The government, however, has the power of augmenting the salaries of the ordinary professors to the extent of from 1000 to 3000 francs. In each university there are 8 professors in philosophy, 9 in the sciences, 7 in law, and 8 in medicine. One or two additional professors may be added to each of the faculties in case of necessity. The professors are nominated by the king, and cannot exercise any other profession without the consent of the government. No one can be a professor without having a degree of doctor, or being a licentiate of that branch of education he is appointed to teach. Government may however dispense with these conditions in the case of men of superior merit.

Agregés.

Attached to each university are a number of agregés named by the king. Their title is honorary, and they are chosen from among those students who have most distinguished themselves at the public competitions or final examinations, from professors of middle instruction who have been at least fifteen years engaged in teaching, or from members of the civil or military body of engineers. They are nominally attached to one of the faculties, but are not prohibited from exercising any of the liberal professions, and may give private lessons or repetitions of the courses taught in the university. In the case of any of the professors being unable to perform his duties, a substitute is chosen from among the agregés attached to that faculty. They may be appointed to give lessons or repetitions, in the university, of any of the courses already taught there, under the direction of the professor of that branch, or to give new courses. They receive no salary except when engaged in teaching in the university.

Management.

The universities are under the management of a rector, a secretary, deans of faculty, the senatus academicus, and the board of assessors. The rector is nominated by the king for three years, and has the direction of all academic matters. He enrols the students, superintends their conduct, and receives the oath of the professors and agregés. The secretary is appointed annually by the king from a list of two candidates nominated by the senatus academicus. He minutes the meetings of the senatus and assessors, prepares the programmes, conducts the correspondence, and is keeper of the seal and archives. The deans of the faculties are chosen annually by the professors of each faculty, and have the right of convoking the professors of their faculty. The senatus and the board of assessors are convoked by the rector; the former composed of the professors under the presidency of the rector, and the latter of the rector, secretary, and the deans of faculty.

Attached to each of the universities is an administrator-inspector nominated by the king to see that the funds allocated to the university are properly expended, that the library, museums, &c., are properly taken care of, and that the various functionaries are performing their duties. He has a salary of 6000 francs.

Each student pays annually for enrolment 15 francs, the amount of which is equally divided among the rector, secretary, and the porters, one-third to each. The student then takes out a ticket for the branches of the course in which he intends to take his examinations. For philosophy and literature, and law, the annual ticket costs 250 francs, and 200 francs for the other faculties. The government may, upon the advice of the faculty, grant tickets for special courses, the cost of which is fixed according to circumstances. The sums received for the tickets are divided among the professors and agregés who have given the courses.

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There are two vacations in the academic year—the one from the beginning of August to the beginning of October, and the other from the Thursday preceding Easter to the second Tuesday thereafter.

The instructions are given in the French language. The minister of the interior, at least once a-year, calls a meeting of eight of the professors (one for each faculty) to deliberate upon the means of improving the superior education.

Subsidies are accorded by government to the universities for the libraries, botanical gardens, cabinets, &c.; but the towns of Liège and Ghent are bound to maintain the buildings. A report upon the state of the universities is presented to the chambers every three years.

University of Brussels.

The free university of Brussels has faculties of philosophy and literature, of science, of law, and of medicine, courses in which are given by ordinary and extraordinary professors and agregés. Each student pays annually 15 francs for enrolment, and a fee of 200 francs for the courses in any of the faculties. The fee for single classes is generally 50 francs. An annual subsidy of 10,000 francs is allocated to the university by the provincial council of Brabant, and the permanent deputation has the right of annually presenting ten youths of the province for gratuitous instruction. An annual subsidy of 3000 francs is also allocated annually by the communal council of Brussels. It is governed by an administrative council, composed partly of permanent members and partly of members chosen annually by the professors of the four faculties and the former students of the university. This council is presided over by the burgomaster of Brussels, who has a casting vote in its proceedings. It chooses from among its members an administrator-inspector, whose services are gratuitous. The rector is also chosen by the council from among the professors.

Catholic University of Louvain.

The Catholic university of Louvain is governed by a grand rector nominated and revocable by the episcopal body; a vice-rector is also nominated by the episcopal body on the advice of the grand rector. The rector nominates the secretary and other functionaries of the university, and lays annually before the episcopal body a detailed report of the state of the university. The senatus academicus is composed of the professors of the faculties under the presidency of the grand rector. The rectoral council is composed of the vice-rector, the secretary, and the deans of the faculties. The faculties are philosophy and literature, the mathematical, physical, and natural sciences, law, medicine, and theology. The courses of the five faculties are given by ordinary and extraordinary professors and lecturers nominated by the episcopal body on the presentation of the rector. The enrolment fee for the first year is 10 francs, and 5 francs annually thereafter. The annual fee for courses in the faculties varies from 150 to 250 francs, except the theological courses, which are gratuitous. It has an extensive library, cabinets of mineralogy, zoology, &c., and a botanical garden. The number of students attending the university of Ghent at the end of 1850 was 351; Liège, 504; Brussels, 346; and Louvain, 774.

A competition takes place annually between the scholars of superior instruction. Competitors are required to be not above twenty-five years of age, except in the case of medical and law students, who may compete if not above twenty-seven years. The examining jury for each faculty is composed of five members, with an equal number of assistants. Four of the members are nominated by the universities, and the fifth by the government. At these competitions two gold medals are given in each of the faculties. To enable students in poor circumstances but of superior parts to receive a university education, bursaries of 400 francs each are annually given by the state on the advice of the jury of examination. The number of these may amount to sixty. Six bursaries of 1000 francs each may be annually given by the government to those who have taken their degree of doctor with the greatest distinction, to enable them to study in other countries. Two are for doctors in law and in philosophy and literature, and four for doctors in science and medicine. They are given for two years. Besides these there are connected with the universities a number of private bursaries of ancient creation, the management and bestowal of which are in the hands of particular persons or corporations in terms of the acts of foundation.

In each of the faculties there are two degrees—of candidate and doctor, besides the degree of doctor in political and administrative science, of candidate in pharmacy, of apothecary,

and of candidate-notary. No one can be examined for being a candidate in philosophy and literature, or in science, without having attended one of the universities for one year; nor can any one be examined for the title of candidate in law without being one in philosophy and literature; and no one as candidate in medicine without being one in the natural sciences. No one can be a doctor in any branch without being first a candidate in that branch; and doctors in medicine have besides to attend, for at least two years, courses of clinical medicine, surgery, and midwifery. No one can practise as advocate, physician, surgeon, accoucheur, or oculist, without having the degree of doctor. Each of these has to undergo strict examinations on all the branches connected with their professions by juries of examiners. Candidates in pharmacy must undergo an examination upon botany and vegetable physiology, organic and inorganic chemistry, and the elements of physics; previous to which they are examined in Latin, French, the elements of algebra and geometry, and the history of the country. They must, previous to receiving the title of apothecary, show that they have been practically engaged for two years, and been examined in theoretical and practical pharmacy, and in the preparation of drugs.

The juries of examination are formed by the government, and the members are chosen equally from the professors of the government, and of private institutions. The degrees are conferred on the student without reference to the place where he has studied. The examinations are both written and oral. The certificates and diplomas take notice of the appearance made by the student—whether in a satisfactory manner, with distinction, with great distinction, or with the greatest distinction.

There are two sessions of the juries annually, the one beginning on the Monday before Easter, and the other on the first Monday of August. The fees of the different examinations vary from 20 to 150 francs (from 15s. 10d. to L.5, 18s. 9d.), as follows:—the entrance examination of a university student, and the preparatory examination of a candidate in pharmacy, 20 francs; the examination of a candidate, or doctor in philosophy and literature, or the sciences, a candidate in pharmacy, an apothecary, or a doctor in political science, 50 francs; of a candidate in medicine, or each of the three examinations of a doctor of medicine, 80 francs; of a candidate in law, the first examination of a doctor of law, or the examination of a notary candidate, 100 francs; the second examination of a doctor of law, or the examination of a doctor in political science, 150 francs.

Normal schools; primary.

There are two government normal schools for primary teachers, one at Lierre, and the other at Nivelles; the former having thirteen and the latter fourteen professors, with each a rector and a demonstrating gardener. The rectors and professors are appointed by the king. The course extends over three years, and includes, besides the ordinary branches, history, geography, commercial arithmetic, book-keeping, rudiments of the natural sciences, theory and practice of agriculture, horticulture, and arboriculture, hygiene as applicable to children and schools, education theoretical and practical, drawing, music, and gymnastics. During the last year of their attendance they are exercised in teaching in the primary schools of the town. They are also instructed in the keeping of registers, making up of reports, &c. The number of scholars in 1849 at Lierre was 87, and Nevilles 124. Of these 48 received diplomas that year. The expense of these schools to the state for the three years preceding 1849 was 230,663 francs (L.9130). There are also seven episcopal normal schools in which the branches taught are similar to the above, except that the ceremonies of the Catholic church are more particularly inculcated. The chief diocesan nominates the rectors and professors. The course lasts for four years. The number of scholars in 1850 was 306.

Bursaries of 200 francs each are annually given by government to assist poor students attending the normal schools who give proofs of their aptitude. These may be continued to them after leaving school, during their noviciate as assistants or teachers.

Each province has one or more institutions for the training of female teachers, and bursaries are provided for young females desirous of entering such institutions. The number of scholars at the end of 1850 was 114.

Middle.

Students of promise who have taken diplomas at either of the government primary normal schools may be admitted to the normal school of middle instruction at Nivelles. The number of students to be admitted is annually fixed by the minister. The course is for one year, and includes the French language, mathematics, land-measuring, the elements of physics, mechanics, and chemistry, and pedagogy. The diploma of professor agregé of middle instruction is given after two searching examinations by a jury of seven members. It mentions the manner in which he passed his examinations. The fees for the two examinations amount to 70 francs.

For training teachers for the superior middle institutions, there are the normal school of the humanities at Liège, and the normal school of the sciences at Ghent. The number to be admitted is determined annually by the minister. They must be young men, between 18 and 23 years of age, of superior talents, qualifying them to perform creditably the duties of professor. Previous to admission they have to produce certificates of character, and to be examined both orally and by writing by a jury of five members; and the number to be admitted is taken from among those that stand highest by the examinations. The branches taught in the school at Liège extend over three years, and include the Latin, Greek, French, and English languages; antiquities, ancient and modern history and literature; geography, ancient, modern, and physical; philosophy, the principles of general grammar, and pedagogy. They undergo an examination annually; and on passing their final examination, they receive a diploma of professor agregé of superior middle instruction for the humanities. Where the branches of the normal school are the same with those taught in the university, the scholars generally attend there. The rector has a salary of 6000 francs, and the professors unconnected with the university from 3000 to 5000 francs. Each student has to pay a fee of 500 francs, but fifteen bursaries of 500 francs each are given for one year to the poorer students, and which may be continued for a longer period on the advice of the rector. The recipients become bound to act as professors in one of the middle schools for five years.

The branches taught in the normal school of sciences at Ghent also extend over three years, and include the higher departments of mathematics, physics, mechanics, chemistry, natural history, &c. The degree of professor agregé of middle superior instruction for the sciences is conferred on those passing the final examination. There are five bursaries of 500 francs in connection with this school.

Engineering school.

Attached to the university of Ghent is a school for civil engineers. The preparatory course extends over two years, and comprehends the mathematical, physical, and natural sciences necessary to the subsequent courses. The special course is divided into two sections, the one for engineers of roads and bridges, and the other for architectural engineers. This course continues for two or three years, and the pupils undergo strict examinations both on entering and leaving. During the summer they are generally sent to visit, or to assist in the various public works that may be going on. The third course, which lasts for three years, is for industrial engineers or persons engaged in arts or manufactures. They are instructed in the application of the various sciences to the arts and manufactures, or trade, particularly to the mechanical arts.

Mining school.

Similar to the above is the mining school attached to the university of Liège. The first course is preparatory to the other two. The special course includes all the branches necessary to a mining engineer. The third course is for those desirous of obtaining a knowledge of mining, minerals, &c., more particularly as connected with the arts and manufactures. This last course extends over four years.

Military schools.

There is a military school at Brussels for training officers for the army. Candidates for admission must be between sixteen and twenty years of age, except in the case of persons in the army, having entered it before the age of twenty, and been at least two years in active service, who are admitted till twenty-five. They are admitted by public competition. The courses are divided into two sections; the one, which extends over two years, is preparatory to the second, which also extends over two years, and is divided into special branches qualifying for the infantry, cavalry, or marines. For the first two years students pay for their education and maintenance 800 francs annually. Those from the army receive their pay during their attendance. The king gives annually twelve bursaries, which may be divided into half bursaries. On entering the second section, they become bound to serve for six years, cease to pay for their maintenance, and receive commissions as sub-lieutenants. They are examined annually, and

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the last year by a jury of military officers appointed by the king.

A school has been established in Lierre for the purpose of educating the sons of the military for subalterns. They are admitted from ten to fourteen years of age, and are bound to serve in the army till their twenty-fourth year. Those, however, who on attaining their fifteenth year are considered unfit for the service are dismissed, but if meritorious they may remain till their sixteenth year, and be provided with situations. Besides the ordinary branches of education, they are taught drawing, geometry, music, dancing, fencing, swimming, gymnastics, and military exercises. The course extends over five years, and the pupils generally enter the army about the age of sixteen. They are placed in the army according to their proficiency, some as sub-officers and corporals, others as common soldiers. The pupils in 1850 were 480.

Each regiment has a regimentary school for training young men in the army for subalterns; and a number of evening schools for affording the means of education to the soldiery. The regimentary schools are under the superintendence of the brigade majors of the territorial divisions, who examine the schools in their districts at least once a-year, and report to the minister. Attendance at one of these schools is obligatory on all subalterns and corporals whose education is not complete, according to their position. The scholars in 1848 were 3857. Special courses are also given to those who intend to compete for admission to the military school. The success of these courses is evident from one-third, and sometimes one-half, of those admitted to that school being from the army. A riding school was established in 1847 for instructing officers of the cavalry, artillery, and staff, in the art of riding, as well as those destined for instructing the troops of horse. The former attend for one and the latter for two years. Attached to the riding school is a school of farriery.

There is also a school of pyrotechny, under the direction of a superior officer of artillery, with a certain number of officers and subalterns. Eight well-educated young men are sent from each regiment of artillery to attend this school. The course continues for two years, and comprehends arithmetic, practical geometry, drawing, theoretical and practical pyrotechny and chemistry.

Navigation schools.

Schools of navigation have been established at Antwerp and Ostend for furnishing properly educated masters for merchant vessels. Instruction is given gratuitously in navigation and the branches connected with it, as arithmetic, geometry, trigonometry, nautical astronomy, &c.; with the elements of commercial law, as applicable to merchant vessels, the English language, and the manœuvring, rigging, and trimming a vessel, both theoretically and practically. Certificates of qualifications as masters or mates are given by a jury of examiners.

The Royal Institution of Messines is for the education of daughters of military men who have died or been disabled in the service of their country. They are admitted from seven to fourteen years of age, and remain till their eighteenth year. They are instructed in branches necessary to qualify them as governesses, domestic servants, &c. Situations are provided for them on leaving. Some of them are trained as teachers for infant-schools, and for this purpose an infant-school has lately been formed in connection with the institution. The number in 1851 was 230.

Agricultural school.

A school of agriculture is established at Tirlemont, to which scholars are admitted from fifteen to twenty-two years of age, after passing an entrance examination. The course extends over three years, and includes the elements of mathematics, physics, mechanics, mineralogy, geology, botany, chemistry, zoology, agriculture, land-measuring, rural architecture, and veterinary science. There is a farm of 115 hectares in connection with the school. The annual fee is 400 francs. There are seven other similar establishments throughout the country, to some of which bursaries are attached; a practical school of horticulture and arboriculture at Yilvorde; and a theoretical and practical school of horticulture at Gentbrugge (East Flanveterinary science, in connection with which there are several bursaries.

It has lately been proposed to establish at Antwerp a kind of commercial university for special instruction in the commercial sciences. It is expected that this will be in operation next year (1854).

Belgium.

The academies and schools of design, painting, sculpture, &c., are divided into three branches. 1. The royal academies of the fine arts, in which painting, sculpture, architecture, and engraving, are taught in the most efficient manner; 2. Academies of design established in the principal towns, and giving instructions in designing, architecture, and the principles of geometry and perspective drawing; 3. Schools of design established in all the larger towns for instructing young persons and artisans in the elements of designing and architecture. In 1850 there were 41 such academies and schools in the kingdom, having 164 professors, and 7450 pupils.

Academies and schools of design.

Academy of fine arts.

The Royal Academy of the Fine Arts at Antwerp is principally intended to afford gratuitous instruction in painting, sculpture, architecture, and engraving, and to propagate and encourage a taste for the fine arts. The programme of studies includes portrait, historical, and landscape painting, sculpture, civil and naval architecture, geometry, designing, engraving, &c., with lectures on anatomy, perspective, history of architecture, &c. In 1850 there were 1060 scholars. A competition in one of the branches of the fine arts is annually held in Antwerp, the laureate at which receives a pension of 2500 francs annually for four years, to enable him to perfect himself in his art in Germany, France, and Italy. The second prize is a gold medal of 300 francs. The Royal Academy of the Fine Arts at Brussels, is an institution similar to that at Antwerp. Instruction is gratuitous, and the vacancies are filled up by competition. The students in 1850 amounted to 761.

Musical conservatory.

The Royal Musical Conservatory at Brussels is under the direction of the minister of the interior, aided by a commission of seven members nominated by the king, with the burgomaster of Brussels as honorary president. The instruction is gratuitous, and includes vocal and instrumental music, composition, and the Italian language. There are thirty professors, and the number of scholars in 1850 was 299. There are six bursaries of 250 francs, and ten of 125 francs, in connection with this institution. There is a similar establishment at Liège, with (in 1850) 300 scholars. There is also one at Ghent unconnected with the government; scholars (1850) 308. Music, both vocal and instrumental, is much cultivated in Belgium, and musical schools and societies are established in almost all the principal towns, and throughout the country. In the end of 1851, there were 461 instrumental music societies, with 12,397 members, and 258 vocal, with 7062 members. A competition in musical composition takes place every two years at Brussels, the laureate receiving a pension of 2500 francs for four years, to enable him to study in France, Germany, and Italy. The second prize is a gold medal of the value of 300 francs.

Royal academies.

Belgium possesses a great number of learned societies, as the Royal Medical Academy, the Royal Academy of Science, Literature, and Art, &c.

There is a government inspector general of science, literature, and art, who has the general superintendence of that department, under the minister of the interior. He visits the exhibitions of the fine arts, and informs the government of such works as merit a place in the National Museum, and of young artists whose talents and proficiency render them worthy of notice. Under him are two administrative boards, the one for literature and science, and the other for the fine arts.

The Royal Medical Academy has its seat at Brussels. It is divided into six sections, each composed of six titular and three assistant members; and has twenty-four corresponding and an indefinite number of honorary members. Each of the sections has certain branches of medical science assigned to it. A meeting is held every month except August, and a general meeting once a-year. The academy answers any questions that may be proposed to it by the government, upon matters connected with public hygiene, and makes researches in all subjects connected with or tending to advance medical science. Its proceedings are published annually. A certain number of gold medals are given annually by the academy for the best essays on prescribed subjects. It receives an annual grant of 20,000 francs from the state.

The Royal Academy of Science, Literature, and Art, also has its seat at Brussels. It is divided into three classes, for the sciences, literature, and the fine arts; the first two are each subdivided into two sections, and the last into branches for painting, sculpture, engraving, architecture, and music. Each class is composed of thirty members, fifty foreign associates, and not more than ten native correspondents. The aca-

demy has a general meeting once a-year. Each of the classes meets monthly, and has also an annual public meeting for conducting the general business and proclaiming the authors of the prize essays. Each class proposes annually certain subjects for essays, to which gold medals of the value of 600 francs are adjudged. The academy receives an annual grant of 40,000 francs from the state. Connected with this academy is a royal commission of history for the purpose of searching for, and editing old chronicles and documents tending to throw light upon the early history of the country. In this patriotic object it is zealously seconded by government.

Royal observatory.

The Royal Observatory for astronomical and meteorolgical observations is under the management of a director and four assistants. It has published an annual since 1834. With the view of precisely determining the measure of time, a small lunette meridian has been constructed in each of the cities of Antwerp, Ostend, Bruges, Ghent, and Liège; and grand meridians are placed on the walls of edifices in numerous other towns. In the observatory are instruments specially provided by government for the use of young men desirous of making meteorological or astronomical observations. Premiums and medals are given to Belgians for useful discoveries, inventions, or improvements in instruments, &c.

Museums.

The Royal Museum of Brussels, for the reception of objects in natural history belonging to the state, is open to the public on Sundays, Mondays, and Thursdays. There is also a museum of industry containing models and plans of machines used in arts, manufactures, and agriculture. Annexed to this museum is a school where instruction is given gratuitously in the construction of such machines. It possesses also a chemical laboratory, library, &c. There is also a royal museum of war instruments at Brussels, open to the public on Sundays and holidays. The royal museum of painting and sculpture is under the direction of a commission, composed of a president and six members nominated by the king, and charged with the collection of works of ancient and modern masters for the museum. It is open to the public on Sundays, Mondays, and Thursdays. A triennial exhibition of works of living artists, Belgian and foreign, in painting, sculpture, engraving, architecture, and lithography, is held at Brussels. The exhibition of 1851 contained 1479 works by 792 artists, of whom 314 were foreign. There are similar exhibitions held in Antwerp, Ghent, Liège, Bruges, &c. The geographical establishment at Brussels has a considerable collection of books and maps, a garden, herbarium, collection of rocks, lava, fossils, &c.

Libraries.

Besides the libraries belonging to different societies, associations, &c., there were in 1849 nineteen public libraries in Belgium. The principal of these is the royal library of Brussels. It then contained about 180,000 volumes, 19,668 manuscripts, 30,000 engravings, and 14,000 medals and coins. The average annual increase is upwards of 3000 volumes. This is the only library that receives copies of copyright works. The public library of Ghent is connected with the university. It has 60,000 volumes and 600 manuscripts, besides pamphlets, &c. The average annual increase for the last ten years has been 650 volumes and 5 manuscripts. The Liège public library has 58,000 volumes, about 26,000 pamphlets, and 430 manuscripts; annual increase about 700. The public library of the Louvain university is the most ancient in Belgium, and is particularly rich in works of ancient history, theology, and literature, including Hebrew, Greek, Latin, and Oriental. In 1846 it had upwards of 60,000 volumes and 319 manuscripts. The library of Tournay has 26,230 volumes and 200 manuscripts; Antwerp 20,000 volumes; Namur 17,000; Mons 15,000; Bruges 10,500; Ypres 9500; and the rest a smaller number. These libraries are open daily for consultation, and in almost all of them volumes may be lent out at the discretion of the conservators. Nor has this occasioned any serious loss. Since 1838 about 10,000 volumes have been lent out of the library at Brussels, and of these only two insignificant volumes have been lost. From 1845 to 1850, 19,805 volumes had been lent out of the library of Ghent, of which only 20 were lost or destroyed, which were replaced at the expense of the borrowers. The number of works consulted in the rooms of this library, from 1st October 1849 to 1st July 1850, was 12,772; and 3494 were lent out.

Archives.

The archives of Belgium contain a great number of interesting and valuable documents connected with the history of the country. These are carefully preserved, classified, and inventoried. The general archives of the kingdom at Brussels contain upwards of 100,000 documents, and the archives of Antwerp upwards of 70,000. Those of the provinces of West and East Flanders, Hainault, Liège, and Namur, are ancient and important. The archives of the city of Bruges, at one time the grand commercial entrepôt of Europe, contain a number of valuable papers bearing upon the events of which this city was the theatre in the middle ages. Unfortunately they do not go further back than 1280, the previous documents having been all destroyed by an extensive fire in that year.

Periodicals.

In 1848, 202 journals were published in Belgium. Of these 18 appeared seven times, 20 six times, 20 three times, 12 twice, and 132 less than twice a-week; 137 were in the French language, 52 in Flemish, 1 in English, 1 in German, and 1 in Polish; 122 were political, 37 literary or scientific, and 33 exclusively devoted to advertisements. The stamp duty having been abolished in 1848, it is impossible to give the number since that period, but it has been much increased. The total number of newspapers stamped during the first quarter of 1848 was 2,781,458, producing a duty of 105,605 fr. The number of literary and scientific reviews and magazines in 1850 was 93.

Hospitals, &c.

The benevolent and charitable institutions of Belgium are numerous and open to all. The duty of supporting these falls in the first instance upon the commune, afterwards upon the province, and finally, in case of necessity, upon the state. They are divided into three classes. 1. Those affording assistance or an asylum to the poor in the case of age, infirmity, disease, want of work, &c., including dispensaries, foundling and maternity hospitals, deaf-mute, and blind institutions, &c. 2. Those more particularly destined to the prevention and suppression of vagabondage and beggary, as the depôts of mendicity and the reform schools. 3. Those specially intended to foster a spirit of independence and foresight among the working classes, as savings-banks, assurance and mutual assistance societies.

Every town of importance, and many of the rural communes have hospitals for the aged, infirm, and indigent. Asylums for incurables are also numerous, but much less so than the former. Farm hospitals have been established in the rural communes of the two Flanders, where the inmates contribute by work to their own maintenance. They form small agricultural colonies of old people and children, mutually aiding and assisting each other. The products of the farms are generally equal to their maintenance. There are fourteen such establishments in West Flanders, with (1851) 1052 inmates; and fourteen in East Flanders.

Foundling hospitals are established in Antwerp, Brussels, Louvain, Bruges, Ostend, &c. The children generally remain only for a short time in the hospitals. They are pensioned out to inhabitants of the rural communes till their twelfth year, at which period the wardship of the hospital terminates. Inspectors are appointed to visit the children quarterly, to report upon their physical condition, see that they are attending schools, &c. The number (1850) was 7574. There are maternity hospitals at Brussels, Louvain, Ghent, Liège, Bruges, Nieuport, and Tournay, in several of which courses of midwifery are given. Maternity societies for aiding females with money, medicine, &c. are formed in many of the towns. In 1846 there were 58 lunatic asylums, 18 public and 40 private, having in all 3143 patients. A colony of lunatics has been formed in the commune of Gheels, province of Antwerp, where, under the direction of a permanent committee, they are pensioned out among the inhabitants, and generally employed in agricultural labours. In 1851 they amounted to 931.

In 1835 the number of the deaf and dumb was 1746, of whom 1376 were from birth, and 370 by disease or accident; of the blind was 3892, 256 from birth, and the rest by disease or accident. In 1850 the deaf and dumb in seven of the provinces (East Flanders and Hainault not given) amounted to 1265, and the blind to 1793. There are in all ten institutions for these, in Brussels, Bruges, Ghent, &c. There are ophthalmic institutions in Brussels, Mons, and Liège.

To prevent the misery, and frequently the crime, arising from the want of employment among the working classes, charity workshops have been established in Ghent, Liège, and other towns. These are accessible to all workmen without employment, and in poor circumstances. The able bodied are paid according to their work, and the aged and infirm according to their necessities. The workshops of apprenticeship and improvement are intended not only to supply work to the unemployed, but principally to initiate the people in the exercise of new or improved branches of industry, and to instruct the young men in some trade or profession by which they may be able to gain an honest maintenance. They have been found of great benefit to many of the poorer classes who would otherwise have been brought up as vagrants and beggars. The apprentice-

ship generally lasts from four to six months. Although the means of obtaining a primary education is provided in connection with these establishments, yet their time is too much devoted to manual labour to derive much profit from the latter. Many thousands are employed in these workshops. Similar to these are the manufacturing schools, intended principally for girls, where they are employed in the manufacture of lace, &c. These are supported partly by the state and partly by the province and communes.

There are five depôts of mendicity or workhouses in the kingdom, at Bruges, Hoogstraeten, Mons, Reckheim, and the Cambre (commune of Ixelles). In December 1850 they contained 3478 persons. The average daily expense of each is 50 centimes (4½d.) A reform school was founded in Ruysselede, in 1848, for male vagrants and mendicants under eighteen years of age. It contained (1851) 500 members, employed in cultivating a large farm of 128 hectares. At a short distance is a similar institution for girls.

In each commune is a *bureau de bienfaisance*, for assisting the poor with money, food, clothing, &c., and, where there are no hospitals, providing them with medical attendance and medicines. It also contributes to the maintenance and education of poor children, foundlings, deaf-mutes, and lunatics. In 1850, 205,516 families, consisting of 901,456 persons, were aided by these charities, and the amount expended was 6,331,240 fr. This, however, cannot be taken as a criterion of the true condition of the people, as many who do not require it take advantage of the society for receiving gratuitous education or medical attendance.

Twenty-two towns in Belgium are provided with *Monts de piété*, charitable institutions for lending money to the poor, upon the security of pledges. Each *Mont de piété* is directed by a board of five members nominated by the communal council. In 1850, 1,307,711 articles were deposited or renewed, 1,253,698 retired, and 51,857 sold; the money lent amounted to 7,775,668 fr.

A savings-bank is established in the principal town of each province, by the Society for the Encouragement of National Industry. The number of depositors in these in 1851 was 23,302, and the amount deposited was 17,024,396 fr. They have also been established in all the manufacturing towns, and in many of the rural communes. *Caisses de prévoyance*, both general and for special classes of workmen, are also numerous. Mutual assistance societies to succour the members in sickness, pay their funeral expenses, and aid their families, are numerous. A report presented to the Chambers in 1851, shows that the number of these was 211, having 24,367 members.

Agriculture.

Since 1830 the agricultural state of the country has been much improved. A superior council of agriculture, composed of two delegates nominated annually from each of the provincial commissions of agriculture, and a president, vice-president, and secretary, appointed by the minister of the interior, is specially charged with the promotion and superintendence of the agricultural interests of the country. In each of the provinces is an agricultural commission of practical men, nominated by the king, one from each of the agricultural districts in the province, and a veterinary surgeon. They encourage the introduction of improvements in the different branches of agriculture, and report annually to the government upon the state of agriculture in their provinces. Each district has an agricultural committee which meets twice a-year. Every five years a grand agricultural exhibition of horses, cattle, agricultural implements, and produce, is held in Brussels, at which numerous gold and silver medals, &c., are given as prizes. Local exhibitions are also held frequently in the various districts. In each of the agricultural districts there is at least one veterinary surgeon for superintending and reporting to the governor of the province upon epidemics and other diseases among cattle. No one can practise as a veterinary surgeon without having obtained a diploma after an examination by jury in the various branches of the art. Indemnities are given by government to agriculturists for losses sustained in crops, cattle, &c., to an extent varying from one-third to one-tenth of the loss.

The agriculturists above twelve years of age, including female servants, form one-fourth of the entire population. Females are extensively engaged in agricultural work, being in 1846 to the males as 61 to 100. In 1846 the number of horses was 194,537, of cattle 1,203,891, sheep 662,508, swine 496,565, goats 110,060. To improve the breeds of horses a government stud of about 40 stallions has been formed at Tervueren. These are annually sent out to stations in the different provinces.

The cultivated land of Belgium amounts to 2,603,036 hectares, or 6,432,477, acres, of which 1,423,453 hectares are in the hands of the proprietors, and 1,179,583 are let to tenants. In West Flanders 85 per cent. are tenants: in Luxembourg three-fourths are in the hands of the proprietors; and in the provinces of Antwerp, Brabant, and East Flanders, three-fourths are let to tenants. It is divided into numerous and mostly small patches (nearly 600,000). Of these 43 per cent. do not exceed 50 ares, or about 1 acre and a quarter, 12 above 50 ares and not exceeding one hectare, or 2 acres and a half, 29 not exceeding 5 hectares, 7·47 not exceeding 10 hectares, and less than 8 of greater extent. The Belgians, particularly in Flanders, are averse to the introduction of improvement, in their agricultural operations, and their implements are generally rude and clumsy. Their lands are however cultivated with great care and are very productive. The proportion to 1000 hectares of the various kinds of land in 1846 was:—

Producing Cereal and Farinaceous crops, . . .	337·34
... Industrial plants, ...	25·22
... Leguminous fruits, ...	26 38
... Alimentary roots, ...	50·66
... Fodder, ...	59·83
Prairie land, ...	139·19
Fallow, ...	31·08
Garden, ...	19·17
Wood, ...	186·58
Uncultivated or only periodically, ...	124·55

Of the cereal and farinaceous crops rye is the most extensively cultivated, and forms an important article of food for the working classes. Wheat and oats are also extensively cultivated, the former particularly in the provinces of Hainault, Brabant, and West Flanders. Comparatively little barley is raised.

The industrial plants are hops, chicory, tobacco, rape and other oleaginous plants, hemp, flax, madder, teasel, beet, &c. Of these the most extensively cultivated is flax, principally in the two Flanders. Tobacco was much more extensively grown a few years ago; at present it is now almost entirely confined to the two Flanders and Hainault. The chicory plant is principally raised in Hainault. The cultivation of beet for the extraction of sugar is continully increasing, and numerous establishments have been formed for its preparation.

The leguminous plants, pease, beans, and tares, are used principally as fodder for cattle: the most common are beans.

The beet-root is even more extensively cultivated as fodder than as an industrial plant, particularly in the provinces of West Flanders, Liège, Hainault, and Brabant. Turnips are, next to the potatoes, the most extensively cultivated of the alimentary roots. In 1846 the extent of ground occupied in potatoes was 115,062 hectares. The disease that has affected this article of food, though it has diminished the amount produced, has much enlarged the extent of its cultivation, being now probably from 30,000 to 40,000 hectares more than in 1845. It has risen much in price, so that from being one of the principal articles of food for all classes it has become one of the most expensive. The fallow ground, formerly considerable, is now only of small extent, being principally sown in fodder crops. Clover is the principal fodder crop. The prairies are partly used as pasture, and partly mown. Draining, and clearing the *bruyeres*, are now actively carried on under the direction of government.

Minerals.

Belgium is rich in various kinds of minerals, as coal, iron, calamine, &c., forming a valuable source of employment to many thousands of its inhabitants.

Under the minister of the interior the mines are superintended by a corps of mining engineers, composed of an inspector-general, chief and ordinary engineers, sub and aspirant engineers. Each of the six mining districts has an ordinary engineer, and each of the two divisions a chief engineer. A sub-engineer is appointed over a certain number of mines. Vacancies in the higher orders of the corps are filled up from among those who have served at least three years in the next lower grade. The council of engineers gives advice on all questions submitted to them connected with the administration and working of the mines.

Belgium is almost traversed from west to east by beds of coal. These may be divided into two great basins. The western basin is the most important, and has an estimated extent of 90,051 hectares, or about 222,400 acres; 75,725 in the province af Hainault, and 14,326 in Namur. The extent of the eastern bed is estimated at 44,062 hectares,—41,745 in the province of Liège, and 2317 in Namur. All varieties, from anthracite to the richest gas-coal, are found. In 1850 there were 153 mines in Hainault, 40 in Namur, 116 in Liège, and a small one in Luxembourg. The number of persons employed was 36,002 men, 4045 women, 6559 boys, and 2363 girls: 5,820,588 tons of coals were extracted, valued at 46,471,393 fr.; the expense of working was 40,310,619 fr. The coal is principally consumed in the country: 1,439,473 tons were sent to France, 197,569 to Holland, 14,410 to Prussia, and 7644 to other countries.

The iron districts are the arrondissement of Charleroi, and the provinces of Namur, Liège, and Luxembourg. Besides the iron mines in Charleroi, Hainault contains a copper mine, commenced in 1849, calamine and blende in the communes of Solre-St-Gery and of Barbencon. Iron is also found in small quantities in the arrondissements of Mons and Tournay. In Namur the iron ore is rich and plentiful, and constitutes the principal mineral wealth of the province. The beds of pyrites are daily becoming of greater importance as the mining is carried to a greater depth. Veins of lead and zinc are

Belgium.

also wrought to a considerable extent, as is also a bed of oolitic oligist at Uezin. The iron mines of Luxembourg are much inferior to those of Namur. The principal are those of Durbuy, Ruette, Grandcourt, Halanzy, and Musson. At Couthuin, in the province of Liège, a prolongation of the bed of oolitic oligist at Uezin is wrought, and at Angleur an important bed of limonite. The ferruginous basins of Theux and La Reid are of the greatest importance, both as public works, and from the quantity of ore that they furnish. Lead and zinc are found here almost always in the same bed. Alumiferous schist is common in several parts of the province. The manganese mine at Bihain has been abandoned. In 1850 the different metallic mines yielded 7308 tons of blende, 62,193 of calamine, 3854 of lead, 4084 pyrites, and 472,883 tons of (buddled) iron. Comparing the average annual produce from 1841 to 1845, with that from 1846 to 1850, we find a considerable increase in each; in calamine of 23,767, lead 2858, pyrites 2871, and iron 261,080 tons. The mining of blende only commenced in 1845, in which year it amounted to 264 tons. The number of workmen employed in these mines was 5695.

Marble is abundant in many parts of Belgium, and the black marbles, as those of Dinant and Gochene, may rival the finest productions of other countries. There are numerous quarries of various kinds, as freestone, granite, limestone, slate, &c. The principal quarrying provinces are Namur and Hainault. They gave employment (1846) to 7892 persons.

In 1850 the stationary steam-engines in the kingdom were 2040, of 51,055 horse-power, being double that of 1838. Most of these (30.969 horse-power) are employed in working the mines. Low-pressure engines are rapidly disappearing. Of these there were 289 in 1844, and only 89 in 1850. The number of steam-vessels (1850) was only 13, having a total of 1000 horse-power; and of locomotive engines on the different government railroads 170, of 10,703 horse-power.

Manufactures.

The total value of manufactures imported in 1850 was 38,646,000 fr., and exported 102,162,000, being an increase of 35 per cent. since 1841. The number of persons employed in the various manufactures in 1846 was 314,842, being 207,784 adult males, 40,673 adult females, 36,356 boys under sixteen years of age, and 30,029 girls.

The number of works in 1850 for the preparation of iron was 351, steel 2, lead 8, copper 20, zinc 19, alum 2, glass 35; 13,223 workmen were engaged, and the value of the produce was 51,261,457 fr. There is a decrease of 37 per cent. on the average of the three years preceding 1848, as compared with the three subsequent, in the iron manufacture. During the former period the demand for iron was great, and the prices were augmented by the number of railways constructing in Belgium and other countries.

Notwithstanding many vicissitudes, flax is the most ancient, and still forms one of the most important branches of industry in the country. In 1846, 29,872 hectares of land were occupied in the cultivation of flax, and 1712 in that of hemp; the various manufactures of these gave employment to 60,023 persons, viz.:—18,563 men, 7348 women, 3852 boys, and 20,793 girls. In 1850 the value of the exports and imports was as follows:—

	Imported.	Exported.
Raw flax	5,825,000 fr.	17,138,000 fr.
... hemp	676,000	26,000
Flax and hemp yarns	896,000	5,027,000
... ... cloths	191,000	10,082,000
	7,588,000	32,273,000

Cotton also forms an important branch of industry, and is at present in a more flourishing condition than at any former period. In 1846 it employed 7552 men, 3129 women, 2494 boys, and 1305 girls. In 1850 the exports and imports were as follows:—

	Imported.	Exported.
Raw cotton	16,504,000 fr.	4,587,000 fr.
Cotton yarn	289,000	455,000
Cotton cloths	3,448,000	8,595,000
	20,241,000	13,637,000

The manufacture of woollens forms also an important branch of industry. The wool for this purpose is principally imported from Prussia, Saxony, &c., the native produce being small in quantity and chiefly used in hosiery. It employed (1846) 10,134 men, 4686 women, 2076 boys, and 1257 girls. Imports and exports (1850):

	Imports.	Exports.
Wool	16,941,000 fr.	1,642,000 fr.
Woollen yarn	3,419,000	1,320,000
... cloths	8,398,000	16,309,000
	28,758,000	19,271,000

The manufacture of silk gave (1846) employment to 655 persons; value of imports (1850) 11,353,000 fr., exports 637,000 fr. Although the cultivation of the mulberry tree for the breeding of silkworms has been carried on since 1826, it has yet made little progress. The lace, ribbon, and hosiery manufactures employed 1494 males, 675 females, 501 boys, and 337 girls. Imports and exports in 1850:

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	Imports.	Exports.
Lace	893,000 fr.	41,000 fr.
Ribbons	493,000	58,000
Hosiery	298,000	513,000
	1,684,000	612,000

The excisable manufactures are beer, vinegar, &c. The number of breweries in the kingdom in 1850 was 2899, employing 6766 persons, and of vinegar works 84, employing 105 persons. The amount of excise received from these establishments was 6,436,931 fr. Distilleries 587, workmen 1647, excise 3,839,741 fr. Salt works 318, workmen 495, excise 4,416,372 fr. Refineries of foreign sugar 50; manufactories of beet-root sugar 28, excise 3,169,509 fr. In 1846 2122 hectares of land were occupied in beet-root for sugar, and 4190 persons were employed in its manufacture. The principal of the other branches of industry, with the number of persons employed in each, as shown by the general census of 1846, are as follows:—The manufacture of nails, particularly in the provinces of Liège and Hainault, employs 6786 persons. The manufacture of bricks and tiles, the chief seat of which is in the province of Antwerp, employs 8203 persons. The manufacture of fire-bricks was introduced in 1836, and has since been making great progress. The manufacture of porcelain and earthenware goods employs 1573 persons; glass and crystal works 3683; paper-making 2169; printing 2026. The maritime fishing employs 207 boats of 5800 tons, and 1224 men. An extensive manufactory of fire-arms at Liège employs 1782. The less extensive manufactures are oil, soap, chemicals, leather, ropes, &c. The number of failures in 1849 was 132, in 1850, 113, and in 1851 to 15th August 83. Eleven vessels of 3333 tons were built in Belgium during 1850.

In 1851 Belgium possessed 149 trading vessels, of the aggregate burden of 30,577 tons.

Commerce.

The value of the imports and exports for the years 1849, 1850, and 1851, was as follows:—

	Imports.	Exports.
1849	405,249,000 fr.	374,776,000 fr.
1850	423,117,000	411,292,000
1851	418,555,325	401,176,052

In 1851 the imports by Belgic vessels were valued at 44,702,097 fr.; by foreign 124,736,164 fr.; and by land and rivers 249,117,064 fr. Exports by Belgic vessels 24,107,306 fr.; by foreign 81,326,815 fr.; and by land and rivers 295,741,931 fr. The laden Belgic vessels entering were 402 of 70,261 tons, and foreign 1591, of 229,771 tons. The laden Belgic vessels leaving were 351 of 62,996 tons, and foreign 1168 of 161,314 tons. The number entering in ballast was 149 of 17,434 tons: 1359 vessels entered the port of Antwerp, 448 Ostend, 234 Ghent, and 101 Nieuport. The imports are principally from France, England, Holland, and the United States, and the exports principally to France, Holland, Prussia, and England.

The imports are divided into three classes, those for direct consumption in the country, those in transit, and those brought into warehouses to be either consumed in the country on paying the duties, or exported. The value of goods imported for consumption, and of the productions of the country exported was for the above three years as follows:—

	Imported.	Exported.
1849	206,777,000 fr.	179,054,000 fr.
1850	211,923,000	210,033,000
1851	218,085,070	200,129,626

These are divided into three branches. 1. *Premières matières*, articles consumed in the state in which they are found, as coals, &c.; 2. Articles of food; and 3. Manufactures. The imports and exports of 1851 so divided, give—

	Imports.	Exports.
Premières matières	93,663,110 fr.	97,742,481 fr.
Food	84,362,885	26,258,285
Manufactures	40,059,075	76,128,860

The value of the goods in transit for the years 1850 and 1851 was—

	Direct.	By warehouse.
1850	175,553,000 fr.	25,706,000 fr.
1851	175,104,292	25,942,134

Of the latter the value exported by Belgic vessels was 7,046,655 fr., by foreign 28,712,479, and by land and canals 165,287,292 fr. Although there is a slight decrease in 1851 as compared with 1850, in comparing 1850 with 1841 we find an increase of 259 per cent. The value of goods in warehouse at 1st January 1851 was 26,626,000 fr.; entered during that year 65,006,000; taken out for consumption 39,922,000; for export 25,942; and 25,480,000 were in bond at the end of that year.

The first five months of 1853, as compared with the same period

Belgium.

of 1852, show a considerable decrease in the importation of many of the principal articles of trade, as coffee, cottons, rice, tobacco, &c. On the other hand, however, the increase in the articles of exportation is even more marked. In the latter there is an increase of 270,000 fr. in portable arms, 16,264 tons in pig iron, 882 tons in wrought iron, 540 tons in nails, and 463 tons in iron used in machines. The exportation of bar iron and rails during the first five months of 1853 amounted to 8447 tons. During the whole of 1852, it was only 7325 tons, and during 1851 only 4015 tons. The increase in the linen and cotton manufactures, and in sugar, is also very considerable. A company has been formed for the establishment of regular steam communication between Antwerp and New York, which will undoubtedly give a great stimulus to trade in Belgium. It is expected to be in operation by May 1854, and except during the first year will have two departures monthly from each side of the Atlantic.

Chambers of Commerce.

There are nineteen chambers of commerce and manufacture established in the principal towns, the members of which are nominated by the king from a triple list of candidates presented to him by the chambers. The members of each vary in number from nine to twenty-one, one-third going out annually. They present to the government or legislative chambers their views as to the best means of increasing the commercial and industrial prosperity of the country, report annually upon the state of their districts, and give useful information or direction to the provincial or civic authorities under their administration.

Commercial Association.

Belgium possesses a great number of commercial and financial associations. In 1851 there were no fewer than 191 legally authorized joint-stock companies for carrying on public works, or enterprises, having a united capital of 880,347,298 fr. Of these 12 were assurance companies, 12 private banking companies, and 14 railway companies. It has eight commercial exchanges, under the direction of government, namely, in Antwerp, Brussels, Ghent, Bruges, Ostend, Mons, Termonde, and Louvain. In 1822 the General Society for the Encouragement of National Industry was formed at Brussels under a royal charter for 27 years, and which has since been extended to 1875. It has a social capital of 30,000,000 florins, divided into 60,000 shares of 500 florins, bearing interest at 5 per cent. The administrative body consists of a governor, nominated by the king, six directors, a secretary, and a treasurer. It discounts bills, receives money at interest, grants loans and advances on titles and other deposits, &c. The national bank, instituted by charter granted in 1850 for twenty-five years, has its seat at Brussels, and has branches in all the provincial capitals and several other towns. Its capital is 25,000,000 fr., in shares of 1000 fr. each. It pays a dividend of 5 per cent. upon the shares, and one-third at least of the profits, exceeding 6 per cent., goes to form a sinking fund. The administration consists of a governor nominated by the king, six directors, and a council of censors. The banking operations are superintended by a government commissary; a report upon its state is presented to the government every month. The state funds are deposited in this bank. The bank of Belgium, chartered in 1835 for twenty-five years, but which has been extended to 1875, has a capital of 30,000,000 fr. Its seat is at Brussels. The bank of Flanders is established in Ghent.

Weights, &c.

The weights and measures of Belgium are the same as those of France. Gold, silver, and copper coins are struck at the royal mint in Brussels. The gold coins are ten and twenty-five franc pieces; the silver are of the value of ¼, ½, 1, 2, and 2½ francs; and the copper of 1, 2, 5, and 10 centimes.

Belgium. Roads, &c.

After England, there is no country in Europe where, in proportion to its extent, the roads are more numerous or better kept than in Belgium. They are of three kinds—those maintained by the state, and those by the provinces and communes. The total length of the two latter cannot be given with accuracy; that of the first is 1247 leagues, or 3865 English miles. The length of the navigable rivers and canals has already been given; the income for the ten years preceding 1851 was 25,642,467 fr., and the expenditure 11,556,282 fr.

Railroads.

A bill was passed in 1834 authorizing the establishment of a system of railroads, of which Malines was to form the centre. One line extends eastward from Malines to the frontiers of Prussia, passing Louvain, Liège, and Verviers, another north to Antwerp, a third west to Ostend, passing Termonde, Ghent, and Bruges, and a fourth south to Brussels and the frontiers of France. Another bill in 1837 authorized a line from Ghent to the French frontiers and Tournay, passing Courtray and branches from Namur, Limbourg, and Luxembourg. The government railways are wrought on account of the government, and are under special administration. The line from Brussels to Malines was opened on 5th May 1835, and was the first railway in operation on the Continent. The total length of the various lines of railway in operation in the beginning of 1851 was 172 leagues of 5000 metres, or 535 English miles, as per following table:—

	Double Lines. Metres.	Single Lines. Metres.	Total. Metres.
Government.....	452,788	171,831	624,619
Conceded	94,943	141,835	236,778
	547,731	313,666	861,397

The amount expended by government in the construction of railways to the end of 1850 was 167,333,412 fr., or L.6,623,614. The expense of working these railways in 1850 was 9,195,315 fr., and the receipts 14,847,540 fr.

Postage.

In 1849 a system of postage was introduced into Belgium similar to that in this country. All letters not exceeding 10 grammes in weight (¼ oz.), destined for places not more than 30 kilometres (18 miles) distant, pay a postage of 10 centimes (1d.), and those to any greater distance within the kingdom 20 centimes. This postage increases with the weight.

Electric Telegraph.

The first electric telegraph, which was that between Brussels and Antwerp, was introduced into the country in 1846 by an English company. A law passed in 1850 has authorized the government to purchase this, as also to establish telegraphs on all the lines of railway.

For an account of the Belgian army and civic guard, see ARMY.

Finances.

The following table shows the annual income and expenditure for the seven years preceding 1851:—

	Income.	Expenditure.
1844	198,810,508 fr.	195,185,657 fr.
1845	129,855,951	134,389,349
1846	114,064,043	122,752,999
1847	113,528,063	127,572,374
1848	146,117,886	135,060,595
1849	113,871,437	112,267,069
1850	132,877,187	118,730,904

The excess of the expenditure over the revenue since the independence of Belgium to the end of 1850 is 16,129,896 fr.

The budgets for 1852 and 1853 are as under:—

	Revenue.			Expenditure.	
	1852.	1853.		1852.	1853.
Land-tax.....	18,359,750 fr.	18,359,750 fr.	Public debt...	36,713,397 fr.	38,119,299 fr.
Personal taxes	9,240,000	9,350,000	Pensions	3,497,922	3,365,922
Tax on patents.....	3,201,000	3,355,000	Ministry of Justice	12,853,454	11,981,558
Rent of mines.....	207,900	207,900	... Foreign Affairs	2,181,931	2,161,849
Custom duties	12,275,000	13,000,000	... Interior.....	7,599,861	6,859,555
Excise duties	20,470,000	23,220,000	... Public Works	16,695,400	17,018,088
Stamp duties	21,695,000	23,495,000	... War	26,787,000	39,937,000
Domains, forests, &c. ..	4,485,000	4,300,000	... Finances	11,626,114	11,241,945
Post-Office.....	3,200,000	3,400,000	Deficiencies & repayments	2,278,718	2,023,000
Railways, &c.	16,040,000	17,375,000	Railways and canals.....	26,708,000	... .
Packet-boats.....	200,000	200,000			
Arrears received	6,936,600	6,861,600			
	117,310,250	123,224,250		146,941,797	132,708,216

The public debt on 1st May 1853 amounted to 643,488,563 fr., of which the sum of 237,036,832 fr. was the share falling to Belgium of the public debt of the kingdom of the Netherlands.

(W. J.) (D. K.)

Belgorod || Believers.

BELGOROD, a city in the Russian government of Kursk, on the river Donetz. It is the seat of an archbishop, and has considerable linen and other manufactures, five churches, 1800 houses, and about 10,000 inhabitants. Long. 36. 40. E. Lat. 50. 55. N.

BELGRADE, a famous town and fortress of Servia, in European Turkey, situated near the confluence of the Save and Danube. The fortress stands on a steep eminence in the centre, and commands the Danube. It is inclosed with high walls, and possesses strong towers and a triple ditch, and is provided with mines and bomb-proof casemates. The principal mosque and the residence of the pasha of Servia are in this part of the town. The water-side division lies near the junction of the two rivers, on the north side, and is likewise well defended by walls and ditches. The Rascian town (so called from its inhabitants) is towards the west, in the direction of the Save; and the Palanka encircles the fortress on the south and east. The city is in many parts well built, but the streets are in general badly paved and filthy. Belgrade is a place of considerable strength, and is garrisoned by a large force. It is gradually losing its Oriental appearance, and assuming more of a European aspect. It has manufactures of arms, silk and cotton goods, carpets, and leather; and it is the principal entrepôt between Constantinople and Saloniki on the one hand, and between Vienna and Pesth on the other. This important town has sustained many sieges, and repeatedly passed from the hands of the Austrians to those of the Turks. It was taken by Solyman II. in 1522, and retaken by the Austrians in 1688, but again lost in 1690. In 1717 it surrendered to Prince Eugene. The imperialists retained it till 1739, when the Turks invested and reduced it. Austria again took it in 1789, but it was restored at the peace of 1791. And, lastly, in the year 1806, the Servian insurgents succeeded in carrying it. Pop. about 30,000, chiefly Servians. Long. 20. 36. E. Lat. 44. 48. N.

BELIAL, בליעל, a Hebrew word which signifies a wicked, worthless person, and is sometimes used to designate the Evil One, as in the sixth chapter of 2 Corinthians, where St Paul says, "What concord hath Christ with Belial?" The inhabitants of Gibeah, who abused the Levite's wife, have the name of Belial given them; and Hophni and Phineas, the sons of the high priest Eli, are called sons of Belial, on account of their crimes, and their unbecoming behaviour in the temple of the Lord.

BELIDOR, Bernard Forest de, a very eminent engineer, born in Catalonia in 1697. He was a brigadier-general in the French service, inspector-general of mines, and member of the academies of sciences at Paris and Berlin, and of the Royal Society of London. He died at Paris in 1761. His works on mathematics and military engineering are held in high estimation. Of these may be mentioned, *Cours de Mathématiques*, 1725, 4to; *La Science des Ingénieurs*, &c., Paris, 1729; *Le Bombardier Français*, Paris, 1731, 4to; *Traité des Fortifications*, Paris, 1735, 2 tom. 8vo; *Architecture Hydraulique*, Paris, 1737–53, 4 tom. 4to; *Dictionnaire Portatif de l'Ingénieur*, 1755, 8vo.

BELIEF, in a general sense, denotes a persuasion or assent of the mind to the truth of a proposition. In this sense, belief has no necessary relation to any particular kind of evidence. Thus we are said to believe our senses, to believe our reason, to believe a witness. But, in its more restricted and technical sense, belief, according to the schoolmen, denotes that kind of assent which is grounded on the authority or testimony of some person or persons asserting or attesting the truth of any matter whatsoever. In this sense it stands opposed to knowledge and science.

BELIEVERS, an appellation given towards the close of the first century to those Christians who had been admitted into the church by baptism. They were thus distinguished from catechumens, who had not been baptized, and consequently did not enjoy the privileges of believers.

Belion || Bell.

BELION, in *Ancient Geography*, a river of Lusitania; otherwise called *Limæa*, *Limius*, *Limia*, and *Lethe*, or the river of oblivion; now *El Lima*, in Portugal.

BELISARIUS, general of the Emperor Justinian's army, who overthrew the Persians in the East, the Vandals in Africa, the Goths in Italy, and, in a degenerate age, renewed the victories and triumphs which had immortalized the glorious times of the republic. But notwithstanding all his exploits, this great commander was falsely accused of a conspiracy against the emperor's life. The real conspirators had been detected and seized, with daggers hidden under their garments; and one of them died by his own hand, while the other was dragged from the sanctuary to which he had fled for refuge. Pressed by remorse, or tempted by the hopes of safety, the latter accused two officers of the household of Belisarius; and they, in the agony of torture, declared that they had acted according to the secret instructions of their patron. But posterity will not hastily believe that a hero who in the vigour of life had disdained the fairest offers of ambition and revenge, should stoop to the murder of his prince, whom he could not expect long to survive. His followers were impatient to fly; but flight must have been supported by rebellion, and he had lived enough for nature and for glory. Belisarius appeared before the council with less of fear than of indignation; after forty years' service the emperor prejudged his case; and injustice was sanctified by the presence and authority of the patriarch. The life of the venerable veteran was indeed spared; but his fortunes were sequestrated, and for the space of a year he was kept a close prisoner in his own palace. At length his innocence was acknowledged, and his freedom and honours were restored; but death, which might have been hastened by grief and resentment, removed him from the world about eight months after his deliverance, A.D. 565. That he was deprived of his sight, and reduced to beg charity in the streets of Constantinople, uttering the doleful solicitation of *Date obolum Belisario*, "give a penny to Belisarius," is a fiction of later times, which has obtained credit as a supposed instance of extreme vicissitude of fortune. This idle fable seems to have been derived from a work of the twelfth century, entitled the *Chiliads*, by John Tzetzes, a monk, who relates the blindness and beggary of Belisarius in ten doggerel verses (*Chiliad* iii. No. 88, 339–348, in *Corp. Poet. Græc.* tom. ii. p. 311). The tale seems to have been imported into Italy with the language and manuscripts of Greece; repeated before the end of the fifteenth century by Crinitus, Pontanus, and Volaterranus; attacked by Alciatus for the honour of the law, and defended by Baronius for the honour of the church. Yet Tzetzes, the father of the fabrication, had confessedly read in the chronicles that Belisarius did not lose his sight, and that he recovered his fortune and his fame. (See the works of Procopius, and the *Life of Belisarius* by Lord Mahon.)

BELL, a well-known instrument, ranked by musicians among the musical instruments of percussion.

Bell-metal is an alloy of copper and tin, usually in the proportion of 80 parts of copper to 20 parts of tin. Zinc generally enters into the composition of small shrill bells. By analysis Dr Thompson found an English bell-metal to consist of 800 parts copper, 101 tin, 56 zinc, and 43 lead. The thickness of a bell's edge is usually 1-15th of the diameter, and its height is twelve times its thickness. The bell-founders have a diapason, or scale, wherewith they measure the size, thickness, weight, and tone of their bells.

The sound of a bell is produced by the vibratory motion of its parts, somewhat like that of a musical chord. The stroke of the clapper must necessarily change the figure of the bell, and from a circle convert it into an oval or ellipse; but the metal having a great degree of elasticity, that part

Bell. impinged on by the clapper, and driven farthest from the centre, will return, and even incline nearer the centre than before; so that the two parts which were extremes of the longest diameter become in turn those of the shortest; and thus the external surface of the bell undergoes alternate changes of figure, and by this means gives that tremulous motion to the air in which the sound consists. M. Perrault maintains that the sound of the same bell or chord is a compound of the sounds of its several composite parts; so that where the parts are homogeneous, and the dimensions of the figure uniform, there is such a perfect mixture of all these sounds as constitutes one uniform, smooth, even sound; while the contrary circumstances produce harshness. This he proves from bells differing in tone according to the part impinged on, although there is a motion of all the parts wherever the blow happens to be given. He therefore considers bells as a compound of an infinite number of rings, which, according to their different dimensions, have different tones, as chords of different lengths have; and when struck, the vibrations of the parts immediately impinged determine the tone, being supported by a sufficient number of consonant tones in the other parts.

Bells are heard at a greater distance when placed on plains than on hills, and still farther in valleys than on plains; the reason of which seems to be, that the higher the sonorous body the rarer is the medium, and, consequently, the less impulse it receives, and the less proper a vehicle it is to convey sound to a distance.

M. Reaumur, speaking of the shape most proper for bells, remarks, that as pots and other vessels more immediately necessary to the service of life were doubtless made before bells, it probably happened that the observing these vessels to have a sound when struck, gave occasion to making bells in that form; but that it does not appear that this is the most eligible figure: for lead, which in its ordinary state has no sonorous property, yet when cast in a melting ladle or otherwise into a segment of a sphere, acquires a certain degree of sonorousness; and hence he infers that such a figure is peculiarly adapted for small bells, such as those of house-clocks, &c.

The use of bells was very ancient. We find them among Jews, Greeks, Romans, Christians, and heathens, variously applied, as on the necks of men, birds, oxen, horses, and sheep. It is remarkable, however, that there is no appearance of bells in any of the Egyptian monuments. Bells were chiefly suspended in buildings, either religious, as in churches, temples, and monasteries; or civil, as in houses, markets, baths; or military, as in camps and frontier towns. In the museum at Naples are several kinds of ancient bells, one of which is a simple disk of metal.

Among the Jews it was ordained that the lower part of the blue tunic which the high priest wore when he performed religious ceremonies should be adorned with pomegranates and gold bells, intermixed alternately and at equal distances. (Exodus xxviii. 33, 34.) The number of the bells worn by the high priest is not specified; but the sacred historian has intimated the purpose they were intended to serve, viz., to give intimation both when he entered and came out of the holy place. The tinkling of a bell at the elevation of the host in the Roman Catholic sacrament of the mass is founded upon this circumstance.

Among the Greeks, those who went the nightly rounds in camps or garrisons, carried with them little bells, which they rung at each sentry-box, to see that the soldiers on watch were awake. A codonophorus or bellman also walked in funeral processions, some space in advance of the corpse, not only to keep off the crowd, but to advertise the *flamen dialis* to keep out of the way, lest he should be polluted by the sight, or by the funerary music. The priest of Proserpine at Athens, called *hierophantes*, rung a bell to call the people to sacrifice. There were also bells in the houses of great men, to call up the servants in the morning. Zonaras informs us that bells were suspended along with whips on the triumphal chariots of victorious generals, in order to put them in mind that they were still liable to public justice. Bells were also put on the necks of criminals going to execution, that persons might be warned by the noise to avoid so ill an omen as the sight of the hangman or the condemned criminal, who was devoted to the *dii manes*. Bell.

Of bells on the necks of brutes, express mention is made in Phædrus; and taking them away was construed theft by the civil law.

With respect to the origin of *church-bells*, Mr Whitaker observes, that as bells were used by the Romans to signify the times of bathing, they were naturally applied by the Christians of Italy to denote the hours of devotion, and to summon the people to church. The first application of them to this purpose is ascribed by Polydore Virgil and others to Paulinus, bishop of Nola, a city of Campania, about A.D. 400. Hence, it is said, the names *nolæ* and *campanæ* were given them; the one referring to the city, the other to the country. In Britain, bells were applied to church purposes before the conclusion of the seventh century in the monastic societies of Northumbria, and even as early as the sixth in those of Caledonia. They were therefore used from the first erection of parish churches. Those of France and England appear to have been furnished with several bells. In France they were sometimes composed of iron; and in England, as formerly at Rome, they were frequently made of brass.

Ingulphus mentions that Turketulus, abbot of Croyland, who died about A.D. 870, gave to the church of that abbey a great bell, which he named *Guthlac*, and afterwards six others, two of which he called *Bartholomew* and *Bettelin*, two *Turketul* and *Tatwin*, and two he named *Pega* and *Bega*. All of them rang together; and the same author says, *Non erat tunc tanta consonantia campanarum in tota Anglia*. Not long after, Kinseus, archbishop of York, gave two great bells to the church of St John at Beverley, and at the same time provided that other churches in his diocese should be furnished with bells. Mention is also made by St Aldhelm, and William of Malmesbury, of bells given by St Dunstan to the churches in the West. The number of bells in every church gave occasion to the curious and singular architecture which is often found in the campanile or bell-tower; an addition which is perhaps more susceptible of architectural embellishment than any other part of the edifice. It was the constant appendage of every parish church belonging to the Saxons, and is distinctly mentioned as such in the laws of Athelstane.

The Greek Christians are usually said to have been unacquainted with bells till the ninth century, when the construction of these instruments was first taught them by a Venetian; but it is not true that the use of bells was entirely unknown in the ancient Eastern churches, and that they called the people to church with wooden mallets. In some learned dissertations on the Greek temples, Leo Allatius proves the contrary from several ancient writers. In his opinion bells first began to be disused after the taking of Constantinople by the Turks; the latter, it seems, having prohibited them lest their sound should disturb the repose of souls wandering in the air. Father Simon, however, thinks that the Turks prohibited the Christians the use of bells from political rather than religious motives; inasmuch as the ringing of bells might serve as a signal for revolts or popular commotions.

In the ancient monasteries we find six kinds of bells enumerated by Durandus, namely, *squilla*, rung in the refectory; *cymbalum*, in the cloister; *nola*, in the choir; *nolula* or *dupla*, in the clock; *campana*, in the steeple; and *signum*, in the tower. Belethus very nearly agrees with Durandus, only for *squilla* he puts *tintinnabulum*, and places the *campana* in the tower, and *campanella* in the cloister.

Bell. Others place the *tintinnabulum* or *tinniolum* in the refectory or dormitory; and add another bell, called *corrigiuncula*, rung at the time of giving discipline, to call the monks to be scourged. The *cymbalum* is said to have been rung in the cloister, to call the monks to meals.

From the researches of a writer who has paid particular attention to this subject, we learn that bells frequently bore such inscriptions as the following:

Funera plango, Fulgura frango, Sabatta pango,
Excito lentos, Dissipo ventos, Paco cruentos.

In the little sanctuary at Westminster, King Edward III. erected a clocher, and placed in it bells for the use of St Stephen's chapel, round the largest of which were cast in the metal these words:

King Edward made mee thirtie thousand weight and three.
Take me down and wey mee, and more you shall fynd mee.

But these bells having been ordered to be taken down in the reign of Henry VIII., some one wrote underneath with a coal:

But Henry the eight
Will bait me of my weight.

This last distich alludes to a fact mentioned by Stowe in his Survey of London, that near to St Paul's school stood a clocher in which were four bells called *Jesus's Bells*, the greatest in all England, against which Sir Miles Partridge staked a hundred pounds, and won them of King Henry VIII. at a cast of dice. Nevertheless, in foreign countries there were bells of greater magnitude. In the steeple of the great church at Rouen, in Normandy, was a bell with this inscription:

Je suis George d'Ambois,
Qui trente cinque mille pois.
Mais lui qui me pesera
Trente six mille me trouvera.

But it was probably destroyed when the greater part of the magnificent edifice containing it was consumed by fire. It is a common tradition that the bells of King's College chapel, in the university of Cambridge, were brought by Henry V. from some church in France soon after the battle of Agincourt. They were taken down and were afterwards sold to a bell-founder in Whitechapel, who melted them down.

The various uses of bells have been summed up in the following old distich:

Laudo Deum verum, plebem voco, congrego clerum,
Defunctos ploro, pestem fugo, festa decoro.

Matthew Paris observes, that anciently the use of bells was prohibited in time of mourning; at present, however, the tolling of them forms one of the principal ceremonies of interment. Mabillon adds, that it was an ancient custom to ring bells for persons about to expire, to advertise the people to pray for them. The passing bell, indeed, was anciently rung for two purposes; one, to bespeak the prayers of all good Christians for a soul just departing; the other, to drive away the evil spirits who were supposed to stand near the bed of the dying, or about the house, ready to seize their prey, or at least to molest and terrify the soul in its passage. By the ringing of the bell,—for Durandus informs us that evil spirits are greatly afraid of bells,—they were kept aloof; and the soul, like a hunted hare, gained the start, or had what is by sportsmen called *law*. This dislike of spirits to bells is mentioned in the *Golden Legend* by Wynkyn de Worde. "It is said, the evil spirytes that ben in the regyon of thayre, doubte moche when they here the belles rongen: and this is the cause why the belles ben rongen when it thondreth, and whan grete tempeste and outrages of wether happen, to the ende that the feinds and wycked spirytes shold be abashed and flee, and cease of the movynge of tempeste." Lobineau observes, that the custom of ringing bells at the approach of thunder is of some antiquity; but that the design was not so much to shake the air, and so dissipate the thunder, as to call the people to church to pray that the parish might be preserved from that terrible meteor. Bell.

In Roman Catholic times bells were baptized and anointed *oleo chrismatis;* they were also exorcised and blessed by the bishop, from a belief that, when these ceremonies were performed, they had power to drive the devil out of the air, to calm tempests, to extinguish fires, aad to recreate even the dead. The ritual for these ceremonies is contained in the Roman pontifical; and it is still usual in such baptisms to give to bells the name of some saint. In Chauncy's *History of Hertfordshire* there is a relation of the baptism of a set of bells in Italy, which was performed with great ceremony a short time before that book was written. The bells of the parish church of Winnington, in Bedfordshire, had each its name cast about the verge, with these rhyming hexameters:

Nomina Campanis hæc indita sunt quoque nostris.
1. Hoc signum Petri pulsatur nomine Christi.
2. Nomen Magdalene campana sonat melode.
3. Sit nomen Domini benedictum semper in eum.
4. Musa Raphaelis sonat auribus Immanuelis.
5. Sum Rosa pulsata mundique Maria vocata.

By an old chartulary, it appears that the bells of the priory of Little Dunmow, in Essex, were, in the year 1501, newcast, and baptized by the following names:

Prima in honore Sancti Michaelis Archangeli.
Secunda in honore S. Johannis Evangelisti.
Tertia in honore S. Johannis Baptisti.
Quarta in honore Assumptionis beatæ Mariæ.
Quinta in honore sanctæ Trinitatis, et omnium sanctorum.

The bells of Osney Abbey, near Oxford, which were very famous, had the respective names of Douce, Clement, Austin, Hautecter, or rather Hautcleri, Gabriel, and John.

Nankin, in China, was anciently celebrated for the largeness of its bells. But their enormous weight brought down the tower which contained them. One of these bells was nearly twelve English feet in height, seven and a half in diameter, and twenty-three in circumference, its figure cylindric, except a swelling in the middle, and the thickness of the metal about the edges, seven inches. From the dimensions, its weight was computed at 50,000 pounds. These bells were cast about four centuries ago. They were designated the hanger (*tchoui*), the eater (*che*), the sleeper (*choui*), the will (*fi*). Father le Comte adds, that there are seven other bells in Pekin cast in the reign of Youlo, each of which weighs 120,000 pounds. But the sound of even the largest Chinese bell is very poor, owing to the circumstance of its being struck with a clapper of wood, instead of iron. The bells of China, however, are far exceeded by those of Moscow. One presented by Czar Beris Godunof to the cathedral weighs 288,000 pounds, and the great bell of Moscow cast in 1653 by order of the Empress Anne, and still remaining on the ground, is computed to weigh 443,772 pounds. It is 19 feet high, and has a marginal circumference of 63 feet 11 inches English. In England the heaviest bell is that made for York Minster in 1845, which weighs 27,000 pounds, but is not more than 7 feet 7 inches in diameter. The Great Tom of Oxford weighs 17,000 pounds; the Great Tom of Lincoln weighs 12,000 pounds; the great bell of St Paul's in London is 11,500 pounds, and has a diameter of 9 feet, or more than 28 feet in circumference.

The practice of ringing bells in change, or regular peals, is said to be peculiar to England. The custom seems to have commenced in the time of the Saxons, and to have been common before the Conquest. The *tolling* of a bell is nothing more than the production of sound by a stroke of the clapper against the side of the bell, the bell itself being in a pendent position and at rest. But in *ringing*, the bell is elevated to a horizontal position, so that, by means of a wheel and a rope, the clapper strikes forcibly on one side as it ascends, and on the other side in its return downwards, pro-

Bell. ducing at each stroke a sound. In England the ringing of bells is reduced to a system, and peals have been composed which bear the names of the inventor.

Electrical BELLS are used in a variety of entertaining experiments by electricians. The apparatus, which is originally of German invention, consists of three small bells suspended from a narrow plate of metal, the two outermost by chains, and that in the middle, from which a chain passes to the floor, by a silken string. Two small knobs of brass are also suspended by silken strings, one on each side of the bell in the middle, which serve for clappers. When this apparatus is connected with an electrified conductor, the outermost bells suspended by the chains will be charged, attract the clappers, and be struck by them. The clappers, becoming electrified, will likewise be repelled by these bells, and attracted by the middle bell, and discharge themselves upon it by means of the chain extending to the floor. After this they will be again attracted by the outermost bells, and thus, by striking the bells alternately, occasion a ringing, which may be continued at pleasure. Flashes of light will be seen in the dark between the bells and clappers, and if the electrification be strong, the discharge will be made without actual contact, and the ringing will cease.

BELL, *Andrew, D.D.*, a clergyman of the English Church, who is well known for his philanthrophic efforts in the cause of education, and more particularly for his success in extending the monitorial system of instruction in schools. He was the projector and founder of those admirable institutions called national schools; and the author of *An Experiment in Education at the Male Asylum, Madras;* and of *Instructions for conducting Schools on the Madras system*, &c., &c. Dr Bell was born at St Andrews in 1753, and received his education in the university there. Some of his early years were spent in America; and he was afterwards chaplain to Fort St George, and minister of St Mary's at Madras. During his residence in the East Indies he acquired considerable property; which, together with some lucrative preferments in England, enabled him to bequeath no less than L.120,000 in support of national institutions and public charities. This benevolent man died at Cheltenham in 1832, and his remains were interred in Westminster Abbey.

To the liberality of Dr Bell St Andrews is indebted for the foundation of Madras College.

BELL, *Benjamin*, an eminent surgeon, born at Dumfries in 1749. He studied at Edinburgh under the celebrated Monro, and combined with the office of head surgeon to the Edinburgh Infirmary an extensive practice in that city. He was the author of several standard works on surgery, among which may be noticed, *A Treatise on Ulcers*, and *A System of Surgery*. He died in 1806.

BELL, *Sir Charles, K.H.*, an eminent anatomist, physiologist, and surgeon, son of the Rev. William Bell, a clergyman of the Episcopal Church of Scotland, was born at Edinburgh in November 1774. Having studied at the High School and university of that city, he devoted himself at an early age to the study of anatomy, under his brother Mr John Bell, who was twelve years older, and who had already laid the foundation of his fame as an anatomist and a surgeon. Under the guidance of this enlightened teacher, Charles Bell soon gave evidence of the talents which seem to have been inherited by every member of his family. While yet a pupil, he published the first volume of his *System of Dissections*, illustrated by engravings from his own drawings. On the 1st August 1799, he was admitted a member of the College of Surgeons, and consequently became one of the surgeons of the Royal Infirmary; for all the members of that college were then in rotation surgeons of the hospital. His knowledge of anatomy, and the admirable use of his hands, exhibited both in his dissections and his drawings, were already conspicuous; and his operations were distinguished by their dexterity and simplicity. He eagerly availed himself of the opportunities afforded by his attendance in the infirmary to improve his knowledge of pathology, and, with that view, invented a method of representing morbid parts in models, some of which are still preserved in the museum of the Royal College of Surgeons of Edinburgh. About this time a controversy arose respecting the medical attendance in the Royal Infirmary, which terminated in the exclusion of several of the surgeons, amongst whom was Charles Bell. In 1804 he offered to pay L.100 a-year, and to transfer for the use of the students the museum he had collected, on condition that he should be "allowed to stand by the bodies when dissected in the theatre of the infirmary, and to make notes and drawings of the diseased appearances;" but this proposal was rejected. In 1806 he removed to London, where he immediately commenced a course of lectures on anatomy and surgery, and rapidly rose to distinction. Bell.

Previous to his departure from Edinburgh he had written his work on the *Anatomy of Expression*, which was published shortly after his arrival in London, and immediately attracted attention. Both as an artist and as a physiologist he had felt the want of some philosophical explanation of the rationale of expression; of those muscular movements which are the natural external indications of the passions and emotions of the mind; and perhaps no other man was so well qualified to supply the deficiency. But he did not confine himself to the illustration of what is useful to the artist; he also explained how an acquaintance with the anatomy of expression might be available to the surgeon or the physician in distinguishing the nature and extent of some important diseases. Independent of its intrinsic merit, this work has another interest; for there is reason to believe that his inquiries into the functions of the nerves in connection with the anatomy of expression led him to prosecute those investigations which terminated in the most remarkable anatomical discovery of our time.

In the same manner as it had been taught before the discoveries of Harvey, that there was a flux and reflux of the blood in the arteries and veins, so it was taught, before the discoveries of Bell, that the same nerves transmitted the mandate of the will *from* the sensorium to the organs of voluntary motion, and likewise carried *to* the sensorium intelligence of the condition of their extremities or sensation; and that, in some mysterious manner, these two impulses might be simultaneously communicated along the same chord in opposite directions, without impairing the efficiency of either. This doctrine, which now appears to be startling, continued to be taught, or was left to be inferred, by every anatomical teacher in Europe for at least a year after Sir Charles Bell had announced—in letters still extant, and bearing the London and Edinburgh post-marks of the 5th and 8th December 1807—his ideas on the nervous system. To him we owe the discovery that no one nerve serves the double purpose of ministering both to motion and to sensation;—that the spinal nerves and the fifth nerve of the brain, which had been regarded each as one nerve, consisted each of two distinct nerves connected with different portions of the brain, inclosed in one sheath for the convenience of distribution, but performing different functions in the animal economy, corresponding with the different portions of the brain to which they could be traced—the one conveying the mandates of the will *from* the sensorium, the other conveying *to* the sensorium intelligence of the condition of distant parts or sensation;—that, as the arteries carry the blood from the heart, and the veins carry it to the heart, so one set of nerves carries the impulses of volition from the brain, and another carries the impulses of sensation to the brain;—that the brain is divided, together with the spinal marrow which is prolonged from it, into separate parts, ministering respectively to the distinct functions of motion and sensation;—and that the

Bell. origin of the nerves from one or other of these sources seems to endow them with the particular property of the division whence they spring. Such were the leading features of Bell's great discovery, the greatest in the physiology of the nervous system for twenty centuries, and one of the most remarkable that the history of anatomy has to record.

For this discovery the Royal Society of London awarded him the first annual medal given by George IV. in 1829; and when a new order of knighthood was instituted on the accession of the late king to the throne, Bell was amongst the first who were invested. This was the only public reward he received, and he had merited it by the services he rendered to the wounded after the battles of Corunna and Waterloo, if he had never rendered any other. On both of these occasions he had proceeded to the scene of action, relinquishing for the time his professional avocations in London.

Of his various writings on the practice of different branches of his profession, it is sufficient to say that they place him in the highest class of our writers on surgery. But there is another series of his works, which, of all his labours, afforded him the greatest pleasure. In his treatise on animal mechanics, written by desire of the Society for Propagating Useful Knowledge, he embodied the substance of some of his lectures on the evidences of design to be found in the anatomy of the human body, which had attracted admiring crowds to the College of Surgeons. These views had been deeply impressed upon his mind, and the success with which he illustrated them probably pointed him out to the executors of the late Earl of Bridgewater as a fit person to maintain a part in that great argument which it was the purpose of that nobleman's bequest to have published. Sir Charles's contribution was the admirable treatise on the Hand. Still following out this favourite subject of his contemplation, he associated himself with Lord Brougham in the illustration of Dr Paley's *Natural Theology*, published in 1836, and contributed some of the most interesting of these illustrations.

This most estimable and distinguished man died suddenly on the 29th April 1842, at Hollow Park, in Worcestershire. (J. M—LL.)

Bell, *George Joseph*, brother of the preceding, was born at Edinburgh on the 20th of March 1770. At the age of eight he entered the High School, but he received no university education further than attending Tytler's lectures on civil history, Stewart's course of moral philosophy, and Hume's lectures on the law of Scotland. He became a member of the Faculty of Advocates in 1791, and was one of the earliest and most attached friends of Francis Jeffrey. It was by his counsel and encouragement that the distinguished critic was persuaded to persevere in his professional career at a time when his prospects of success at the bar were dark and discouraging. In 1804 he published a *Treatise on the Law of Bankruptcy in Scotland*, in 2 vols. 8vo, which was gradually enlarged in future editions, till at length a fifth edition was published in 1826, in 2 vols. 4to, under the title of *Commentaries on the Law of Scotland and on the Principles of Mercantile Jurisprudence*—an institutional work of the very highest excellence, which has guided the judicial deliberations of his own country till the present time, and has had its value acknowledged by no less jurists than Story and Kent. In 1821 he was unanimously elected professor of law in the university of Edinburgh; and in 1831 he was appointed to one of the principal clerkships in the Supreme Court. He was in 1833 placed at the head of a commission to inquire into the expediency of making various improvements in the Scottish bankruptcy law; and in consequence of the reports of the commissioners, chiefly drawn up by himself, many beneficial alterations have been made in this department of the law. He died at Hull on the 23d September 1843.

Bell, *Henry*, an ingenious mechanic, well known for his successful application of steam-power to the propulsion of ships, was born at Torphichen in Linlithgowshire, in 1767. Having received the ordinary education of a parish school, he was apprenticed to his uncle, a mill-wright; and, after qualifying himself as a ship-modeller at Borrowstownness, went to London, where he found employment under Rennie, the celebrated engineer. Returning to Scotland in 1790, he first settled as a carpenter at Glasgow, and afterwards removed to Helensburgh, on the Firth of Clyde, where his wife superintended a large inn, together with the public baths, while he pursued his mechanical projects, and also found occasional employment as an engineer. It was not until January 1812 that he gave a practical solution of the difficulties which had beset all previous experimenters, by producing a steamboat of about twenty-five tons, propelled by an engine of three-horse power, at a speed of seven miles an hour. A particular account of this vessel, which he named the "Comet," as well as of the experiments of his predecessors in the same line, will be found under the head Steam Navigation. It will there be seen that, although the honour of priority, by about four years, is admitted to belong to Robert Fulton, an American engineer, it appears to admit of no doubt that Fulton had received very material assistance in the construction of his vessel from Bell and others in this country. The latter days of this ingenious man were rendered comfortable by a handsome sum subscribed for him among the citizens of Glasgow; and he also received from the trustees of the river Clyde a pension of L.100 a-year. He died at Helensburgh, November 14. 1830.

Bell, *John*, of Antermony, a Scottish traveller in the first half of the last century. He was born in 1691, and was educated for the medical profession, in which he took the degree of M.D. In 1714 he set out for St Petersburg, where, through the introduction of a countryman, he was nominated medical attendant to Valensky, recently appointed to the Persian embassy, with whom he travelled from 1715 to 1722, through Russia, Turkey, Persia, and China. He had scarcely rested from this last journey, when he was summoned to attend Peter the Great in his perilous expedition to Derbend and the Caspian Gates. The narrative of this journey he has enriched with interesting particulars of the public and private life of that remarkable prince. In 1738 he was sent by the Russian government on a mission to Constantinople, to which, accompanied by a single attendant who spoke Turkish, he proceeded in the midst of winter, and all the horrors of a barbarous warfare; and in May 1738 he returned to St Petersburg. It appears that after this he was several years established as a merchant at Constantinople, where he married in 1746. In the following year he retired to his estate of Antermony in Scotland, where he lived in ease and affluence, beloved by his neighbours and respected by all who knew him. He died in 1780.

His travels, published at Glasgow, in 2 vols. 4to, 1763, were speedily translated into French, and widely circulated in Europe. (T. S. T.)

Bell, *John*, an eminent anatomist and surgeon, was born at Edinburgh May 12. 1763. He had the merit of being the first in Scotland who applied with success the science of anatomy to practical surgery. While still a young man, he established, in the face of much opposition, an anatomical theatre in Surgeon Square, where he attracted large audiences by his admirable lectures on anatomy, physiology, and surgery, in which he was assisted by his younger brother Charles. After his exclusion from the infirmary (to which reference has been made in the notice of Sir Charles Bell), Mr Bell ceased to lecture, and devoted his time to study and practice. He died at Rome in 1820, while on a tour in Italy for the benefit of his health. To great skill in his profession he united high and varied mental abilities and extensive learning. His principal works are the following:—*Anatomy of the Human Body*, 3 vols. 8vo, 1793–1802; *Discourses on the Nature and Cure of Wounds*,

Bell || Bellarmino.

2 vols. 8vo, 1793–95; *Principles of Surgery*, 3 vols. 8vo, 1801; and several volumes of Engravings illustrative of the Human Anatomy. His *Observations on Italy* were published by his widow in 1825.

BELL ROCK LIGHTHOUSE. See LIGHTHOUSES.

BELL'S REAPING MACHINE. See AGRICULTURE.

BELLA, STEFANO DE LA, an eminent engraver, born at Florence A.D. 1610. He was apprenticed to a goldsmith; but some prints of Callot having accidentally fallen into his hands, he was seized with a passion for engraving; and studied the art under Canta Gallina, who had also been the instructor of Callot. De la Bella at first imitated the manner of Callot: but afterwards adopted one entirely his own, which in freedom and spirit is said even to have surpassed that of his fellow-disciple. In 1642 he went to Paris, where Cardinal Richelieu engaged him to go to Arras and make drawings of the siege and taking of that town by the royal army. After residing a considerable time at Paris, he returned to Florence, where he obtained a pension from the grand duke, whose son, Prince Cosmo, he instructed in the art of design. He died in 1664.

BELLAGGIO, a town in Lombardy, at the point where the lake of Como is separated from the lake of Lecco. It is well built, and surrounded by most picturesque scenery.

BELLAI, or BELLAY, *Guillaume du*, lord of Langey, a French general, who signalized himself in the service of Francis I. His great abilities as a negotiator occasioned the remark of the Emperor Charles V., that "Langey's pen had fought more against him than all the lances in France." He was sent as viceroy into Piedmont, where he took several towns from the imperialists. His address in penetrating into the most secret designs of the enemy was extraordinary; and he spared no expense for that end. He was extremely active in influencing some of the universities of France to give a judgment agreeable to the desires of Henry VIII., when that prince wished to divorce his queen in order to marry Anne Boleyn. Langey composed several works, the most remarkable of which was the history of his own times. He died in 1543, and was buried in the church of Mans, where a noble monument was erected to his memory.

BELLANO, a town of Lombardy, situated at the end of the vale where the Pioverna forms a magnificent cataract, on the east side of the lake of Como. It is a place of considerable trade, with many country seats in the vicinity.

BELLARMINO, ROBERTO (*Cardinal Bellarmin*), the most eminent of Romish doctrinal controversialists, was born October 4. 1542, at Montepulciano, in Tuscany. At the age of eighteen he enrolled himself among the Jesuits, and was appointed by that society to teach theology at Louvain. The fame of his preaching in that town is said to have attracted even Protestants from England and Holland to hear him. After a residence of seven years in the Low Countries, he returned to Italy, and was appointed by Gregory XIII. to deliver controversial lectures in the college founded by that pontiff. Bellarmin, in the capacity of divine, accompanied the legation sent into France in 1590 by Sixtus V. Eight years afterwards, Clement VIII. made him a cardinal, which dignity he is said to have accepted with extreme reluctance. In 1601 he was appointed to the archbishopric of Capua; but he resigned that office on being made librarian of the Vatican by Paul V., and devoted himself, till the time of his death, to the affairs of the court of Rome. It has been said that the circumstance of his being a Jesuit was the sole cause of his exclusion from the papacy on the demise of Leo XI. and of Paul V. Bellarmin died at Rome, September 17. 1621. It is certain that no Jesuit ever did greater honour to his order, and that no author ever defended the cause of the Romish church in general, and that of the pope in particular, with greater ingenuity and skill. The Protestants have owned this sufficiently; for during the space of fifty years there was scarcely any divine of note among them who did not fix upon Bellarmin as the subject of his books of controversy. But notwithstanding the zeal with which Bellarmin maintained the power of the pope over the temporality of kings, he displeased Sixtus V. in his work *De Romano Pontifice*, by not insisting that the power which Jesus Christ gave to his vicegerent was direct, instead of indirect; and he had the mortification to see it put into the Index of the Inquisition, though it was afterwards removed. At his death he left to the Virgin Mary one half of his soul, and to Jesus Christ the other. Bellarmin is said to have been a man of great chastity and temperance, and remarkable for his patience. His stature was low, and his mien ungainly; but his countenance was expressive of genius. His style, though not pure, is perspicuous; and the words which he first made use of to express his thoughts were generally so suitable, that few erasures appeared in his writings. Cardinal Bellarmin was the author of numerous works, the principal of which are the following: *Disputationes de Controversiis Christianæ Fidei*, &c.; *Institutiones Hebraicæ linguæ; Explanatio in Psalmos; De Scriptoribus Ecclesiasticis; De Editione Latinâ Vulgatâ; De Officiis Episcoporum; Doctrina Christiana; De Ascensione Mentis in Deum per scalas Rerum Creatarum; De Arte Bene Moriendi; De gemitu Columbæ.*

Bellaspoor || Bellenden.

BELLASPOOR, a town of Northern India, on the left bank of the Sutlej, which is here 100 yards broad when the water is lowest. Its elevation is 1465 feet above the level of the sea, and the situation is exceedingly picturesque.

Mr Forster, who visited the place in 1783, found the houses well and regularly built of stone and mortar, and the streets all paved, though roughly; but in 1820, according to Moorcroft, the town was in a ruinous condition from having been twice plundered by the Ghoorkas. The traveller last mentioned effected the passage of the river in the vicinity of Bellaspoor, by means of the *mussuk* or float composed of inflated skins. His party consisted of 300 persons, with sixteen horses and mules, and 150 tons of baggage and merchandise. Thirty watermen, each managing a skin, conveyed the whole across in about an hour and a half. Bellaspoor is the chief place of the hill state of Kuhloor, and the residence of the rajah. Long. 76. 50. Lat. 31. 19. (E. T.)

BELLEAU, REMI, a French poet, born at Nogent-le-Rotrou, in 1528. He lived in the family of René of Lorraine, Marquis of Elbeuf, and attended him in his expedition into Italy in 1557. Belleau was one of the seven poets or his time who were denominated the *French Pleiades*. He died at Paris in 1577. His works were published at Paris in 1578 in 2 vols. 12mo.

BELLEGARDE, a barrier fortress of France, stands on one of the Eastern Pyrenees, in Long. 2. 50. E. Lat. 42. 27. N.

BELLE-ISLE, an island on the coast of France, in the arrondissement of L'Orient and department of Morbihan. Its extent is about 75 square miles; and it contains three towns and a number of villages, with 9000 inhabitants.

BELLE-ISLE, an island of North America, at the mouth of the strait of the same name, between New Britain and the north end of Newfoundland. It is 21 miles in circumference, and 16 miles from the coast of Labrador. Long. 55. 20. W. Lat. 52. 5. N.

BELLENDEN, JOHN, archdeacon of Moray, occupies a conspicuous place in the literary annals of Scotland, but his personal history is still involved in some degree of obscurity. Several writers have confounded him with Sir John Bellenden of Auchinoul; an error founded only on the identity of their names, as the judge appears to have survived the archdeacon for twenty-seven years. Bellenden was probably educated in the university of St Andrews. Bale refers his birth to the eastern part of the kingdom, probably Haddington or Berwick. His education is represented as uncommonly liberal; and as he took the degree of D.D. in the university of Paris, his

Bellenden, John.

course of academical study must have been very complete.[1] Dr Campbell has remarked that his phraseology occasionally savours of a French education:[2] it must however be recollected, that the poets of this age were too generally disposed to adopt terms of a French as well as Latin origin; and that the practice cannot be considered as peculiar to those who had been educated in France. Sir David Lindsay, in a poem supposed to have been written in the year 1530, mentions him in the following terms:

Bot now of late is starte up hastelie,
Ane cunnyng clark quhilk wrytith craftelie,
Ane plant of poetis callit Ballendyne,
Quhose ornat warkis my wit can nocht defyne:
Get he into the courte auctoritie,
He will precell Quintyn and Kenedie.[3]

The literary merit of Bellenden does not seem to have been disregarded by the court; but he experienced the precarious fortune which so frequently attends courtiers. For this information we are partly indebted to his poem entitled the Proheme of the Cosmographe:

And fyrst occurrit to my remembring,
How that I wes in seruice with the kyng,
Put to his grace in zeris tenderest,
Clerk of his comptis, thoucht I wes inding,
With hart and hand, and euery othir thing
That mycht hym pleis in ony maner best,
Quhill hie inuy me from his seruice kest,
Be thaym that had the court in gouerning,
As bird but plumes heryit of the nest.

In the epistle subjoined to his translation of Boyce's history, he likewise states that he had been in the service of the king from his majesty's early infancy. It has been conjectured that he was employed in superintending the young monarch's education: but he makes no allusion to such an appointment, of which it would have been very natural to remind the king, if they had ever stood in the relation of tutor and pupil; and he very clearly informs us that his place in the royal household was that of clerk of accompts. James's preceptor was Gavin Dunbar, afterwards promoted to the archbishopric of Glasgow. Being dismissed from the king's service, as he states in the verses last quoted, Bellenden is supposed to have entered into that of Archibald earl of Angus, because a person of the same name was the earl's secretary in the year 1528. In the course of that year, Angus and some of his relations were accused of treason: John Ballentyne, who is described as his secretary, presented himself at the bar of the parliament on the 4th of September, and delivered a written protest in the name of the earl of Angus, his brother George Douglas, and his uncle Archibald Douglas of Kilspindie, stating the reasons why they ought not to be compelled to answer to the charge of treason which had been preferred against them; and in the afternoon of the same day, the secretary again made his appearance, probably because they found such a protest altogether unavailing, and explained the conditions on which the earl was willing to surrender to his trial.[4] But in a transaction of this nature we should expect to find him employing a lawyer rather than a clergyman; and accordingly we are informed by Hume that the individual who thus appeared for the Douglases was "Sir John Ballandine, who was then one of their dependers, and afterward justice clerk."[5]

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Whatever may have been Bellenden's employment at this period, it is certain that he was soon afterwards an attendant at court; and that at the request of the king he undertook a translation of the Roman history of Livy, and the Scotish history of Boyce.[6] In this formidable task he appears to have been engaged in 1530 and the three ensuing years. The treasurer's accounts contain various entries respecting the remuneration of his labours: the sum total which he is there stated to have received amounts to L.114; namely, L.78 for the translation of Boyce, and L.36 for that of Livy. But this was not the only reward which he obtained. The archdeaconry of Moray had become vacant during the vacancy of the see; and two clergymen, Duncan and Harvey, having solicited the pope in favour of James Douglas, were convicted of treason, and their property escheated to the crown. The annual emoluments arising from the pensions and benefices of John Duncan, who was parson of Glasgow, and from all the property belonging to Alexander Harvey for the two successive years 1536 and 1537, were bestowed upon Bellenden. For the first grant he paid a composition of 350 marks, and for the second, of L.300.[7] It must have been upon the present occasion that he was promoted to the archdeaconry, which had lapsed to the crown in consequence of the vacancy in the bishopric: it was perhaps about the same period that he was appointed a canon of Ross; and this appears to have been the full extent of his preferment in the church, while many worthless and illiterate men were enjoying its highest dignities and emoluments.

His translation of Hector Boyce's history of Scotland is said to have been printed in the year 1536.[8] Neither the title-page nor the colophon exhibits the year of the im-

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[1] "Interea Musarum memoriæ fœliciter litabat Joannes Balantyn, archidiaconus Moraviensis, accuratissima sedulitate in literis a puero usque educatus." (Gray, *Oratio de illustribus Scotiæ Scriptoribus*, p. xxx.)

[2] *Biographia Britannica*, vol. i. p. 572, 2d edit.

[3] Lindsay's *Works*, vol. i. p. 287.

[4] *Acts of the Parliaments of Scotland*, vol. ii. p. 322–4.

[5] Hume's *History of the Houses of Douglas and Angus*, p. 258. Edinb. 1644, fol.

[6] It is not to be supposed that the king was able to read Latin authors with much facility. Lindsay, vol. i. p. 259, mentions that he was taken from school at the age of twelve; and the metrical paraphrast of Boyce's history has more particularly described the state of his knowledge:

The kingis grace I knaw is nocht perfyte
In Latyn toung.

We cannot however suppose that the king was entirely ignorant of the Latin language. It may perhaps be considered as a proof of his knowledge, that he urged Buchanan to write against the Franciscan friars, and to render his satire more poignant. "Igitur acrius in eos jussus scribere, eam silvam, quæ nunc sub titulo Franciscani est edita, inchoatam regi tradidit." (*Buchanani Vita*, p. 3.) Sir David Lindsay, in a poem composed about this period, exhorts James to study the chronicles of Scotland; and it might possibly be his intention to refer his grace to Bellenden's translation. (*Works*, vol. i. p. 302.)

The cronikillis to knaw I the exhort,
Quhilk may be mirrour to thy majestie;
Thare sall thou find baith gude and evill report,
Of everilk prince efter his qualitie:
Thocht thay be deid, thair deidis sall nocht dee.
Traist weill how salt be stylit in that storie
As thow deservis, put in memorie.

[7] Maitland's *Biographical Introduction*, p. xl.

[8] Mackenzie's *Lives of Scots Writers*, vol. ii. p. 596.

Bellenden, John.

pression; so that the date here assigned, if it is not merely conjectural, must have been ascertained from some other document. The book was printed by Thomas Davidson, who styles himself printer to the king.[1] On the 26th of July 1533, a sum of money was paid to Bellenden "for ane Cronikle gevin to the kingis grace," but this must have been in manuscript. The printed book describes the translator as archdeacon of Moray and canon of Ross: the bishopric did not become vacant till the year 1534,[2] and, as we have already seen, the archdeaconry was vacated at a later period. Under the date of April 1538, when he obtained a grant of the two clergymen's emoluments for the preceding year, he was not described as a dignitary. It has likewise been stated that the work was reprinted in 1541,[3] but such copies as we have had an opportunity of inspecting seem all to belong to the same edition. It was Bellenden's intention to execute a complete version of Livy, but he did not advance beyond the first five books, nor was his translation printed till the year 1822. From a manuscript in the Advocates Library, it was then published by Mr Maitland, to whose antiquarian zeal we are likewise indebted for a new edition of his other translation, as well as for some curious and interesting notices of Boyce and Bellenden.[4] The archdeacon is reported to have continued the history of Scotland for one hundred years subsequent to the period at which the printed narrative closes;[5] and a passage in his Proheme of the History seems to imply that he had at least formed such a project.

Bring nobyll dedis of mony yeris gone
Als fresche and recent to our memorie
As thay war bot in-to our dayis done,
That nobyll men may haue baith laud and glorie
For thair excellent brut of victorie.
And yit becaus my tyme hes bene so schort,
I thynk, quhen I haue oportunite,
To ring thair bell in-to ane othir sort.[6]

These two works exhibit the most ample specimen of ancient Scottish prose that has descended to our times, and are distinguished beyond most others by their fluency and neatness of style. Bellenden frequently surprises a modern reader by the happy vivacity of his expressions; nor can we peruse these translations without being convinced that his learning and talents had qualified him for original composition. In his version of the Scotish historian, he does not adhere very scrupulously to his author; he has assumed the liberty of adding, as well as of retrenching, and may therefore be considered as having exceeded the proper limits of a translation. He has at all events produced a very curious, and, to those who have a competent knowledge of the language, a very entertaining work. To his version of Boyce's history he has subjoined an epistle, addressed to James the Fifth, and written in a strain of manly freedom: of the distinction between a king and a tyrant, and of the miseries to which wicked princes have generally been exposed, he speaks in bold and unequivocal terms, which may excite some degree of surprise, but which cannot fail of exciting a high degree of respect for his character.[7] Bellenden was then a dignitary of the church, and might still hope for preferment; and in all ages ambitious churchmen have been sufficiently disposed to encourage sovereigns in their most flagrant attempts to encroach on the liberties of their subjects; but the conduct of the worthy archdeacon, and of some other beneficed clergymen of the ancient Scottish church, must completely exempt them from this censure. John Mair, who was provost of St Salvator's College, and treasurer of the chapel royal, and Hector Boyce, who was principal of King's College, canon of Aberdeen, and rector of Tyrie, have each written the history of their native country, and have each evinced a laudable zeal in vindicating the unalienable rights of the people. If such sentiments were cherished by some of the catholic clergy, it is not surprising that they should animate the breast of Buchanan, who had never been accustomed to pace in the trammels of the church, and who had more completely imbibed the spirit of classical antiquity.

Bellenden, John.

Whatever might be the liberality of his political sentiments, Bellenden seems to have been unprepared for any change in the national religion.[8] Stern and unbending virtue is not on all occasions to be expected among mankind: truths which threaten the extinction of dignity and emolument cannot so easily be embraced; nor must we forget the invincible force of prejudices, admitted in early youth,

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[1] Heir beginnis the Hystory and Croniklis of Scotland. Fol.—It was "imprentit in Edinburgh be me Thomas Dauidson, prenter to the kyngis nobyl grace." On the reverse of the title Davidson has inserted an address, consisting of five stanzas, and entitled "The Excusation of the Prentar." In the library of the university of Edinburgh, and in that of the duke of Hamilton, there are splendid copies of this work printed on vellum.

[2] Keith's *Catalogue of the Scottish Bishops*, p. 150.

[3] Herbert's *Typographical Antiquities*, vol. iii. p. 1474.

[4] The History and Chronicles of Scotland: written in Latin by Hector Boece; and translated by John Bellenden, archdean of Moray, and canon of Ross. Edinb. 1821, 2 vols. 4to. The first five books of the Roman History: translated from the Latin of Titus Livius by John Bellenden, &c. Edinb. 1822, 4to. The two works are uniformly and elegantly printed.

[5] Balei *Scriptores Britanniæ*, cent. xiv. p. 223.

[6] This metaphor, which is not peculiarly elegant, seems to have been a favourite with the Scotish poets, and particularly with the bishop of Dunkeld.

Ane nothir wyse that bell sall now be roung
Than euer was to fore herd in our toung. (Douglas's *Virgil*, p. 38.)

For quhy the bell of rethorick bene roung
Be Chawcer, Gower, and Lidgate laureat. (Lindsay's *Works*, vol. i. p. 284.)

[7] In the Proheme of the History, Bellenden takes occasion to suggest that it is impossible for a king to possess at once the hearts and the goods of his barons.

Schaw mony reasonis how na king micht haif
His baronis hartis and thair geir atanis.

[8] It however appears from the following stanza of the same Proheme, that he was not insensible to the profligate lives of the clergy.

Schaw how of kirkis the superflew rent
Is ennime to gud religion,
And makis preistis more sleuthfull than fervent
In pietuus werkis and devotion,
And not allanerly perdition
Of commoun weill be bullis sumptuus,
Bot to evill prelatis gret occasion
To rage in lust and life maist vicius.

Bellenden, William.

and cherished through a lengthened life. The archdeacon of Moray is represented as a strenuous opponent of the reformation, which he did not live to see completed.[1] He is said to have visited Rome, and there to have terminated his career in 1550.[2] The particular object of his journey has not been recorded: nor are we better informed with respect to his age; but if he was entered at the university in 1508 and died in 1550, we may conjecture that he had scarcely exceeded his sixtieth year. In this academical record however we are only guided by the identity of names, without the aid of any additional evidence.

Bellenden has been extolled as a master of every branch of divine and human learning,[3] and his attainments have even extorted applause from the zealous bishop of Ossory, John Bale, who has so frequently treated the papists with unrelenting severity. In his poetical remains, which are not numerous, he frequently displays an excursive fancy, with considerable taste and skill as a versifier; and it is therefore to be regretted that so few of his compositions have been preserved. The most poetical of his works is the Proheme of the Cosmographe: the principal incidents are borrowed from the ancient fiction of the choice of Hercules,[4] but he has imparted to his copy the characteristic air of an original. Nor is his Proheme of the History destitute of poetical merit. These two poems, as well as the metrical prologue to his translation of Livy, bear internal evidence of having been composed for the instruction of the young king. Two copies of his unpublished prolusion on the conception of Christ are to be found in Bannatyne's MS.

Beside the works already enumerated, Bellenden is said to have composed a tract on the Pythagorean letter, *De Litera Pythagoræ;* nor is there any necessity to adopt Dr Mackenzie's emendation, and substitute *Vita* for *Litera:* the letter of Pythagoras was upsilon, which he had selected as his favourite in consequence of certain emblematical properties indicated by its form. Vossius has mentioned Bellenden as the author of a work on cosmography,[5] but this is evidently his translation of Boyce's preliminary description of Scotland. It was stated by Dr Campbell that many of his writings were then in the possession of persons of distinction in Scotland; and he particularly mentions that several of his poems were in the possession of Laurence Dundas, apparently the professor of humanity at Edinburgh.[6] It is not however improbable that all these were merely the works with which we are still acquainted, and that the poems to which he alludes were modern transcripts. (D. I.)

Bellenden, *William*, is a Scottish name familiarly known to those who have explored the recesses of modern literature, but with respect to the history of the individual himself very few particulars have hitherto been discovered. Whether he belonged to any family of distinction, we are not informed; nor is the gentility of his birth attested by Dempster, who supplies the only biographical notices with which we are acquainted. According to this contemporary authority, he was a professor in the university, and an advocate in the parliament of Paris. We must apparently conclude that he relinquished the functions of a professor, and betook himself to the practice of the bar. The same writer has stated that both Queen Mary and King James employed him in some diplomatic services, and that the latter nominated him master of requests.[7] That he bore such a title, is sufficiently ascertained from his own publications, in all of which he is described as "Magister supplicum Libellorum Augusti Regis Magnæ Britanniæ;" but there are obvious reasons for suspecting that his office, if not unconnected with emolument, was altogether unconnected with official duty; for he appears to have spent the greater part of his life in France. *Magister Libellorum* was an officer in the court of the Roman emperors,[8] and it was his duty to receive and examine petitions addressed to the prince. A similar office was established in several modern kingdoms; and *Maître des Requêtes* being an honourable title in France, Bellenden might solicit and obtain such a title from a sovereign who could not so easily bestow an ample salary. The terms employed by Dempster in describing his appointment, seem rather to indicate honour than emolument. It is supposed that he must have belonged to the Scottish establishment, for, in England, a person who bore this title was a judge of a particular court: of the court of requests, which professed to distribute justice gratuitously, the lord privy seal was chief judge, and was assisted by two judges called masters of requests, the one for the common, and the other for the civil law.[9] In a list of the officers of state in Scotland, "William Ballenden, *magist. supplic. libellor.*" is said to have succeeded Mark Ker as master of requests in 1608, and to have been succeeded in 1624 by Sir James Galloway, afterwards Lord Dunkeld.[10] But the date of his appointment seems to have been borrowed from that of his earliest publication; and Bellenden continued to describe himself as master of requests in the year 1625.

If he practised at the bar in Paris, his early education must in all probability have been French; and if he was a regent or professor in one of the colleges, he may be supposed to have adhered to the popish religion. Since the massacre of St Bartholomew, which had proved fatal to Ramus and other men of learning, there probably had been no protestant professor in any college of Paris. His nephew, William Bellenden, was a catholic and a priest.

Bellenden's earliest publication bears the subsequent

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[1] "Jacobus Balandenus, Moraviensis ecclesiæ archidiaconus, in celebri Sorbonæ schola magistri laurea donatus, summo studio popularium suorum animos heresi laborantes, cum scribendo tum disputando, conatus est liberare." (Conæus *de duplici Statu Religionis apud Scotos*, p. 167. Romæ, 1628, 4to.) Both Conn and Dempster have inaccurately given him the name of James.

[2] "Romæ tandem obiise dicitur." (Bale, cent. xiv. p. 223.) "Obiit Romæ, anno, ut puto, 1550." (Dempster, p. 107.) The former writer speaks with some degree of hesitation respecting the place, and the latter respecting the date.

[3] "Laboriosa cura et incredibili studio artes omnes humanas atque etiam divinas percepit." (Dempster. *Hist. Ecclesiast. Gent. Scotor.* p. 107.)

[4] Xenophontis *Memorabilia*, lib. ii. § 21.

[5] Vossius *de Scientiis Mathematicis*, p. 252.

[6] *Biographia Britannica*, vol. i. p. 573.

[7] "Guilielmus Bellendenus, sive Ballantinus, honestissimo bonarum artium studio Parisiis inclaruit professor in academia, patronus causarum in supremo Galliarum senatu; tum demum oratoris munere honestatus principibus suis, Reginæ Mariæ, filioque Jacobo, fidelem operam navavit, a quo posteriore magistri libellorum supplicum elogio honorifico est donatus. Ejus sunt: Princeps Ciceronis, lib. i. Orator Ciceronis, lib. i. Senator Ciceronis, lib. i. In omnia Ciceronis Opera Observationes, lib. i. Vivit adhuc Lutetiæ, et plura molitur." (Dempsteri *Historia Ecclesiastica Gentis Scotorum*, p. 119. Bononiæ, 1627, 4to.)

[8] Brissonius *de Verborum quæ ad Jus Civile pertinent Significatione*, tom. ii. p. 769. edit. Heineccii.

[9] See Sir Thomas Smith's *Common-wealth of England*, p. 245. edit. Lond. 1633, 12mo.—"Therein, for the most part," says Sir Thomas Ridley, "are handled poore miserable persons causes, as widows and orphans, and other distressed people, whose cases wholly relie on pietie and conscience." (*View of the Civile and Ecclesiasticall Law*, p. 276, 2d edit. Oxford, 1634, 4to.) The court of requests was instituted about the ninth of Henry VII., and was dissolved by statute, 16 Car. I. c. 10.

[10] Scot's *Staggering State of the Scots Statesmen*, p. 189. Edinb. 1754, 12mo.

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title: "Ciceronis Princeps, Rationes et Consilia bene gerendi firmandique Imperii: ex iis repetita quæ ex Ciceronianis defluxere fontibus in libros xvi. de Statu Rerum Romanarum, qui nondum lucem acceperunt." Paris. 1608, 8vo. This was followed by[1] "Ciceronis Consul, Senator, Senatusque Romanus: illustratus publici observatione juris, gravissimi usus disciplina, administrandi temperata ratione; notatis inclinationibus temporum in Rep. et actis rerum in Senatu: quæ a Ciceroniana nondum edita profluxere memoria annorum DCCX. congesta in libros xvi. de Statu Rerum Romanarum: unde jam manavit *Ciceronis Princeps*, dignus habitus summorum lectione principum. Editio prima. Ad inclytum serenissimumque Principem Henricum Principem Scotiæ et Walliæ." Paris. 1612, 8vo. This mode of noting a first edition is somewhat pleasant;[2] nor must we overlook the important intelligence that his former publication had been thought worthy of the attention of mighty princes. Both these works partake of the nature of a cento. In the first of them, the author has collected from the writings of Cicero the various precepts and remarks which relate to the origin and principles of regal government, and with no small labour has combined the whole in a regular and systematic form. Adopting a similar plan in the other work, he has compiled a treatise on the dignity and authority of the consuls, and on the constitution of the Roman senate. Although this may seem an effort of mere diligence, it required both learning and ability to present such materials in such a shape.

His next publication is entitled "De Statu prisci Orbis in Religione, Re politica, et Literis, liber unus. Ad serenissimum Principem Carolum Principem Scotiæ et Walliæ" Paris. 1615, 8vo. This is a work of more originality, and affords a very favourable specimen of the author's talents and erudition.[3] It exhibits, in a very condensed form, a sketch of the history of philosophy and civil polity, tracing its progress among the Hebrews, Greeks, and Romans. Of this work very few copies appear to have been separately published; for the author speedily combined all the three tracts in a volume which bears the following title: "De Statu libri tres. I. De Statu prisci Orbis in Religione, Re politica, et Literis. II. Ciceronis Princeps, sive de Statu Principis et Imperii. III. Ciceronis Consul, Senator, Senatusque Romanus, sive de Statu Reip. et Urbis imperantis Orbi. Primus, nunc primum editus: cæteri, cum tractatu de Processu et Scriptoribus Rei Politicæ, ab autore aucti et illustrati." Paris. 1615, 8vo. Notwithstanding this notice on the title-page, we suspect that the second and third treatises were not actually reprinted. Each treatise has a distinct series of pages, and it was therefore easy to combine the whole. In its separate form and in this volume, *Ciceronis Consul* exhibits the very same list of typographical errors. Dr Parr remarks, that in all the copies which he had seen, the date seems to have been changed from M.DC.XV. to M.DC.XVI. by the printer adding the letter I after the impression had been finished: but in a copy belonging to the Advocates Library, the additional letter is apparently printed, not with a type, but with a pen; and in a copy belonging to the writer of this notice, the original date remains unaltered. Another minute variation may likewise be mentioned; in the latter copy, the plate in the second treatise is not impressed on the reverse of a printed page of the dedication. In a paper written by Dr Bennet, the late bishop of Cloyne, we find the subsequent statement respecting the books *De Statu*. "The great work being now completed, Bellenden looked forward with a pretty well-grounded expectation for that applause which his labour and his ingenuity deserved. But his views were disappointed, by one of those events which no art of man could foresee or remedy. The vessel in which the whole impression was embarked was overtaken by a storm before she could reach the English coast, and foundered with all her cargo. A very few copies only, which the learned author either kept for his own use, or had sent as presents by private hands, seem to have been preserved from the destruction which awaited the others."[4] We are not aware of any early authority for such a statement; and the learned prelate, misled by an imperfect recollection, seems to have misapplied Dr Warton's account of Bellenden's larger work, which is likewise an account that requires confirmation. There is a manifest fallacy in supposing that almost all the impression of such a book must have been destined for England. After a long interval, the fame of the author was greatly extended by Dr Parr's publication of "Gulielmi Bellendeni, Magistri supplicum Libellorum Augusti Regis Magnæ Britanniæ, &c. de Statu libri tres. Editio secunda longe emendatior." Lond. 1787, 8vo. The preface, extending to seventy-six pages, is written in a style of elegant and powerful Latinity, but is too much replenished with modern politics, and, in the opinion of some readers, is not free from a considerable mixture of pedantry. It is however such a composition as no other Englishman of that period could perhaps have produced.

Bellenden, William.

The last work which Bellenden himself published is of very small extent, consisting merely of two short poems: "Caroli Primi et Henricæ Mariæ, Regis et Reginæ Magnæ Britanniæ, &c. Epithalamium; et in ipsas augustissimas Nuptias, celeberrimamque Legationem earum causa obitam, &c. panegyricum Carmen, et Elogia." Paris. 1625, 4to. This little work has likewise been republished by Dr Parr.

But the greatest labour of his life was a posthumous production, which made its appearance under the title of "Guilielmi Bellendeni Scoti, Magistri supplicum Libellorum Augusti Regis Magnæ Britanniæ, de tribus Luminibus Romanorum libri sex-decim." Paris. 1633, fol. With respect to the date of this publication, one bibliographer frequently contradicts another, and some minute particulars require explanation. In the Advocates Library, that great repository of Scottish literature, there are two copies of the book, which exhibit considerable variations. In both of them we find the same extract of the royal privilege, dated on the third of September 1631. The one bears, "Achevé d'imprimer pour la premiere fois, le vingtseptiesme jour d'Aoust 1633." Of this copy the dedication, "Henrico Borbonio, Sacro-sancti Imp. Rom. Principi, illustriss. Metens. Præsuli," is subscribed by the author's nephew, "Guilielmus Bellendenus, Presbyter Scotus." It consists of nearly four pages, but is not fol-

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[1] This work of Bellenden did not escape the notice of the learned and indefatigable Fabricius, *Bibliographia Antiquaria*, p. 490. edit. Hamb. et Lips. 1716, 4to.

[2] Another learned philologer had recently set him the example: "Julii Cæsaris Bulengeri Juliodunensis de Theatro Ludisque Scenicis libri duo. *Editio prima.*" Tricassibus, 1603, 8vo.

[3] Dr Parr, in his famous preface to Bellenden, p. v. mentions this work with much commendation. "Stylus est Bellendeni per librum huncce, dilucidus in primis, neque exquisitus nimis. Sententiæ hic illic occurrunt reconditæ, quibus adhibita, tanquam obrussa, est ratio. Operis porro totius ita sunt aptæ inter se colligatæque partes, nihil ut sit asperum, vel hiulcum, vel dissolutum, nihil in alienum irruerit locum, nihil non positum sit suo."

[4] See Dr Johnstone's *Memoirs of Parr*, p. 182.

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lowed by a preface. The other copy has a similar title-page, but with the date of 1634; and the note subjoined to the privilege bears, "Achevé d'imprimer pour la premiere fois, le vingtroisiesme jour de Mars 1634." It contains a different and a shorter dedication, "Potentissimo et invictissimo Principi Carolo Magnæ Britanniæ Regi, &c." subscribed by the publisher, Toussaint du Bray. This dedication is followed by a brief preface, "Lectori benevolo." In other respects the two copies present a complete resemblance; and it appears sufficiently evident that one set of copies must have been intended for the French, and another for the British market.

Of this elaborate work, which consists of no fewer than 824 pages, printed on a small type, the subject is very faintly indicated by the title. It is the author's object to combine, in an historical form, all the statements and reflections of Cicero which relate to the civil and religious affairs of Rome; and his plan is executed in such a manner as to display the essence of the Roman history, from the foundation of the city to the extinction of the republic.[1] In the text he adheres to his former method of expressing himself in no other words than those of Cicero; but he has interspersed occasional observations, drawn from various sources of information. The latter part of the work, relating to the times of his great prototype, is very ample and satisfactory; and here it is evident that the materials must be chiefly derived from the epistles. The reader cannot fail to perceive that this is precisely such a digest as would be necessary for an historian of the life and times of Cicero; it is such a digest as Dr Middleton professes to have formed by his own unaided industry. "My first business therefore," as he is pleased to state, "after I had undertaken this task, was, to read over Cicero's works, with no other view than to extract from them all the passages that seemed to have any relation to my design; where the tediousness of collecting an infinite number of testimonies scattered through many different volumes; of sorting them into their classes, and ranging them in proper order; the necessity of overlooking many in the first search, and the trouble of retrieving them in a second or third; and the final omission of several through forgetfulness or inadvertency; have helped to abate that wonder which had often occurred to me, why no man had ever attempted the same work before me, or at least in this enlarged and comprehensive form, in which it is now offered to the public."[2] If previously acquainted with the work of Bellenden, he must have been fully aware that this labour of collecting and digesting was altogether superfluous; nor is it probable that such a book was unknown to Dr Middleton, a man of extensive learning, and the keeper of a great public library, that of the university of Cambridge. He has therefore been repeatedly accused of plagiarism; and it must be confessed that the accusation does not appear to be destitute of foundation. "It may be worth observing," says Dr Warton, "that he is much indebted, without acknowledging it, to a curious book little known, entitled *G. Bellendeni Scoti de tribus Luminibus Romanorum*, &c. It comprehends a history of Rome, from the foundation of the city to the time of Augustus, drawn up in the very words of Cicero, without any alteration of any expression. In this book Middleton found every part of Cicero's own history, in his own words, and his works arranged in chronological order, without further trouble. The impression of this work being shipped for England, was lost in the vessel, which was cast away, and only a few copies remained that had been left in France."[3] The same opinion respecting the biographer's plagiarism is adopted, and strongly expressed by Dr Parr.[4]

Bellero-phon.

M. Morabin, the French biographer of Cicero, who soon followed Dr Middleton, has, in the dedication of his work, acknowledged his acquaintance with Bellenden, but has not mentioned him in the most appropriate terms. "Si Bellenden, dans son traité *De tribus Luminibus Romanorum*, a évité cet écueil, en rassemblant tout ce qu'il y a d'historique dans Cicéron, et en n'employant que les expressions de cet orateur, il a donné dans un autre; et sa compilation, de quelque utilité qu'elle puisse être à un auteur qui embrasseroit une histoire générale, ne sauroit guère servir dans la composition d'une histoire particulière, qu'à fournir la matière d'un gros livre qui ne seroit lu."[5] But certainly an ample collection of materials was in either case desirable; and for a person who undertook to write the history of Cicero in two volumes quarto, it might have been thought necessary to inspect all the materials which Cicero had himself furnished.

Bellenden has bestowed upon his book a title which to many readers must require explanation. It appears to have been his original intention to compose, on a similar plan, three different works illustrative of the civil and literary history of Rome. The first of his three luminaries is Cicero, who has supplied him with the materials of civil history. According to Lenglet du Fresnoy, the other two whom he had in his contemplation were Seneca and the elder Pliny;[6] and we may conclude that, by means of the same laborious arrangement and digest of their respective writings, he intended to exhibit a comprehensive view of the moral and physical science of the Romans. (D. I.)

BELLEROPHON or BELLEROPHONTES, in fabulous history, the name given to Hipponous the son of the Corinthian king Glaucus and Eurymede, after his murder of the noble Corinthian Bellerus. In order to expiate his crime, he fled to Prœtus, whose wife Anteia or Stenebœa, became enamoured of the young stranger; and when he rejected her advances she accused him to the king of an attempt against her honour. Prœtus, unwilling to infringe the laws of hospitality, made Bellerophon the bearer of his own death warrant in a sealed letter addressed to his father-in-law Iobates king of Lycia; whence the proverb *Bellerophontis literas affert*, equivalent to "Uriah's letter." As a certain means of destruction, Bellerophon was sent to kill the Chimæra; but with the assistance of the winged horse Pegasus he rose into the air, and slew the monster with his arrows. The like success attended his expeditions against the Solymi and the

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[1] Clement has described this work in terms of too extensive import: "Guillaume Bellenden, grand admirateur de Cicéron, s'est donné la torture pour écrire l'Histoire *des Empereurs* et des Consuls Romains, avec les propres termes de cet ancien orateur, dont il a cité constamment les ouvrages à la marge: et comme il n'osoit pas s'étendre à son gré, en écrivant d'une manière si bornée, il a ajouté des notes à la fin de chaque livre, dans lesquelles il explique plus amplement ses idées." (*Bibliothéque curieuse historique et critique, ou Catalogue raisonné de Livres difficiles à trouver*, tom. iii. p. 72.)

[2] Middleton's *Hist. of the Life of M. T. Cicero*, vol. i. p. xx.

[3] Warton's *Essay on the Genius and Writings of Pope*, vol. ii. p. 324.

[4] "Permoleste autem fero," says Dr Parr, "potuisse illum, qui ingenii tam acris elegantisque esset, laudibus Bellendenum meritis ac debitis privare. Fidentissime enim confirmamus, Middletonum non modo ex Bellendeni opere supellectilem sibi sublegisse satis lautam atque amplam, sed libri ipsius prope formam, qua res ferret, adumbrasse." (*Præf.* p. iii.)

[5] Morabin, *Histoire de Cicéron, avec des Remarques historiques et critiques.* Paris, 1745, 2 tom. 4to.

[6] "L'auteur avoit dessein de faire la même chose sur Pline l'ancien, et sur Seneque; mais il n'y a eu d'imprimé que ce qui regarde Cicéron, et l'ouvrage même n'est pas commun." (Lenglet du Fresnoy, *Méthode pour étudier l'Histoire*, tom. xi. p. 72, edit. 1772.)

Belles-Lettres || Bellini.

Amazons; and on his return to Lycia he slew a party of the bravest Lycians who were set in ambush against his life Iobates, in admiration of his valour, and convinced that his innocence alone could have shielded him in all these perils, gave him his daughter in marriage, and nominated him his successor in the kingdom; intelligence that drove Stenebœa to despair and suicide. Bellerophon now grew vain of his prosperity; and as he attempted, with the assistance of Pegasus, to ascend to heaven, Jupiter checked his presumption by sending a gadfly which stung the horse, and caused Bellerophon's fall to the earth, where he wandered in contempt and misery to the end of his days: while Pegasus, mounting to heaven, was placed among the constellations.

BELLES-LETTRES, a French term for polite literature generally. It would be endless to enumerate the various branches both of science and literature which learned men have thought proper to comprehend under this title. Rhetoric, poetry, history, and philology, are usually included under *belles-lettres;* but the vagueness of the term has rendered its use nearly obsolete, though it is still retained in some universities.

BELLEVOIS, an excellent painter of marine subjects, but of whose history nothing is recorded except that he died at Hamburg in 1684.

BELLEY, a town of France, in the department of Ain, and capital of an arrondissement of the same name, is situated near the Rhone, 39 miles east of Lyons. It is the seat of a bishopric founded as early as 412, and contains an episcopal palace, an ecclesiastical school, a museum, and a public library. In the vicinity are the best lithographic stones in France. Pop. (1851) 4517. The arrondissement comprehends nine cantons and 112 communes, with a population of 83,626.

BELLINI, Gentile, a Venetian painter, born in the year 1421. He was employed by the republic of Venice; and to him and his brother that state is indebted for the noble works which are to be found in its council-hall. Mahommed II. having seen some of his performances, was so struck with them that he wrote to the republic, entreating that the artist might be sent to him. Bellini accordingly proceeded to Constantinople, where he painted a number of pieces, among which was the decollation of St John the Baptist, whom the Turks revere as a great prophet. Mahommed admired the proportion and shading of the work; but remarking a defect in regard to the skin of the neck, from which the head was separated, the sultan, to prove the truth of his observation, sent for a slave and ordered his head to be struck off. The painter by no means relishing this capital style of instruction, and, anxious to place his own head beyond the reach of experiment, earnestly solicted his dismission, which was granted by the grand signior. The republic settled a pension upon him at his return, and made him a knight of St Mark. He died in 1501, in the eightieth year of his age.

Bellini, *Giovanni*, the son of Jacopo Bellini, and brother of Gentile, was born at Venice in 1422. He surpassed his brother in grace and softness; and may be considered as the chief emancipator of the Venetian school from the dry manner of his predecessors. His works are numerous, but his best pictures are to be seen only in Italy. (Lanzi, *Storia Pittor.*)

Bellini, *Jacopo*, an early Venetian painter, who having learned the art of painting in oil, produced some pictures in that manner which are still considered as remarkable productions. He died in 1470.

Bellini, *Lorenzo*, a celebrated physician and anatomist, born at Florence A.D. 1643. After completing his studies in general literature, he went to Pisa, where, assisted by the generosity of the grand duke Ferdinand II., he studied under two of the most learned men of that age, Oliva and Borelli, the former of whom instructed him in natural philosophy, and the latter in mechanics. He likewise studied medicine under Redi, and mathematics under Marchetti. At the early age of twenty he was chosen professor of philosophy at Pisa, but did not long continue in this office; for he had acquired such a reputation for skill in anatomy, that the grand duke procured him a professorship in that science, and was himself a frequent auditor at his lectures. Bellini died in 1703, in the sixtieth year of his age. His works were publicly read and explained at Leyden by our countryman Dr Pitcairn, professor of physic there.

Bellini || Belon.

Bellini, *Vincenzio*, the operatic composer, was born at Catania in Sicily, on the 3d November 1802 according to the best authorities. He was the son of a musician, and received his education in the Conservatorio at Naples, under Zingarelli. His principal works are the following well-known operas:—*Il Pirata, La Straniera, La Sonnambula, Norma, I Puritani.* He died at Puteaux near Paris, after a short illness, September 23. 1835. Combined with an elegant person and fascinating manners, Bellini possessed high moral worth; and his compositions, which are characterized by tenderness and sweetness, are a happy reflection of the amiable disposition of the author.

BELLIS, a genus of composite plants, the best known of which is the common daisy. See Botany.

BELLONA, in *Roman Mythology*, the goddess of war, and the companion of Mars. Some, however, describe her as his sister or his wife. She is commonly represented in an attitude expressive of fury and distraction, with her hair composed of snakes clotted with gore, and her garments stained with blood; sometimes she is depicted driving the chariot of Mars, with a bloody whip in her hand, sometimes with a lighted torch or brand, and a trumpet. Bellona had a temple at Rome near the Circus Flaminius. Her priests, called Bellonarii, used to mangle their bodies with knives in order to pacify the deity, offering their own blood in sacrifice.

BELLORI, Giovanni Pietro, an eminent antiquary and connoisseur, born at Rome in 1615. He wrote *Vite de' Pittori, Scultori, ed Architetti, Moderni*, 4to, Rome 1672, of which the first part only was printed; and he was also the author of various works on antiquities and medals. He died in 1696.

BELLOVĂCI, a people of Gallia Belgica, the most powerful and bravest of the Belgæ. In Cæsar's time they could bring 100,000 men into the field.

BELLOWS, a machine so contrived as alternately to inspire and expire the air, by enlarging and contracting its capacity. See Blowing Machines.

BELLUNO, one of the delegations into which the Austrian kingdom of Venetian Lombardy is divided. It is bounded on the west and north by the Tyrol, on the east by Friuli, on the S.E. by Treviso, and on the S.W. by Vicenza. Its extent is 1240 square miles, or 793,600 acres. It is generally a hilly and mountainous country. The widest valley is that through which runs the river Piave, and which, like several other much narrower ones, is tolerably fertile in rye, barley, oats, and buckwheat; while some parts yield a little wheat, much maize, and some flax and hemp. The mountains contain veins of iron, lead, copper and vitriol; but the mines are all worked upon a very contracted scale. The population amounted in 1817 to 114,772, in 1827 to 122,840, and in 1851 to 157,120. The capital, of the same name, stands at the confluence of the Piave and the Ardo. Besides the cathedral, there are thirteen churches, and several religious houses for males and for females. The inhabitants amount to 9800, some of whom are employed in the spinning of silk. Long. 12. 8. 46. E. Lat. 46. 7. 46. N.

BELOMANCY (*βέλος* and *μαντεία*), a kind of divination by means of arrows drawn at random from a bag or quiver; practised by the ancient Scythians, Babylonians, Arabians, and other Eastern people. (See Ezekiel xxi. 21.)

BELON, Pierre, a distinguished French naturalist, born at the hamlet of Soulletière, in Le Maine, about the year 1517. He published several works in Latin and in French, including a book of travels, or observations of many singularities

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and memorable things found in Greece, Asia, Judæa, Egypt, and other foreign countries. Botany and zoology are particularly indebted to Belon; and he may be considered as the great reviver of the study of natural history. He was murdered near Paris by one of his enemies in 1564.

Boundaries.

BELOOCHISTAN, a country of Asia, situate on the north-western coast of the Indian Peninsula. It is bounded on the N. by Afghanistan; on the E. by Sinde; on the S. by the Persian Gulf and the Arabian Sea; and on the W. by Persia. It extends from Lat. 24. 50. to 30. 20., and from Long. 57. 56. to 68. 38.; its extreme length from E. to W. being 660 miles, and its breadth 370.

The outline of the sea-coast is in general remarkably regular, running nearly due E. and W., a little N. of Lat. 24. 46. from Cape Monze, on the border of Sinde, in Long. 66. 35., to Cape Zegin, in Long. 58. 4. It is for the most part craggy, but not remarkably elevated, and has in some places, for considerable distance, a low sandy shore, though almost everywhere the surface becomes much higher inland. The principal headlands, proceeding from E. to W., are Cape Monze or Ras Moarree, which is the eastern headland of Sonmeanee Bay; Goorab Sing, Ras Arubah, Ras Noo, forming the western headland of Gwadel Bay; Ras Jewnee, forming the eastern point of Gwettar Bay, and Cape Zegin at the western extremity. There is no good harbour along the coast, though extending about 600 miles; but there are several roadsteads with good holding-ground, and sheltered on several points. Of these the best are Sonmeanee Bay and Choubar Bay, at which last point is the only place on the coast deserving the name of a town, there being elsewhere nothing but small and wretched villages.

History.

Of the early history of this portion of the Asiatic continent little or nothing is known. The poverty and natural strength of the country, combined with the ferocious habits of the natives, seem to have equally repelled the friendly visits of inquisitive strangers and the hostile incursions of invading armies. The first distinct account which we have is from Arrian, who, with his usual brevity and severe veracity, narrates the march of Alexander through this country, which he calls the country of the Oritæ and Gadrosii. He gives a very accurate and judicious geographical account of this forlorn tract, its general aridity, and the necessity of obtaining water by digging in the beds of torrents; describes the food of the inhabitants as dates and fish; adverts to the occasional occurrence of fertile spots, the abundance of aromatic and thorny shrubs and fragrant plants, and the violence of the monsoon in the western part of Mekran. He notices also the impossibility of subsisting a large army, and the consequent destruction of the greater part of the men and beasts which accompanied the expedition of Alexander. At the commencement of the eighth century, this country was traversed by an army of the kaliphate.

The Belooches are, with few exceptions, Mahommedans of the Soonnee persuasion. They date their origin from so late a period as the Mahommedan invasion of Persia, and are very desirous of being supposed to be of Arabian extraction; but the latter part of this supposition derives no confirmation from their features, their manners, or their language, which bear not the slightest similitude to those of the Arabs. There can be little doubt, however, that they originally came from the westward; of which indeed there is strong evidence in the affinity between the Beloochekee and Persian languages; and their institutions, habits, and religion, seem to indicate that they are of Turkoman lineage. It appears highly probable, indeed, that, during the frequent sanguinary revolutions to which the monarchy of the Seljukide Tartars was subject, some of these barbarians had been forced to wander over the country in quest of new settlements; and that a portion of them had found refuge in the mountainous districts of Beloochistan. But, besides the Belooches, there are in Beloochistan other distinct tribes of inhabitants. These are, the Brahooés, apparently a race of Tartar mountaineers, who settled at an early period in the southern parts of Asia, but whose history is extremely obscure and uninteresting; the Dehwars, a Persian colony, whose original settlement cannot be traced; and the Hindus, who appears to have been the first settlers in the upper part of the Brahooick Mountains, on their being expelled from Sinde, Lus, and Mekran, by the armies of the khalifs of Baghdad. This last tribe appears for a time to have constituted the governing party. Beloochistan was subsequently exposed to the transient and devastating inroads of the Moguls, and became nominally a portion of the dominions of the Emperor Akbar. The Brahooés and Belooches, however, gradually spread over the country; and the Hindu power was at length subverted by a revolution, which placed the ancestors of the present khan of Kelat upon the throne.

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The precise period at which this revolution took place cannot be accurately ascertained; but it is probable that two centuries have not elapsed since that event. The last rajah of the Hindu dynasty found himself compelled to call for the assistance of the mountain shepherds, with their leader, Kumbur, in order to check the encroachments of a horde of depredators, headed by an Afghan chief, who infested the country, and even threatened to attack the seat of government. Kumbur successfully performed the service for which he had been engaged; but having in a few years quelled the robbers against whom he had been called in, and finding himself at the head of the only military tribe in the country, he formally deposed the rajah, and assumed the reins of government.

The history of this country subsequently to the accession of Kumbur is involved in the same obscurity as during the Hindu dynasty. It would appear, however, that the sceptre was quietly transmitted to the descendants of that chief, who seem to have persevered in a peaceable system of government, until the time of Abdulla Khan, the fourth in descent from Kumbur; who, being an intrepid and ambitious soldier, turned his thoughts towards the conquest of Kutch-Gundava, then held by different petty chiefs, under the authority of the Nawaubs of Sinde.

After various success, the Kumburanees at length possessed themselves of the sovereignty of a considerable portion of that fruitful plain, including the chief town, Gundava. It was during this contest that the famous conqueror Nadir Shah, commonly called Thamas Koolee Khan, advanced from Persia to the invasion of Hindustan; and while at Kandahar, he despatched several detachments into Beloochistan, and established his authority in that province. Abdoolla Khan, however, was continued in the government of the country by Nadir's orders; but he was soon after killed in a battle with the forces of the Nawaubs of Sinde. He was succeeded by his eldest son, Hajee Mohummud Khan, who abandoned himself to the most tyrannical and licentious way of life, and completely alienated his subjects by his arbitrary and oppressive system of taxation. In these circumstances Nusseer Khan, the second son of Abdulla Khan, who had accompanied the victorious Nadir to Delhi, and acquired the favour and confidence of that monarch, returned to Kelat, and was hailed by the whole population as their deliverer. Finding that expostulation had no effect upon his brother, he one day entered his apartment when the prince was alone, and stabbed him to the heart. As soon as the tyrant was dead, Nusseer Khan mounted the *musnud*, amidst the universal joy of his subjects, and immediately transmitted a report of the events which had taken place to Nadir Shah, who was then encamped near Kandahar. The shah received the intelligence with satisfaction, and despatched a firman, by return of the messenger, appointing Nusseer Khan beglierbey of all Beloochistan. This event took place in the year 1739.

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Nusseer Khan proved an active, politic, and warlike prince. He took great pains to re-establish the internal government of all the provinces in his dominions, and improved and fortified the city of Kelat. On the death of Nadir Shah in 1747, he acknowledged the title of the king of Cabûl, Ahmed Shah Abdalla. In 1758 he declared himself entirely independent; upon which Ahmed Shah despatched a force against him, under one of his ministers. The khan, however, levied his troops and totally routed the Afghan army. On receiving intelligence of this discomfiture, the king himself marched with strong reinforcements, and a pitched battle was fought, in which Nusseer Khan was worsted. He retired in good order to Kelat, whither he was followed by the victor, who invested the place with his whole army. The khan made a vigorous defence; and, after the royal troops had been foiled in their attempts to take the city by storm or surprise, a negotiation was proposed by the king, which terminated in a treaty of peace. By this treaty it was stipulated that the king was to receive the cousin of Nusseer Khan in marriage; and that the khan was to pay no tribute, but only, when called upon, to furnish troops to assist the royal armies, for which he was to receive an allowance in cash equal to half their pay.

Subsequently to this period, the khan frequently distinguished himself by his gallantry and judgment in the wars carried on by the monarch of Cabûl; and, as a reward for his eminent services, the king bestowed upon him several districts to hold in perpetual and entire sovereignty. Having succeeded in quelling a dangerous rebellion, headed by his cousin Beheram Khan, this able prince at length died at an extreme old age, after a long and prosperous reign, in the month of June 1795, leaving three sons and five daughters. He was succeeded by his eldest son, Muhmood Khan, then a boy about fourteen years of age. During the reign of this prince, who has been described as a very humane and indolent man, the country was distracted by sanguinary intestine broils; the governors of several provinces and districts withdrew their allegiance; and the dominions of the khans of Kelat gradually so diminished, that they now comprehend only a small portion of the provinces which were formerly subject to Nusseer Khan.

In 1839, when the British army advanced through the Bolan Pass towards Afghanistan, the conduct of Mehrab Khan, the ruler of Beloochistan, was considered so treacherous, hostile, and dangerous, as to require "the exaction of retribution from that chieftain," and "the execution of such arrangements as would establish future security in that quarter." General Willshire was accordingly detached from the army of the Indus at Quetta to assault Kelat. A gate was knocked in by the field-pieces, and the town and citadel were stormed in a few minutes. Above 400 Belooches were slain, among them Mehrab Khan himself; and 2000 prisoners were taken. The British force consisted of 1049 men. In the following year Kelat changed hands, the governor established by the British, together with a feeble garrison, being overpowered. At the close of the same year, it was re-occupied by the British under General Nott. In 1841, Nadir Khan, the youthful son of the slain Mehrab Khan, was recognised by the British, who soon after evacuated the country.

The territories of Beloochistan are now comprised under the following divisions—Ihalawan, Sarawan, Kelat, Mekran, Lus, Kutch-Gundava, and Kohistan.

Physical aspect; Mountains.

The most remarkable features of this extensive country are its rugged and elevated surface, its barrenness, and its deficiency of water. A stupendous range, to which the appellation of the Brahooick Mountains has been assigned, and which seems to be the primitive root of all the others, springs abruptly to a conspicuous height out of the sea, at Cape Moaree, or Monze, in E. Long. 66. 58. N. Lat. 25., whence it takes a north-easterly direction for about ninety miles. There it projects a ridge, E. by N., the base of which is washed by the river Indus, at the fort of Sehwan. From the separation of this arm, in Lat. 25. 45. to that of 30., the primitive body runs due N., marking the western limits of Sinde, Kutch-Gundava, and a part of Seistan; and from thence it once more regains its original inclination to the N.E., and decreases in magnitude and elevation so rapidly, that, in the course of forty miles, it sinks to a level with the hills inhabited by the Kaukers and other Afghan tribes, with which it becomes incorporated. To the westward the Brahooick Mountains send forth many collateral chains, some of which extend the whole length of Beloochistan, and join the mountains of Persia; others elongate southward till they touch the sea, or come within a few miles of it, and then either take the inclination of the coast or subside in the low and barren plains in its vicinity. The main body, or rather its western face, stretches away N.W. by N., to the 28th degree of N. latitude, where it meets the south-eastern corner of the sandy desert, about the 64th degree of E. longitude: from thence it inclines with a northern aspect between the N.E. and N. points of the compass to Nooshky, in latitude 30° N.; from which place it runs more easterly, till at length it gradually sinks, like the eastern front, to an equality of size with the Afghan hills. Besides the Brahooick chain, there are several other ranges of mountains, extending in various directions and ramifications throughout Beloochistan, but all of them inferior to the former in magnitude and height. This stupendous chain is believed to attain its greatest altitude at Kelat; from which city, according to the natives, a traveller, whatever route he may pursue, must descend; but the descent is so very trifling for a long way on either side of that capital that it is not perceptible by the eye.

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In brief, Beloochistan may be described as one maze of mountains, except on the N.W.; in which direction the surface descends to the Great Desert on the S., where a low tract stretches along the sea-shore, exhibiting a dreary waste of inconsiderable rocks or dry barren sands, and for a small extent on the E., where the burning plain of Kutch-Gundava extends along the eastern base of the Hala Mountains. From this plain to the elevated table-land lying to the W., the eastern face of the mountain range is furrowed by two long and very deep ravines, through which the Bolan (called by Pottinger "Koahee") and Moola Rivers hold their way. Along the courses of these rivers lie the celebrated passes bearing their names, and affording the means of communication between the valley of the Indus and Beloochistan.

Rivers.

In the northern part of Beloochistan, the only rivers of any importance are the two just mentioned, and these are little more than prolonged torrents, being ultimately lost in the sands of Kutch-Gundava. Pottinger observes that "there is not a single body of running water in this part of the country worthy of a higher appellation than that of a rivulet, unless when swollen by partial floods to a tumultuous and unfordable torrent, nor one even of that description that can be said to flow through a regular and unbroken channel to the main." The southern part abounds in torrents, which rise in the mountains, and cross the low sandy tract lying between them and the ocean. Near the base of the mountains the channels are very small, and in the dry season are filled with vegetation. Towards the coast they are much broader and deeper. Of this description of watercourse is the Hub, rising in that part of the Hala Mountains which separates Beloochistan and Sinde. After heavy rains, it rushes down with a vast body of water; but on the setting in of dry weather the flow ceases; there is no longer any stream, the bed containing merely a few pools. The Poorally, another of these torrents, farther west, has generally a very inconsiderable stream, which in long-continued dry weather totally ceases at Lyarce, about twenty miles

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from its mouth. Below that town it becomes a creek of the sea, navigable for small boats. The Aghor, farther west, passes by Hinglaj, the celebrated place of Hindu pilgrimage. It is thought to have a longer course than most of the streams along this coast, and to rise amidst mountains frequently covered with snow, as, at the setting in of hot weather its waters, as is the case with such rivers, become higher. Proceeding westward from Hinglaj to the mouth of the Dustee, a distance of 250 miles, we find that only a few small rivulets occur. The Dustee, where Pottinger crossed it, was, within 100 yards of the beach, about 20 inches deep, and 20 yards wide; yet, if his opinion be correct, it has a course of nearly 1000 miles, rising in the Gurmsehl, near the southern course of the Helmund river. The upper part, called the Boordoor, makes its way, in the wet season, through the loose and parched sands of the desert south of Seïstan; but for the greater part of the year its channel is a dry ravine. Pottinger makes a bold, yet perhaps not improbable, conjecture, that this was formerly a channel through which the superfluous water of the valley of the Helmund was discharged into the ocean, but that now the whole is carried off by means either of absorption or of evaporation from the swamp of Hamoon. Westward of the Dustee there are only a few small brooks, which discharge themselves into the sea, and, in fact, along the whole distance of 600 miles, through which the coast of Beloochistan extends, there is no stream which might not in dry weather be forded by a child.

Climate and soil.

The climate of Beloochistan is extremely various in the different provinces. The soil in general is exceedingly stony. In the province of Kutch-Gundava, however, the soil is rich and loamy, and so very productive, that, it is said, were it all properly cultivated, the crops would be more than sufficient for the consumption of the whole of Beloochistan.

Minerals.

Gold, silver, lead, iron, tin, antimony, brimstone, alum, sal-ammoniac, and many kinds of mineral salts, and saltpetre are found in various parts of the country. The precious metals have only been discovered in working for iron and lead, in mines near the town of Nal, about 150 miles S.S.W. of Kelat. The different other minerals above enumerated

Vegetable products.

are very plentiful. The gardens of Kelat produce many sorts of fruit, which are sold at a very moderate rate, such as apricots, peaches, grapes, almonds, pistachio-nuts, apples, pears, plums, currants, cherries, quinces, figs, pomegranates, mulberries, plantains, melons, guavas, &c. All kinds of grain known in India are cultivated in the different provinces of Beloochistan, and there is abundance of vegetables. Madder, cotton, and indigo are also produced; and the latter is considered superior to that of Bengal. The culture of the date fruit is conducted with great attention in the province of

Animals.

Mekran. The domestic animals of Beloochistan are horses, mules, asses, camels, dromedaries, buffaloes, black-cattle, sheep, goats, dogs, and cats, besides fowls and pigeons; but there are neither geese, turkeys, nor ducks. The wild animals are lions, tigers, leopards, hyenas, wolves, jackals, tiger-cats, wild dogs, foxes, hares, mangooses, mountain goats, antelopes, elks, red and moose deer, wild asses, &c. Of birds they have almost every species to be met with either in Europe or India.

City of Kelat.

The principal city of this country is Kelat, the capital of the whole of Beloochistan. This city stands on an elevated site on the western side of a well-cultivated plain or valley, about eight miles long and two or three broad, a great part of which is laid out in gardens and other inclosures. The town is built in an oblong form, and on three sides is defended by a mud wall, eighteen or twenty feet high, flanked, at intervals of 250 yards, by bastions, which, as well as the wall itself, are pierced with numerous loopholes for matchlock-men. The defence of the fourth side of the city has been formed by cutting away perpendicularly the western face of the hill on which it is partly built. On the summit of this eminence stands the palace, commanding a distinct view of the town and adjacent country. That quarter of the hill on which the khan's residence is erected has been inclosed by a mud wall, with bastions; the entrance to it is on the south-western side; and here, as well as at the city gates, which are three in number, there is constantly a guard of matchlock-men. Within the walls there are upwards of 2500 houses, and the number of these in the suburbs probably exceeds one half of that amount. The houses are mostly built of half-burnt brick or wooden frames, and plastered over with mud or mortar. In general the streets are broader than those of native towns, and most of them have a raised pathway on either side for foot-passengers, and an uncovered kennel in the centre; the latter of which is a great nuisance, from the quantity of filth thrown into it, and the stagnant rain-water that lodges there. The upper stories of the houses frequently project across the streets, and thereby render the part beneath them gloomy and damp. This seems a very rude attempt to imitate the bazaars of Persia and Cabûl. The bazaar of Kelat is extensive, well furnished with every kind of goods; and all the necessaries of life may be procured daily at a moderate price. The town is supplied with delicious water from a spring in the face of a hill on the opposite side of a plain, whence it meanders nearly through its centre; having the town and suburbs on one side, and on the other the gardens. It may be remarked of this spring, that the waters, at their immediate issue from the smaller channels, possess a considerable degree of tepidity until after sunrise, when they suddenly become exceedingly cold, and remain so during the day.

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Inhabitants.

We have no data from which we can form an accurate computation of the total amount of the population of Beloochistan. The inhabitants are divided into two great classes, distinguished by the appellations of Belooche and Brahooé; and these two are again subdivided into an infinite number of tribes, which it were tedious and unnecessary to enumerate. The most remarkable distinctions between these two classes consists in their language and appearance. The Belooche or Beloochekee language partakes considerably of the idiom of the modern Persian, although greatly disguised under a singularly corrupt pronunciation. The Brahooékee, on the other hand, has nothing analogous to the Persian idiom. It appears to contain a great number of ancient Hinduwee words; and, as it strikes the ear, bears a strong resemblance to the dialect spoken in the Punjaub. With regard to external appearance, the contour of these two classes seems to differ, in most instances, as much as their language. The Belooches in general have tall figures, long visages, and raised features; the Brahooés, on the contrary, have short thick bones, with round faces and flat lineaments.

Manners.

The Belooches are a handsome active race of men, not possessing great physical strength, but inured to changes of climate and season, and capable of enduring every species of fatigue. In their habits they are a pastoral people, and much addicted to predatory warfare, in the course of which they do not hesitate to commit every kind of outrage and cruelty. Notwithstanding their predatory habits, however, they are considered to be a hospitable people. After the fashion of other barbarous tribes in that part of the world, they will protect and kindly entertain a stranger while their guest, but feel no scruple in robbing and murdering him as soon as he has left their precincts. They are indolent, and, unless excited by amusement or war, or compelled to action by some urgent motive, spend their time in the manner common to all savage people—in idleness, rude dissipation, and the enjoyment of such coarse luxuries as they can procure; in lounging, gambling, smoking tobacco or hemp, and chewing opium. The tenets of their religion, and still more, perhaps, their poverty, preserve them from the abuse of fermented liquors. Their principal articles of food are milk in all its forms, the flesh of domestic animals, not ex-

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cepting that of the camel, and game, including wild asses, the flesh of which is considered a delicacy. Their appetites, like those of most savages, are voracious; they consume incredible quantities of flesh when it can be obtained, and prefer it in a half-cooked state. They also use grain in the form of bread, and of various preparations; but they enjoy most such articles of food or condiment as possess a strong and stimulating flavour, as capsicum, onions, and garlic. Their indolence prompts them to keep as many slaves as they can obtain and support. Polygamy is universal. Some of the lower order have as many as eight women, either as wives or mistresses, and the number is increased in proportion to the rank and means of the man. Wives are obtained by purchase, payment being made in cattle or other articles of pastoral wealth. The ceremony of marriage is performed by the moollah or priest; and on this occasion, as well as on some others affecting females, practices similar to those of the Levitical law are observed. For instance, in this country, as also among the Afghans, a man is expected to marry the widow of a deceased brother. When a death takes place, the body is watched for three successive nights by assembled friends and neighbours, who spend their time in feasting, so that the ceremony seems intended rather to furnish enjoyment to the living than to render honour to the dead.

Dress.

The common dress of the Belooches is a coarse white or blue calico shirt, buttoned round the neck, and reaching below the knee; their trousers are made of the same cloth, or of a kind of striped stuff called Soosee, and puckered round the ankles. On their heads they wear a small silk or cotton quilted cap, fitted to the shape of the skull, over which, when in full dress, they place a turban, either checked or blue, and a *kummurbund* or sash, of the same colour, round their waists. In winter the chiefs and their relatives appear in a tunic of chintz, lined and stuffed with cotton; and the poorer classes, when out of doors, wrap themselves up in a surtout made of cloth manufactured from a mixture of goats' hair and sheep's wool. The women's dress is very similar to that of the men; their trousers are preposterously wide, and made of silk, or a mixture of silk and cotton.

Government and laws.

The fluctuation of power renders it difficult to define precisely the nature of the government of Kelat. During the reign of Nusseer Khan, the whole kingdom might be said to have been governed by a complete despotism; yet that ruler so tempered the supreme authority by the privileges granted to the feudal chiefs within their own tribes, that, to a casual observer, it bore the appearance of a military confederation. The tribes all exercise the right of selecting their own *sirdar*, or head; and the khan has the power of confirming or disapproving of their nomination; but this power is never exercised, and appears to be merely nominal. The khan of Kelat declares war and makes treaties connected with the whole of Beloochistan, and can order the sirdar of each tribe to attend in person with his quota of troops. Agreeably to a code of regulations framed by one of the earliest princes of the Kumburanee dynasty, the entire administration of justice was vested in the person at the head of the government. The sirdar, however, has the power of adjusting petty quarrels, thefts, and disputed points of every description, among the inhabitants of a kheil or society; but, in all cases of importance, an appeal lies in the last instance to the khan at Kelat.

The amount of revenue enjoyed by the khan of Kelat is inconsiderable, as the ruling races, Belooche and Brahooé, pay no direct taxes, and their poverty and simple habits prevent them from contributing much indirectly. His income is therefore derived from his resources as a proprietor of lands or towns, from a proportion of the produce paid in kind by the Afghan, Dehwar (Parsee), and Jet cultivators; from dues on direct and transit trade, and from arbitrary exactions, a never-failing mode with Eastern potentates of recruiting an exhausted treasury. Pottinger estimates the amount at 350,000 rupees; Masson, who had ample means of acquiring information through colloquial channels, at 300,000: which of these statements makes the nearest approximation to correctness cannot be determined, but neither seems improbable. With such a revenue, it is obvious that no standing army can be maintained; and Masson, certainly very competent to the task of acquiring information on this subject, states that Mehrab Khan, the late ruler, "nearly destitute of troops in his own pay, was compelled, on the slightest cause for alarm, to appeal to the tribes, who attended or otherwise as suited their whims or convenience." Pottinger computes the numbers available for the service of the khan at 60,000 fighting men, but has not mentioned how so vast a host could, if collected, find food in this barren country. Mehrab Khan could on no occasion assemble more than 12,000; and in his final struggle for property, power, and life, the number of his troops did not amount to 3000. The Belooche soldier is heavily encumbered with arms, carrying a matchlock, a spear, a sword, a dagger, and a shield. Pottinger considers them good marksmen, and states that in action they trust principally to their skill in this respect, avoiding close combat; but their readiness in general to close with the British troops shows that he is in this instance mistaken. They formed the strength of the armies of Sinde; but the battle of Meanee proves how little, even with great superiority of numbers, they are able to withstand a disciplined force. The greater part serve on foot; but a number, not inconsiderable, have horses, and, in their irregular forays, camels, which they often prefer, on account of their greater powers of endurance. (J. C.) (E. T.)

Belper || Belt.

BELPER, a market-town and chapelry of Derbyshire, in the parish of Duffield, and hundred of Appletree. The town is agreeably situated on the banks of the Derwent, which is here crossed by a handsome stone bridge. It is seven miles north of Derby, on the line of the North Midland railway. Belper, now one of the most flourishing towns of Derbyshire, is principally indebted for its prosperity to the establishment of cotton works here by Messrs Strutt. It also manufactures linens, nails, hosiery, &c. It has three churches, several chapels for Independents, Methodists, Baptists, &c., a mechanics' institution, and a subscription library. Pop. (1851) 10,082.

BELSHAM, Thomas, LL.D., for some years the principal of the Dissenters' Academy at Daventry, was born at Bedford in 1750. He abandoned Calvinism for the Unitarian theology, and proved himself in numerous publications a learned exponent of that system. In 1801 he gave to the world *Elements of the Human Mind, and of Moral Philosophy*, in which, following the doctrines of Hartley, he explained all mental operations by the association of ideas. He died at Hampstead in 1829.

Belsham, *William*, the younger brother of the preceding, was born in 1752, and died at Hammersmith in 1827. He published various political tracts in support of Whig principles, and was the author of a history of Great Britain from the accession of George I. to the peace of Amiens in 1802, in 12 vols. 8vo. His volume on the *Philosophy of the Mind* is less known.

BELSHAZZAR, the last king of Babylon, generally supposed to be the son of Evilmerodach, and grandson to Nebuchadnezzar. See Daniel, chap. v. It may be noticed that Xenophon's account (*Cyropæd.* viii. 5, 30) agrees with the Book of Daniel as to the fate of Belshazzar.

BELT, Great and Little, the name of two straits which connect the Baltic with the Cattegat. The former lies between the islands of Zealand and Funen. Its greatest width is about twenty miles, and its depth varies from five to twenty fathoms. The navigation of the Great Belt is dangerous, from the number of sand-banks and small islands which it

Belt || Belzoni.

contains. The shores in general are neither bold nor lofty, but they afford convenient harbours and anchorage. Vessels passing this strait pay toll at Nyborg, where a guard-ship is stationed to enforce compliance. The Little Belt separates the island of Funen from Jutland. Its greatest breadth is not more than the half of that of the Great Belt, and at the fortress of Fredericia, where the tolls are levied, it does not exceed a mile. The depth is from four to twenty fathoms. It contains several sand-banks, and the current from the Baltic to the Cattegat is of great strength. The passage of both Belts is attended with risk for large vessels, and on that account the Sound is more generally frequented.

BELT, *Balteus*, properly denotes a kind of military girdle or cincture, usually of leather, by which the sword or any other weapon is sustained. The belt was an essential piece of the ancient armour; insomuch that we sometimes find it used to denote the whole armour. In later ages the belt was given to a person when he was raised to knighthood; and hence it has also been used as a badge or mark of the knightly order.

BELTS, in *Astronomy*. See ASTRONOMY.

BEL-TEIN, or BEL-TANE, a superstitious custom formerly observed in the Highlands of Scotland, being a kind of rural sacrifice, performed by the herdsmen on the 1st of May. It seems to have been a remnant of some Oriental superstition relative to the worship of Baal or the Sun, and derived from Druidical times. Some account of this festival may be found in Pennant's *Tour*, General Stewart's *Sketches*, and in almost every work which treats of the Highlands. The Beltane of the Irish is celebrated on the 21st of June.

BELTURBET, a town of Ireland, in the county of Cavan, on the river Erne, 77 miles N.W. of Dublin. A corn-market is held here weekly. Pop. (1851) 2054.

BELUNUM, in *Ancient Geography*, a considerable town of Rhætia, about twenty miles N.E. of Feltria, in the territory of the Veneti; now *Belluno*.

BELUS, now *Nahr Naman*, a small river of Phœnicia, which enters the sea close to Acre, the ancient Ptolemais. Here the discovery of the manufacture of glass is said to have been accidentally made by some shipwrecked mariners who kindled a fire on its banks. See Pliny, xxxvi. 26. Reland conjectures that the name Βηλεύς may be the origin of the Greek ὕέλος or ὕαλός, *glass*.

BELVEDERE, in *Italian Architecture*, denotes a pavilion on the top of a building, or an artificial eminence in a garden. The word signifies a *fine prospect*.

BELVEDERE, a town of Naples, in the province of Calabria Citra, on the Mediterranean, 32 miles N.W. of Cosenza. Pop. 4000.

BELZONI, GIOVANNI BATTISTA, the well-known traveller, was born of humble parentage at Padua, about 1778. Much of his early youth was passed at Rome, with an intention of adopting the monastic life; but from this plan he was diverted by the French invasion. He came to England in 1803; and for some time obtained a livelihood as an athlete at Astley's amphitheatre and elsewhere, for which his colossal stature and extraordinary muscular power eminently qualified him. While residing at Rome he had paid considerable attention to the study of hydraulics, and with the view of constructing improved machines for the purposes of irrigation, he went in 1815 to Egypt, where he was employed by the pacha to construct an hydraulic machine for his garden at Zubra, near Cairo, which, however, proved an unsuccessful attempt. He was then employed by Mr Salt to remove the colossal bust erroneously styled the "Young Memnon." This he effected with much ingenuity, and shipped it for England. Pursuing his travels through Egypt, he was the first to open the temple of Ipsambul, an undertaking involving extraordinary personal exertion. During a second journey in Upper Egypt he made excavations at Carnac, which well repaid his labours. It is unnecessary here to recount his various and most interesting discoveries, as they are detailed at some length in the articles EGYPT, NUBIA, &c. In 1820 he published a narrative of his operations; and in the following year he exhibited at London a beautiful model of the two principal chambers of the magnificent tomb he had opened at Beban-el-Molouk, near Thebes. In 1823 he again visited Egypt; but while making preparations for passing from Benin to Timbuctoo, he was attacked by dysentery at a place called Gato, and there he died on the 3d of December.

Bem || Benares.

BEM, JOSEPH, a distinguished general in the Hungarian war of 1848, was born in Poland, of German parents, in 1795. He died in exile at Aleppo in December 1850. See HUNGARY.

BEMBEA. See BAMBA.

BEMBO, PIETRO, *Cardinal*, a noble Venetian, secretary to Leo X., and one of the best writers of that illustrious age. He was a good poet, both in Italian and Latin; but he is justly censured for the licentiousness and immodesty of some of his poems. Besides these, he published *A History of Venice; Letters;* and a book in praise of the Duke and Duchess of Urbino. He died in 1547, in the seventy-seventh year of his age. His collected works and life were published at Venice in 1729, in 4 vols. folio.

BEN or BEINN, a Gaelic word signifying a mountain. Hence the names Ben-Nevis, Ben-Macdhui, &c.

BENACUS LACUS, the ancient name of the Lago di Garda.

BENARES, a British district of Hindustan, situate on both sides of the river Ganges, in the territory denominated the North-West Provinces of Bengal. It lies between Lat. 25. 7. and 25. 32. Long. 82. 45. and 83. 38., and has an area of 994 square miles. The principal commercial products of the district are sugar, opium, and indigo. According to the census of 1848 the population amounts to 741,426, of whom 676,050 are Hindus, and 65,376 Mussulmans. The total number of towns has been returned at 1888; of these 1818 contain each less than 1000 inhabitants; 67 have each more than 1000 and less than 5000 inhabitants; two are stated each to have more than 5000 and less than 10,000; and one alone contains more than 50,000 inhabitants. The territory was ceded to the East India Company in 1775 by the vizier of Oude.

BENARES, an extensive and opulent city of Hindustan, in the province of Allahabad, is the capital of the Benares district. It has long been celebrated among the Hindus as a seat of piety and learning, as well as a noted emporium of trade. The Ganges here forms a fine sweep of about four miles in length, and the city is situated on the northern bank of the river, and on the outward side of the curve, which is the most elevated. It is about three miles in length by one in breadth, rising from the river in the form of an amphitheatre, and is thickly studded with domes and minarets. The bank of the river is entirely lined with stone, in which are many very fine ghats or landing-places, built by pious devotees, of large stones, to the height of thirty feet before they reach the level of the street, and highly ornamented. These are generally crowded with bathers and worshippers. Shrines and temples, even within the limits of the river's rise, almost line its banks. The streets of this great city are so winding and narrow that there is not room for a wheel-carriage to pass; and it is difficult to penetrate them even on horseback. The streets are considerably lower than the ground-floors of the houses, which have mostly arched rows in front, with little shops behind them; and above these they are richly embellished with verandahs, galleries, projecting oriel windows, and very broad overhanging eaves supported by carved brackets. The houses are built of a very good stone from Chunar, and are mostly lofty, none being less than two stories in height, most of them three, and several of five or six stories, close to each other, with terraces on the summit, and extremely small windows, for the sake alike of coolness and of privacy. The Hindus are fond of painting the

Benares.

outside of their houses of a deep red colour, and of covering the most conspicuous parts with paintings in gaudy colours of flower-pots, men, women, bulls, elephants, gods, and goddesses, in all the forms of Hindu mythology. The number of temples is very great; they are mostly small, and stuck in the angles of the streets, and under the shadow of the lofty houses. Their forms are not ungraceful, and many of them are covered over with beautiful and elaborate carvings of flowers, animals, and palm branches, rivalling in richness and minuteness the finest specimens of Gothic or of Grecian architecture.

The mosque, which was built by Aurungzebe on the site of a Hindu temple, and in order to mortify the Hindus, is a handsome building, placed on the highest and most conspicuous point of land, and close to the river. Its minarets are very lofty, and command an extensive view of the town and adjacent country, and of the numerous Hindu temples scattered over the city and the surrounding plains. The Sanscrit College, instituted in 1792, is a large building divided into two courts with galleries above and below. An English department has been attached to this college. In 1850 the number of pupils amounted to 240; of whom six were native Christians, sixteen Mahometans, and 218 Hindus. The course of instruction embraces Sanscrit, Persian, Hindu law, and general literature. In this city a new government college has been recently established, in which the whole range of European literature and science is thrown open to the native student.

Benares, having from time immemorial been a holy city, contains a vast number of Brahmins who either subsist by charitable contributions or are supported by endowments in the numerous religious institutions of the city. These establishments are adorned with idols, and send out an unceasing sound from all sorts of discordant instruments; while religious mendicants from the numerous Hindu sects, with every conceivable deformity "which chalk, cow-dung, disease, matted locks, distorted limbs, and disgusting and hideous attitudes of penance, can show, literally line the principal streets on both sides." Some are seen with their legs or arms distorted by long continuance in one position; others with their hands clenched until the finger-nails have pierced entirely through the hand. A stranger, as he passes through the streets, is saluted with the most pitiful exclamations from these swarms of beggars. But besides this immense resort to Benares of poor pilgrims from every part of India, as well as from Thibet and the Burman empire, numerous rich individuals in the decline of life, and almost all the great men who are disgraced or banished from home by the political revolutions which have been of late years so frequent among the Hindu states, repair to this holy city to wash away their sins in the sacred waters of the Ganges, or to fill up their time with the gaudy ceremonies of their religion. All these devotees give away large sums in indiscriminate charity, some of them to the annual amount of L.8000 or L.9000; and it is the hope of sharing in these pious distributions that brings together from all quarters such a concourse of religious mendicants. Bulls are reckoned sacred by the Hindu, and being tame and familiar, they walk lazily up and down the streets, or are seen lying across them, interrupting the passage, and are hardly to be roused, as, in compliance with the prejudices of the fanatic population, they must be treated in the gentlest manner. Monkeys, also held sacred, are seen clinging to all the roofs and projections of the temple.

But, amid all this wretchedness and fanaticism, Benares is a splendid, wealthy, and commercial city; the bazaars are filled with the richest goods, and there is a constant bustle of business in all the principal streets. It is a great commercial emporium for the shawls of the north, the diamonds of the south, and the muslins of Dacca and the eastern provinces; and it has very considerable manufactures of silk, cotton, and fine wool, as well as of gold and silver lace; while English hardware, swords, shields, and spears from Lucknow and Monghyr, and the finer manufactures of Europe, are exported to Bundelcund, Gorruckpoor, Nepaul, and other tracts removed from the main channel of communication by the Ganges. The population of the city and suburbs, exclusive of the military cantonment, is returned at 183,491, of which number 147,082 are Hindus, and 36,409 Mahometans; and during religious festivals, the concourse of people from all parts is immense. Yet the city, notwithstanding its crowded population and narrow streets (the new market-place, constructed by the present government, being the only square or open part in it), is not unhealthy; which is probably owing to its dry situation on a high rocky bank, sloping towards the river, and to the frequent ablutions and temperate habits of the people. There are but few Europeans in Benares; a judge, collector, and register, with a few other civil servants, constitute the whole of the Company's establishment; to which may be added a few private merchants and planters. The residence of the English judge and civil establishment is at Secrole, a pleasant village about two miles from the city, where there is a military cantonment for a battalion of sepoys. Distant N.W. from Calcutta 420 miles; from Allahabad E. 74; from Delhi S.E. 466; Lat. 25. 17. Long. 83. 4. (D. B.—N) (E. T.)

Benavidius || Bench.

BENAVIDIUS, or BONAVIDUS, *Marcus Mantua*, a celebrated civilian, who during sixty years taught civil law with high reputation at Padua, the place of his birth. He died in 1582, aged ninety-three.

BENBECULA, a low, sandy, and unproductive island of the Hebrides, eight miles in length, and the same in breadth. It is situated between the islands of North and South Uist, from the latter of which it is separated by a narrow channel. It forms part of the county of Inverness.

BENCH, or BANC, in *Law*, has various significations.

Free-Bench signifies that estate in copyhold-lands which the wife, being espoused a virgin, has, after the decease of her husband, for her dower, *dum sola et casta fuerit*, according to the custom of the manor. With respect to this free-bench, different manors have different customs.

Queen's Bench, a court in which the sovereign was formerly accustomed to sit in person. It is called the King's Bench in the reign of a king, and was styled the Upper Bench during Cromwell's protectorate. This was originally the only court in Westminster Hall, being styled *Aula Regia*, and from it the courts of Common Pleas and Exchequer are supposed to have been derived. As the sovereign in person is still presumed in law to sit in this court, though only represented by the judges, it is said to have supreme authority; and the proceedings in it are supposed to be *coram nobis*, that is, before the sovereign. This court consists of a lord chief justice and four other judges, or *puisné* justices, the former appointed by writ, the latter by patent, who are, according to Sir William Blackstone, "by their office the sovereign conservators of the peace, and supreme coroners of the land." They hold their offices *quamdiu se bene gesserint*, and in case of misconduct are removable only by address of both houses of parliament. By the 2d and 3d Will. IV. cap. 116, and 14th and 15th Vict. cap. 41, the chief justice receives a salary of L.8000, and the other judges of L.5000 each, with an allowance of L.40 a year to the senior.

"The jurisdiction of this court," observes Mr Justice Blackstone, "is very high and transcendent. It keeps all inferior jurisdictions within the bounds of their authority, and may either remove their proceedings to be determined here, or prohibit their progress below. It superintends all civil corporations in the kingdom, and commands magistrates and others to do what their duty requires in every case where there is no other specific remedy. It protects the liberty of the subject by speedy and summary interposition." It takes cognisance both of civil and criminal causes: its jurisdiction on the plea side or civil branch embracing all actions

Bench || Bends.

between subject and subject, excepting only those of the real class and matters of revenue, and extending throughout the entire realm of England, the principality of Wales, and the town of Berwick-on-Tweed; and on the crown side or crown office, it includes all criminal causes from high treason down to the most trivial breach of the peace, and whether against the public good or to the injury of any particular person. Nor can any private subject suffer unlawful violence or injury against his person, liberty, or possessions, without a proper remedy being afforded him here, not only for satisfaction of damages sustained, but for the punishment of the offender; and wherever this court meets with an offence contrary to the first principles of justice, it may punish it by its own authority. Persons illegally committed to prison, though by the king and council, or by either house of parliament, may be bailed in it, and in some cases even upon legal commitments. Writs of mandamus are issued by this court, for the restoring of officers in corporations unjustly turned out, freemen wrongfully disfranchised, and in a variety of other cases. Into this court also indictments from all inferior courts may be removed by writ of *certiorari*, and tried either at bar or at *nisi prius*. Error lies from this court to the court of Exchequer Chamber, under the 11th Geo. IV., and 1st Will. IV. cap. 70.

The officers on the crown side are, under the 6th and 7th Vict. cap. 20, "the queen's coroner and attorney, one master, and one assistant-master." On the side of the pleas there are five masters and the following clerks: four to the masters, six in the rule department, three in the writ department, four in the judgment department, three in the appearance department, two in the treasury department, one in the error and outlawry departments; to which may be added, the marshal and associate to the chief justice, comptroller of judges' fees, three ushers, three tipstaffs, train bearer, crier at *nisi prius*, and body clerk. (R. M—M.)

Common Bench. See Common Pleas, Court of.

BENCHERS, in the inns of court, the senior members of the society, who are invested with the government of the body to which they belong.

BENCOOLEN, formerly the chief establishment possessed by the East India Company in the island of Sumatra, on the south-western coast. It was for a few years a distinct presidency. In 1719 the settlers were expelled by the natives, but were soon permitted to return. In 1760 all the English settlements on the coast of Sumatra were destroyed by a French fleet under Comte d'Estaign. They were afterwards re-established and secured to the British by the treaty of 1763; but in 1825 they were finally ceded to the king of the Netherlands in exchange for the Dutch settlements on the continent of India. Long. 102. 3. E. Lat. 3. 50. S.

BEND, in *Heraldry*, one of the nine honourable ordinaries, containing a third part of the field when charged, and a fifth when plain.

BENDER, a town of Bessarabia in European Russia, seated on the river Dniester, 48 miles from its mouth. It is inclosed by a wall and ditch, and has a citadel, with about 10,000 inhabitants. It was stormed and taken by the Russians in 1770, and again in 1809, and finally ceded to them by the treaty of Bucharest in 1812. In the vicinity is Varnitza, the retreat of Charles XII. after the battle of Pultowa. Long. 29. 36. E. Lat. 46. 50. 32. N.

BENDIDEIA, a festival celebrated by the Athenians in honour of Bendis, a Thracian divinity, whom they identified with their own Artemis. This festival bore much resemblance to those of Dionysus.

BENDING, in nautical language, the tying of two ropes or cables together; thus, to *bend the cable*, is to make it fast to the ring of the anchor; to *bend the sail*, to make it fast to the yard.

BENDS, in a ship, more generally called *wales*, are the thickest and stoutest planks in her side, on which men set their feet when climbing up. They form the chief strength of a ship's sides, and have the beams, knees, and foot-hooks, bolted to them.

Bendy || Benedictines.

BENDY, in *Heraldry*, is the field divided into four, six, or more parts, diagonally, varying in metal and colour.

BENE, a city of the province of Mondovi, in the kingdom of Sardinia. It stands on a hill between the rivers Sturo and Tanaro, 18 miles N.E. of Cuneo, and contains several churches and other religious houses. Pop. 6000.

BENEDICITE, among ecclesiastical writers, an appellation given to the song of the three children in the fiery furnace, on account of its beginning with the word *benedicite*. The use of this song in Christian worship is very ancient, having been sung in all the churches as early as the time of St Chrysostom.

BENEDICT, St, the founder of the order of the Benedictine monks, was born in Italy about A.D. 480. He received the first part of his education at Rome; and at fourteen years of age he removed to Sublaco (Subiaco), about thirty miles distant. Here he lived an ascetic life, shut up in a cavern, where nobody knew anything of him except St Romanus, who used to descend to him by a rope, and supply him with food. Being afterwards discovered by the monks of a neighbouring monastery, they chose him for their abbot; but as their manners were not in accordance with his own, he returned to his solitude. Many persons followed him and put themselves under his direction; so that in a short time he was enabled to build twelve monasteries. In the year 528 or 529 he retired to Monte Cassino, where idolatry was still prevalent, a temple of Apollo having been erected there. He instructed the people in the adjacent country, and, having converted them, broke in pieces the image of Apollo, and built two chapels on the mountain. Here he also founded a monastery, and instituted the order of his name, which in time became so famous, and extended itself all over Europe. In this place, too, he composed his *Regula Monachorum*, which Gregory the Great speaks of as the most sensible and best written piece of the kind ever published. The period of his death is uncertain. He was looked upon as the Elisha of his time, and is reported to have wrought a great number of miracles, which are recorded in the second book of the Dialogues of St Gregory the Great.

Benedict, abbot of Peterborough, an ancient English historian. He was educated at Oxford, became a monk in the monastery of Christ Church in Canterbury, and was some time afterwards chosen prior by the members of that society. Although a great admirer and the biographer of Thomas à Becket, he was so much esteemed by Henry II. that, by the influence of that prince, he was elected abbot of Peterborough A.D. 1177. He assisted at the coronation of Richard I. in 1189, and was appointed keeper of the great seal in 1191. He died on Michaelmas day 1193. He wrote, besides his life of à Becket, a history of Henry II. and Richard I., from 1170 to 1192, which was published at Oxford by Hearne in 1735, 2 vols. 8vo.

Benedict XIV., Pope (Prosper Lambertini), was born of an illustrious family, at Bologna, in 1675. He was celebrated for his learning, moderation, and exemplary life, which gained him the esteem even of Protestants. He greatly patronized learned men and celebrated artists, and was an elaborate writer on theological subjects. His works fill 16 vols. 4to. He succeeded Clement XII. in 1740, and died in 1758, at the age of eighty-three.

BENEDICTINES, an order of monks who profess to follow the rules of St Benedict. The Benedictines, who of all the regular clergy are alone entitled to the appellation of *monks*, wear a loose black gown with large wide sleeves, and on their heads a capuche or cowl ending in a point behind. In the canon law they are styled *black friars*, from the colour of their habit.

Benedic-tion.

The rules of St Benedict, as observed by the English monks before the dissolution of the monasteries, were as follows: The monks of this order were obliged to perform, seven times in twenty-four hours, their devotions, the whole circle of which had reference to the passion and death of Christ; they always went two and two together; every day in Lent they fasted till six in the evening, and abated of their usual time of sleeping and eating, but they were not allowed to practise any voluntary austerity without leave of their superior; they never conversed in their refectory at meals, but were obliged to attend to the reading of the Scriptures; and they all slept in the same dormitory, in separate beds, and lay in their clothes. For small faults they were shut out from meals, for greater they were debarred religious commerce and excluded from the chapel; and incorrigible offenders were excluded from the monasteries. Every monk had two coats, two cowls, a table-book, a knife, a needle, and a handkerchief. The furniture of their cells was a mat, a blanket, a rug, and a pillow.

In the year 596 Pope Gregory sent into England Augustin, prior of the monastery of St Andrew at Rome, with several other Benedictine monks; to whom the English owe their conversion from idolatry. Augustin became archbishop of Canterbury, and the Benedictines founded several monasteries in England, besides the metropolitan church of Canterbury, and other cathedrals.

Pope John XXII., who died in 1334, found, after an exact inquiry, that, since the rise of the order, it had produced 24 popes, nearly 200 cardinals, 7000 archbishops, 15,000 bishops, 15,000 abbots, and above 4000 saints, besides founding upwards of 37,000 monasteries. There have been likewise of this order 20 emperors and 10 empresses, 47 kings, and above 50 queens, 20 sons of emperors and 48 sons of kings, above 100 princesses, daughters of kings and emperors, besides dukes, marquises, earls, countesses, &c., innumerable. The order has produced an immense number of eminent writers and learned men. Rabanus set up the school of Germany; Alcuinus founded the university of Paris; Dionysius Exiguus perfected the ecclesiastical computation; Guido invented the scale of music, Sylvester the organ; and they boast of having produced Anselm, Ildephonsus, Venerable Bede, and many others of equal or superior name. There are nuns likewise who follow the rule of St Benedict.

BENEDICTION, in a general sense, the act of blessing, or giving praise to God, or returning thanks for his favours. Neither the ancient Jews nor the early Christians ever ate without a short prayer. The Jews are obliged to rehearse a hundred benedictions a-day; of which eighty are to be spoken in the morning. The first treatise of the first order in the Talmud, entitled *Seraim*, contains the form and order of the daily benedictions. Benedictions were likewise given among the ancient Jews, as well as Christians, by the imposition of hands. When at length the primitive simplicity of the Christian worship became corrupted by ceremony, they added the sign of the cross. The custom of receiving benediction by bowing the head before the bishops, is very ancient; and even emperors did not decline this mark of submission.

BENEDICTION is also used for an ecclesiastical ceremony, whereby a thing is rendered sacred or venerable. In this sense benediction differs from consecration, as in the latter unction is applied, but not in the former. Thus the chalice is consecrated, and the pix blessed, as the former, not the latter, is anointed; but in common usage these two words are applied promiscuously.

Beatic BENEDICTION, *Benedictio beatica*, is the viaticum given to dying persons.

Nuptial BENEDICTION, the external ceremony performed by the priest in the office of matrimony. The nuptial benediction is not essential to, but the confirmation of, a marriage in the civil law.

Benefice.

BENEFICE was applied by the old Romans to the portions of lands obtained by conquest and given to the soldiers as rewards or *beneficia* for past services, and as an encouragement to future exertions. Hence in time it became applicable to the portions of land granted under the feudal system by a lord to his vassal for maintenance, and as a stipendiary return for military services which they were expected to render. In this sense, a benefice was an estate in land, at first granted for life only, and so called because it was held *ex mero beneficio* of the donor; and the tenants were bound to swear fealty to their lord, and to serve him in the wars. In aftertimes, as these tenures became perpetual and hereditary, the name of *beneficia* was transferred to the livings of the clergy, and that of *feuda* assumed.

According to Duarenus, its strict and proper interpretation is "an ecclesiastical estate which is granted to some priest or clergyman for term of life, to be enjoyed by him on the account of his ministry in the church." But in the various statutes relating to church matters the term is expressly defined. Under the 12th section of the 1st and 2d Vict. cap. 106, and section 3 of the Amendment Act, 14th and 15th Vict. cap. 98 (as to the holding of benefices in *plurality*), the word is to be understood to mean a "benefice with cure of souls," and therein to comprehend "all parishes, perpetual curacies, donatives, endowed public chapels, parochial chapelries, and chapelries or districts belonging or reputed to belong, or annexed or reputed to be annexed, to any church or chapel."

Under the 2d and 3d Vict. cap. 49, sec. 21 (relating to the assignment of districts to churches augmented by Queen Anne's Bounty), it extends to "all rectories with cure of souls, vicarages, perpetual curacies, and chapelries, the incumbents of which respectively shall, in right thereof, be corporations sole."

Under the 5th and 6th Vict. cap. 27, sec. 15, and 5th and 6th Vict. cap. 108, sec. 31 (as to the grant of farming leases, and leases for long term of years), it comprehends "every rectory, vicarage, perpetual curacy, donative, endowed public chapel, parochial chapelry, and district chapelry, the incumbent of which, in respect thereof, shall be a corporation sole."

According to the canons of the Church of England, a benefice cannot be taken without the bishop's consent, nor be divided; and any division is decreed null, nor is it to be given on the bare report of the death of the incumbent, nor to be promised while full, nor to be seized by violence, nor to be farmed to a layman, unless to a clerk who shall be fully instituted as general procurator for the time agreed; and under the 1st and 2d Vict. cap. 106, sec. 108, benefices, so far as pluralities and residence are concerned, are subject to the jurisdiction of the archbishop or bishop within whose province or diocese they are locally situate.

The following requisites are indispensable in order to be legally entitled to a benefice: 1. Presentation, nomination, or collation; 2. Examination as to ability, &c., by the bishop; 3. Institution or collation, after taking the oaths against simony, of allegiance and supremacy, of canonical obedience, and by subscribing the three articles concerning the supremacy, the Common Prayer and the Thirty-nine Articles, and the declaration of conformity; 4. Induction; 5. Reading the Common Prayer, the Thirty-nine Articles, and declaration of assent thereto, together with the ordinary's certificate of subscription to the declaration of conformity; and, 6. Taking the oaths of allegiance, supremacy, and abjuration at the sessions.

An avoidance of a benefice takes place—1. By death; 2. By resignation; 3. By cession, or the acceptance of a benefice incompatible therewith; 4. By deprivation under a sentence in the ecclesiastical court; 5. By act of law, for simony, non-subscription of articles, &c.; and, 6. By non-compliance with the requisites.

Benefice || Bengal.

By the returns for the year 1850 made to Her Majesty in council by the respective archbishops and bishops, there were in the dioceses of England and Wales—

Total number of benefices in which the incumbents were resident, ...	8077
Total number of benefices in which the incumbents were non-resident, ...	2952
Miscellaneous cases, ...	699
Total,	11,728
Total number of benefices on which there is a glebe-house, ...	8214

Of these 11 are under L.10; 19 from L.10 to L.20; 32 from L.20 to L.30; 235 from L.30 to L.50; 1629 from L.50 to L.100; 1602 from L.100 to L.150; 1354 from L.150 to L.200; 1979 from L.200 to L.300; 1326 from L.300 to L.400; 830 from L.400 to L.500; 954 from L.500 to L.750; 323 from L.750 to L.1000; 134 from L.1000 to L.1500; 32 from L.1500 to 2000; 16 of L.2000 and upwards. Among the last-mentioned is the rectory of Stanhope, in the county of Northumberland, of the annual value of L.4843; and the rectory of Doddington, in the county of Cambridge, worth L.7306 a-year.

Benefice in commendam (*ecclesia commendata*) is, according to Godolphin, an ecclesiastical living which, being void, is commended to the charge and care of some sufficient clerk, to be supplied until it may be conveniently provided with a pastor; the person to whom the church is thus commended having the fruits and profits thereof only for a certain time. The law relating to this subject has, however, been abolished by the 6th and 7th Will. IV. cap. 77, sec. 18, which enacts that no ecclesiastical dignity, office, or benefice, shall be held in *commendam* by any bishop, unless he held the same at the time of the passing of the act, and every *commendam* thereafter granted, whether to retain or to receive, and whether temporary or perpetual, is declared to be absolutely void to all intents and purposes.

BENEFICIARII, in *Roman Antiquity*, those who were promoted on account of their merits, or exempted by special favour from ordinary military service. The term was likewise applied to such as were discharged from the military service, and provided with *beneficia* or pensions. They were sometimes called upon to do military service as volunteers, when they were denominated *evocati*. Before their recall they were styled *emeriti*.

Beneficiary || Bengal.

The word *beneficiarius* frequently occurs in the Roman inscriptions found in Britain, where *consulis* is always joined with it; but besides *beneficiarius consulis*, we find in Gruter *beneficiarius tribuni, prætorii, legati, præfecti, proconsulis*, and such like expressions.

BENEFICIARY, *Beneficiarius*, one who holds a benefice. A beneficiary is not the proprietor of the revenues of his church; he has only the administration of them, though not accountable for his conduct therein to any but God and his superior.

This term is applied by the writers of the middle ages to a feudatory or vassal; and also to the clerks or officers who kept the accounts of the *beneficia*.

BENEFIELD, Sebastian, a very eminent divine, born in 1559, at Prestonbury in Gloucestershire, and educated at Corpus Christi College, Oxford. In 1613 he was chosen Margaret professor in that university; which appointment he held with great reputation till 1626, when he resigned it and retired to his rectory of Meysey-Hampton, in Gloucestershire. He published commentaries upon the first, second, and third chapters of Amos; a considerable number of sermons; and some Latin treatises. He died in 1630.

BENEFIT of Clergy. See Clergy.

BENEFIT Societies. See Friendly Societies.

BENEVENTO, a city of Italy, capital of a small delegation of the same name, which belongs to the States of the Church, and is bounded by the Neapolitan province of Principato Ultra. The town is surrounded by walls and defended by a castle. It is situated on a hill near the confluence of the Calore and the Sabato, 32 miles N.E. of Naples. It occupies the site of the ancient Beneventum, and is almost entirely built of the ruins of that town. Except Rome, perhaps no city can boast of so many remains of antiquity. Of these the most beautiful and perfect is the Arch of Trajan, 52 feet in height, consisting of a single arch of Parian marble of the Corinthian order, highly ornamented with basso and mezzo rilievos. See Serlio, *Architettura*. It is the see of an archbishop, and has a cathedral, several churches, a town-hall, diocesan seminary and library, and several hospitals. Pop. of delegation (1843) 23,910; of city 17,500.

B E N G A L,

Boundaries

The largest and most important division of Hindustan, situate towards its eastern extremity, and containing Calcutta, the seat of the British government in India. Excluding the possessions of the native princes, over which the British government merely exercises political supremacy, and excluding also the Punjab and the Agra, or north-western provinces, which are administered by functionaries having the powers and authority of lieutenant-governors, the tract embraced within the presidency of Bengal lies between the 10th and the 28th degrees of north latitude, and between the 83d and 99th degrees of east longitude. Its most northern extremity is situate in the province of Assam, and its most southern point lies on the coast of Tenasserim. The district of Mirzapore, under the jurisdiction of the lieutenant-governor of Agra, forms the extreme boundary on the west, and the frontier of Siam constitutes its most eastern limit. The longest line which could be drawn with extremities lying within the limits of the presidency, is that in a direction from S.E. to N.W., from the Pak Chan river in Tenasserim to the north-western angle of the district of Sarun, where the river Gunduck issues from the mountains of Nepaul, in Lat. 27. 25. Long. 83. 55., and would measure about 1550 miles in length. A considerable part of this line would, however, lie across the Bay of Bengal. The longest line that could be drawn without crossing the bay is from N.E. to S.W., from the boundary of Assam to that of the British district of Palamow, a distance of about 870 miles. The extreme breadth of the presidency, measured at right angles to this last-stated line, is about 465 miles, bearing from S.E. to N.W., from the mouth of the Hooghly to the exit of the Gunduck from the mountains of Nepaul. The area of the presidency, as thus defined, amounts to 225,103 square miles.

Aspect of the country.

Bengal, especially as it approaches the sea, may be designated a level country. Even in its northern frontier, it is reached only on one point by any of the branches that diverge from the Himalayas. A spur from the great culminating range bounds the north-eastern extremity of Assam; and thence taking a southerly direction through the native states of Munneepore and independent Tipperah, forms the eastern frontier of the British district of Chittagong. Continuing from this point its southerly course, it stretches, under the name of the Yoomadoung Mountains, through the province of Arracan to its southernmost point at Cape Negrais, forming the western boundary of the valley of the Irrawaddy. This spur where it touches upon Assam attains an elevation of 14,540 feet above the level of the sea, and there its summit is covered with perennial snow.

Bengal. At the Blue Mountain, in the latitude of Chittagong, it rises to the height of 8000 feet; but, with these exceptions, the general elevation of the ridge ranges between 3000 and 4000 feet. Westward of this ridge, the northern frontier of Bengal is bounded by the Sub-Himalaya Mountains, of no great elevation. Separated from these subordinate ranges by the valley of the Ganges, is the eastern extremity of the tropical zone, crossing the continent of India from west to east, and known as the Vindhya range. In its approach towards Bengal, this mountainous tract expands into several parallel ranges, some of which, stretching into the British districts of Palamow, Ramghur, Chota, Nagpore, and the northern part of Orissa, hem in the presidency on its western frontier. The area thus circumscribed by mountains is, as before observed, a level country. The Ganges, which enters on the western frontier, and runs diagonally across Bengal, gives to the country its peculiar character and aspect. About 200 miles from its mouth it spreads out into numerous branches, forming a large delta composed, where it borders on the sea, of a labyrinth of creeks and rivers named the Sunderbunds, and exhibiting during the annual inundation the appearance of an immense sea. At this time the rice-fields to the extent of some hundreds of miles are submerged, and are navigated by boats of various sizes and shapes, many of them handsome, and fitted both for commerce and for state. The scene presents to a European eye many objects of singular novelty and interest; namely, the fields covered with water to a great depth, with ears of rice floating on the surface; the stupendous dikes, which restrain, without altogether preventing, the excesses of the inundations; and peasants, in all quarters, repairing to the markets, and even to the fields, with their families and their domestic animals, in the fear that the swelling waters may sweep away their habitations, with all that they contain, in the absence of their boats. The many navigable streams which fall into the Ganges intersect the country in every direction, and afford a wonderful facility of internal communication. In most parts boats can approach, by means of lakes, rivulets, and water-courses, to the door of almost every cottage; and even in the driest season there is scarcely any spot twenty miles distant from a navigable river. The lower region of the Ganges is the richest and most productive portion of Bengal, abounding in valuable produce. Another mighty river by which Bengal is intersected is the Brahmapootra, the source of whose remotest tributary is on the opposite side of the same mountains that give rise to the Ganges. These two rivers,—which, from the contiguity of their sources, and their resemblance in length of course and bulk, have been termed sisters and rivals,—proceed in opposite courses until they are more than 1200 miles asunder; and again approaching each other, intermix their waters before they reach the ocean. The other principal rivers in Bengal are the Gogra, Sone, Gunduck, Coosy, Teesta; the Hooghly, formed by the junction of the Bhagrattee and Jellinghee; and farther to the west, the Dammoodah and the Mahanuddy. In a level country such as Bengal, where the soil is composed of yielding and loose materials, the courses of the rivers are continually shifting, from the wearing down of their different banks, and also from the water being turned off, by obstacles in its course, into a different channel. As this channel is gradually widened, the old bed of the river is left dry. The new channel into which the river flows is of course so much land lost, while the old one constitutes an accession to the adjacent estate. Thus one man's property is diminished, while that of another is enlarged or improved. Rules applicable to such contingencies are accordingly in operation, under which the land-tax is subject to increase or diminution in proportion to the quantity of land lost or acquired.

Climate. The position of Bengal brings it within the range of the tropical heats; and the year is distinguished into three seasons, the cold, the hot, and the rainy. The cold season begins in October, when the rains cease. During the succeeding four months the temperature is mild and agreeable, Fahrenheit's thermometer falling frequently to 70°. The spring and the dry season then succeed, and continue for four months, during which the heat continues progressively to increase, until it becomes almost intolerable to the natives themselves, the thermometer in the shade rising to 100°. In the beginning of April, occasional thunder-storms in the middle and south-eastern parts of Bengal, with rain or hail driven by sudden tempests of north-west wind, temper the immoderate heat. In the eastern districts, mild and refreshing showers of rain are still more frequent; but towards the west, in the country contiguous to Bahar, a parching west wind prevails in the day-time during the greater part of the hot season; night, however, bringing a cooling breeze from the opposite quarter. These west winds sometimes gives place to easterly gales which continue for days and weeks. The southerly and northerly winds, which alternately prevail in the Bay of Bengal during the summer and the winter, extend their influence over that part of the flat country which faces the bay, until they are diverted in their progress up the country by mountains corresponding with the course of the Ganges. About the beginning of June, the south-west monsoon, with thunder and lightning that seem to rend the sky, ushers in the periodical rains which refresh the atmosphere and the parched earth. The rains continue for four months, when all the rivers are in flood; and in the latter part of this season, in September, if the rains break up early, the weather is extremely close and sultry, and the inhabitants, especially the Europeans, suffer from sickness. Fogs are frequent during the dry months; and dews continue copious and refreshing, greatly assisting vegetation, as they afford nearly as large a supply of moisture as the loose soil of the country appears to require. These heavy dews are supposed to be no more than sufficient to compensate for the daily evaporation by the sun during the dry season, and so far to contribute to salubrity. The damp of the climate is ascribed to the natural want of any general system of drainage in a level country, to the luxuriant vegetation, and to the denseness of the woods, which obstruct the free circulation of the air, and retain an undue quantity of moisture amid decayed leaves and other putrid vegetable substances. This is found in all countries to be a fertile source of disease; and there is little doubt that the clearing of the forests, and a judicious system of drainage, would be followed in Bengal, as in all other parts, by a decided improvement in the climate.

Bengal.

Soil and produce. The soil of so extensive a province varies, of course, in its character and fertility with the physical peculiarities of the country. In the level tract interlaced by the Ganges and Brahmapootra, with their numerous branches and tributaries, the soil is alluvial, its basis being composed of sand, on which are annually deposited, by the retiring waters, clay, calcareous matter, and other fertilizing substances. In the tracts which lie beyond the reach of inundation, it is marked by different degrees of productiveness, from the dry and arid rocks of the south-western frontier overrun with brushwood, to the hills of Chittagong and Tenasserim clothed with magnificent forests. Taken as a whole, however, the soil of Bengal, enriched as it is by the combined influence of fierce suns and deluging rains, may be said to be characterized by an amazing fertility. Its productions are those both of the tropical and the temperate climates. Of the grains which contribute to the subsistence of man, rice is of the first importance: it is the great staple of Bengal agriculture, is particularly luxuriant within the tract of inundation, and thrives in all the southern districts. It is sown after the first showers at the end of March down to the setting in of the rainy season, and occupies a period ranging (according to its variety, of which there are three principal deno-

Bengal. minations) from three to five months to ripen. The early crop is sown broadcast; the later crop, after the seed has attained the height of a few inches, is planted with the hand in rows at the distance of about a foot asunder. The rice-harvest is succeeded by the cold-weather crops, which are sown in autumn and reaped in spring. They consist chiefly of vetches, gram, barley, pease, mustard, &c. Millet and other small grains, sown at the beginning of the rains and reaped at the end, constitute the food of the poorer classes, and, bearing a very low price, are of importance. Maize is less cultivated in Bengal than in those countries where the climate is more suitable, having no preference above millet to compensate for the greater labour required for its culture. Potatoes have lately been introduced into Bengal, and have succeeded well. They are suited to the climate; and the small potato is little inferior to that raised in England. Esculent plants are found in Bengal in great abundance and variety. The different species of the cucumber are much more numerous than in Europe, and whole fields are covered with them. The water-melon is of incredible size; and its stalk, leaves, and blossoms form a finely variegated matting, with which most of the cottages in the villages are entirely covered.

The universal and vast consumption of vegetable oils which takes place in Bengal is supplied by the extensive cultivation of mustard, linseed, sesamum, and palma-christi, in addition to the produce obtained from the cocoa-nut. The sesamum comes to maturity during the rains, or soon after them, the others during the cold season. Among the most important of the commercial crops are tobacco, sugar, the opium poppy, indigo, cotton, and silk, most of which require land solely appropriated to their peculiar culture; of late years coffee has been successfully cultivated. Tobacco, which was unknown in India before the discovery of America, is now produced everywhere. The sugar-cane has flourished in Bengal from the remotest times; there is scarcely a district in which its cultivation is not pursued with success, and there seems to be no limit to its production, except the demand for it. It is cheaply and frugally manufactured; and as it now enters the British market on equal terms with West India sugar, it forms an important article of export. The manufacture of indigo appears to have been known and practised in Bengal from an early period; and from the East Europe was supplied with this dye until the superior produce of America engrossed the markets. European skill has, however, succeeded in reviving this branch of trade in Bengal, and the indigo now exported from this presidency amounts to five-sixths of the supply obtained from the whole world. Cotton is raised in abundance, but the produce scarcely exceeds the consumption: and the demand of the British and China markets for the cotton wool of India is almost wholly supplied from the western side of the country. Silk is an ancient product of India; the silkworm, it is said, being originally introduced from China. Formerly the raw material was brought from India to Greece and Italy, whence Europe was chiefly supplied. Bengal still carries on a trade in this valuable article; and although the quality is scarcely equal to the finest Italian silk, the annual export from Calcutta exceeds in value half a million sterling. A coarse species of silk is procured from the wild silkworm, which is found in the countries bordering on Bengal, and in several districts included within it. It is rendered useful in the fabrication of inferior silks, though bearing no comparison to the produce of the domesticated insect. The cultivation of the poppy is entirely regulated and controlled by the government. Annual contracts are made with the farmers to sow certain quantities of land with the plant, and to deliver the produce to the government in the form of opium at a fixed price. The sowings commence in November, and the crop arrives at maturity by the end of February. The revenue realized by the government from the sale of opium produced in Bengal alone amounts to between two and three millions sterling per annum. Bengal.

The orchard is a great object of cultivation with the peasant in Bengal; and it attaches him to his native soil, from the almost superstitious predilection which he feels for the trees planted by his ancestor. The seasons, however, from the long continuance of the rains, which occupy the greater part of the summer, are not particularly favourable for bringing fruit to maturity; yet the orange, lime, shaddock, citron, tamarind, and other fruits, may be reckoned among the productions of Bengal. Orchards of mango, a tree thriving with little care, and yielding a fruit esteemed one of the best among those of India, diversify the plains. In size and foliage this tree resembles the Spanish chesnut; its fruit is extremely delicious, and is said to surpass in flavour the large yellow peach of Venice. Another fruit-tree is the cocoa-nut, valuable not only on account of the nut, from which a superior oil is largely extracted, but in consideration also of its timber, which is peculiarly fitted for the construction of water-pipes and other useful purposes. Even the husk which envelopes the fruit furnishes a fibre from which the best cordage is manufactured. The mulberry is extensively planted in consideration of its leaves, which afford the food of the silkworm. Assam abounds with the genuine tea plant; and the bassia thrives in various localities, especially in the hilly districts. Its produce is esculent and nutritious, and its flowers yield an intoxicating spirit. From its seeds is expressed an oil which is sometimes used as a substitute for butter. There are also valuable forest trees, among which may be noticed the teak, equal to the oak for purposes of ship-building, the sal and the banyan. There is also the bamboo, which, being hollow, light, and strong, is serviceable in supplying the peasant with materials for his buildings, as well as for the manufacture of baskets, mats, and other articles of like character, to which, when split, its flexible fibre is well adapted.

Minerals. From the alluvial character of the greater portion of the soil of Bengal, no great amount of mineral wealth is to be expected. In the hilly tracts, however, both in the eastern and western parts of the country, two of the most useful products which the mineral kingdom can boast, coal and iron ore, exist in abundance. Gold, in the form of dust, is found in a few places, but not in quantities sufficient to encourage to any extent the search for it.

Landed tenures and land tax. The lands in Bengal, prior to the entrance of the British, were under the management and control of rajahs and zemindars, who collected the rents from the immediate occupiers and cultivators, and were held responsible for the payment of a fixed yearly sum into the treasury of the nabob. The titles of the different classes of occupiers were not very exactly defined; and in the anarchy which prevailed in the country, rights of every description were often violated. When the British obtained possession of Bengal, a difference of opinion arose respecting the character of the zemindars and the rights of the tenantry; one party asserting that the zemindar was the true landlord, in whom alone was vested the proprietary right; the other contending that the cultivators were the real proprietors, and that the zemindar was merely the collector of the revenue for the behoof of the sovereign, who, according to the Eastern maxims of policy, was the proprietor of all the lands in the country. Without entering into a controversy, which at this period can be attended with no practical results, it seems certain, and is indeed admitted on all hands, that the lands were assessed in a certain rate for the public tax; and that as long as this tax was regularly paid, the occupiers of land were secured in the possession of their properties, which they mortgaged for debts, and quietly transmitted to their heirs through a series of generations. It was not, however, to each individual occupier, but to the zemindar, that government looked for the immediate payment of the tax, which he again col-

Bengal. lected from the under-tenants, called the ryots or cultivators; and whether we admit the zemindars to be proprietors, or merely government stewards, it seems clear that the tax was a sort of quit-rent, and that its regular payment was the tenure by which both zemindar and cultivator held their properties. Between the acquisition of the Dewanny in 1765 and the year 1793, various expedients were resorted to by the British government in the collection of the land revenue; and during that period the relation between the zemindar and the cultivator remained undisturbed. In the year last mentioned, however, Lord Cornwallis introduced into the lower provinces the permanent settlement, whereby the state pledged itself not to increase the public demand on the land at any future period. The arrangement was made not with the cultivators, whose rights were virtually disregarded, but with the zemindars as the proprietors of the land; and there can be little doubt that the settlement was based upon erroneous principles. This is the more extraordinary, as in the discussions which took place previous to the settlement a sound and just view of the subject seems to have prevailed. It was admitted, that the cultivator had a right to the soil so long as he paid the public assessment, which was held to have been fixed beyond the power of the zemindar. It was acknowledged that the zemindar had no right of absolute property in the land itself, and there was no proof "of the existence of such right discernible in his relative situation under the Mogul government in its best form." Yet the Bengal government proceeded to recognise the zemindars as the actual proprietors of the land, and to transfer to their keeping, and surrender to their mercy, the rights of all other persons,—rights far more generally admitted and respected than the right of the zemindar to collect and pay over the revenue of government. The right of the ryot appears, as has been expressed, to be "the greatest right in the country," and "a right which never seems to die." The zemindars have in many cases been in a state of constant change, but the right of the ryot is believed to be inalienable. He may quit his land for any period of time, and the cultivation may be assumed by others; but if he or his heir return and reclaim the land, he has only to come to a compromise with the party in possession for the value of the crop on the ground, and his inheritance is restored to him immediately.

The permanent zemindary settlement was a favourite plan of Lord Cornwallis, and undoubtedly originated in benevolent intentions. Its effects, however, have not been such as its projectors anticipated. It was felt and declared to be "the duty of the ruling power to protect all classes of the people, and more particularly those who from their situations are most helpless;" but the interests of all parties, except of the zemindars, were unfortunately sacrificed.

By the permanent arrangement the amount of the payment to government, which had previously been variable, was fixed in perpetuity. But while the government thus excluded itself from any prospective increase of revenue, by limiting its own demand upon the zemindar, it did not protect the cultivator from oppression, by limiting the demand of the zemindar upon him. A provision was indeed made that puttahs or leases should be granted; but this was, in fact, annihilating the rights of the superior class of cultivators who had an hereditary title to their land, and reducing them to the condition of the inferior class who possessed no hereditary right of occupancy. The zemindar was elevated from the situation of a revenue agent to that of a landlord. He was enjoined to grant leases, but he might demand whatever terms he pleased, and obtain the best that he was able. He even acquired a power to dispose of rights far more ancient, and in the eyes of the people more venerable, than his own; and might, to use the words of the home government, "oust even the hereditary ryots from the possession of their lands, when the latter refused to accede to any terms of rent which might be demanded of them, however exorbitant." The local government had anticipated, that the reciprocal wants of the zemindars and cultivators would compel them to enter into just and equitable arrangements; but these flattering expectations were not realized, and it is almost impossible not to feel some surprise that they should have deceived the good and able men by whom they were indulged. The reciprocity, as Lord Hastings observed, is by no means clear. It indeed resembles some other projects of alleged reciprocal advantage, of which it has been said that the reciprocity is all on one side. The zemindar wants cultivators; but, in the language of Lord Hastings, "he wants them upon his own terms; and he knows that if he can get rid of the hereditary proprietors who claim a right to terms independent of what he may vouchsafe to give, he will obtain the means of substituting men of his own; and such is the redundancy of the cultivating class, that there will never be a difficulty of procuring ryots ready to engage on terms only just sufficient to secure bare maintenance to the engager." The existence of such a state of things justified his lordship in affirming that, "if it were the intention of our regulations to deprive every class but the large proprietors, who engaged with government, of any share in the profits of the land, that effect has been fully accomplished in Bengal." This was not indeed the intention of the originators of the permanent zemindary settlement, but it has unhappily been the result of their measures. Bengal.

Cotton piece goods form the staple manufacture of Bengal; though the use of Indian fabrics of this description in Europe has almost entirely ceased, while even in India the demand for them has been in a great degree superseded by the cheaper goods of Great Britain. The district of Dacca, in the eastern quarter of Bengal, has long been famed for the manufacture of plain muslins, distinguished by various names according to the fineness and the closeness of their texture, as well as for flowered, striped, or chequered muslins of the most beautiful and exquisite fabrics. Several kinds more closely woven are manufactured on the western side of the delta of the Ganges; but those of a more rigid texture do not seem to be limited to particular districts: coarse turbans and handkerchiefs are also made in almost every province. Under the general appellation of calicoes, are included various species of cloth, which are still distinguished by their Indian designations. Moorshedabad and its neighbourhood is the chief seat of the silk manufacture. Manufactures and commerce.

The internal trade of Bengal consists chiefly in the exportation from the grain districts of corn and rice in exchange for salt. The supply of this article in Bengal is provided partly by manufacture conducted on account of the government, partly by importation, and to a small extent by private manufacture under a system of excise. The duty on all imported salt is at the rate of five shillings on 82 lb., or about three farthings per lb.; and the same rate of duty is levied on the home manufacture of the article, the prime cost of which amounts to about one farthing per lb. The wholesale price of salt at Calcutta may therefore be estimated at one penny the pound. Its supply is no longer a monopoly; for though the manufacture and sale have not been relinquished by the government, yet the public participate in its provision, under a combined system of customs and excise. The net revenue derived from salt by the government within the presidency of Bengal exceeds a million and a half sterling per annum.

Salt is a very ancient source of revenue in the East; but a feeling against its manufacture being carried on by the government has been for some time on the increase. During the parliamentary session of 1853, a clause was proposed to be inserted in the India bill, then in its progress through parliament, forbidding the manufacture after the 1st May 1856; and though opposed by the ministry, it was in the House of Commons carried. By the House of Lords it was however rejected, it being deemed unsafe thus suddenly to

Bengal. diminish the resources of India by so large an amount as that of the revenue produced by the trade as at present conducted. The facilities afforded for the introduction of English salt have for several years past caused a great increase of the imported article, the quantity received in Calcutta in the official year 1850–51 being double that of previous years.

The internal trade of Bengal is greatly aided by the navigable communications which intersect the country in every direction. The boats used in this navigation vary in form and construction, being each adapted to the nature of the rivers which they generally traverse. Steam navigation has been introduced upon the Ganges with success; and the macadamized trunk road from Calcutta to Delhi has afforded facility of communication with the capital to various parts of the presidency: but there can be little doubt that in the course of a few years the rivers and roads of Bengal will alike become subsidiary to the great arteries of communication which, in the form of railways, are now commencing to intersect the country. The line from Calcutta to Burdwan is advancing rapidly to completion; from this point it will be continued in a northerly direction to Rajmahal on the Ganges, whence it will traverse the heart of the presidency in a north-westerly direction to Allahabad.

Bengal carries on an extensive commerce with Britain. The exports consist chiefly of all the staple articles of the country, such as cotton, silk, sugar, rum, and indigo. The imports are metals of all sorts, wrought and unwrought; woollen and cotton manufactures of various kinds, which can be sent from Britain and sold cheaper than the home manufactures of the same description; naval and military stores; gold and silver bullion; and almost every article of British manufacture. An extensive trade is carried on to China and the countries and islands to the east. The exports are chiefly opium, saltpetre, gunpowder, cotton, and cotton piece goods. Bengal.

The wild animals are such as are commonly found in Hindustan, namely, the elephant, the rhinoceros, the bear, the tiger, the leopard, the wild boar, the jackal, and the buffalo, with apes, monkeys, &c., which swarm in all the woods, and some times plunder the fruit shops of a village; for, being considered sacred animals, they are never disturbed by the natives. The elephant is tamed for domestic uses, and is found extremely valuable in the military service. The Ganges and its numerous tributary streams abound in a variety of excellent fish; and during the periodical rains, when reservoirs and jhils overflow, and the rivers rising run into every creek, fish are to be had for the mere catching, and then become the food of the poorest classes. It also abounds in a peculiar species of crocodile. Animals.

The area and population of the several districts and territorial divisions comprised within the presidency are given in the table below. Population.

District.	Area, Sq. miles.	Pop.	District.	Area, Sq. miles.	Pop.	District.	Area, Sq. miles.	Pop.
Jessore	3,512	381,744	Birbhoom	4,730	1,040,876	Cachar	4,000	60,000
Twenty-four Pergunnahs	1,186	288,000	Dacca	1,960	600,000	Lower Assam: Camroop	2,788	300,000
			Furreedpore and Deccan Jelalpore	2,052	855,000	Lower Assam: Nowgong	4,160	70,000
Burdwan	2,224	1,854,152				Lower Assam: Durrung	2,000	80,000
Hooghly	2,089	1,520,840	Mymensing	4,712	1,487,000			
Nuddea	2,942	298,736	Sylhet, including Jyntea	8,424	380,000	Upper Assam: Joorhat (Seebpoor)	2,965	200,000
Bancoora	1,476	480,000				Upper Assam: Luckempoor	2,950	30,000
Baraset	1,424	522,000	Backergunge, including Deccan Shabazpore	3,794	733,800	Upper Assam: Sudya, with Mutruck	6,942	30,000
Bhangulpore	5,806	2,000,000						
Dinajpore	3,820	1,200,000						
Monghyr	2,558	800,000	Shahabad	3,721	1,600,000	Goalpara	3,506	400,000
Poorneah	5,878	1,600,000	Patna	1,828	1,200.000	Arracan	15,104	321,522
Tirhoot	7,402	2,400,000	Bahar	5,694	2,500,000	Tenasserim Provinces	29,168	115,431
Maldah	1,000	431,000	Sarun, with Chumparan	2,560	1,700,000			
Cuttack	3,061	1,000,000				Sumbulpore	4,693	800,000
Pooree	1,768		Chittagong	2,560	1,000,000	Ramgurh, or Hazareebah	8,524	372,216
Balasore	1,876	556,395	Tipperah and Bulloah	4,850	806,950 / 600,000			
Midnapore & Hidgellee	5,029	666,328				Lohurdugga: Chota Nagpore	5,308	482,900
Koordah	930	571,160	The Sunderbunds from Saugor Island on the west, to the Ramnabad Channel on the east	6,500	Unknown.	Lohurdugga: Palamow	3,468	
Moorshedabad	1,856	1,045,000				Singboom	2,944	200,000
Bagoorah	2,160	900,000				Maunbhoom: Pachete	4,792	772,340
Rungpore	4,130	2,559,000				Maunbhoom: Barabhoom	860	
Rajshaye	2,084	671,000						
Pubna	2,606	600,000	Cossya Hills	729	10,935	Total	225,103	41,094,325

The following are the principal towns, with their population: Calcutta, 413,182; Dacca, 60,617; Moorshedabad, 146,963; Burdwan, 53,900.

Small villages containing from 100 to 500 inhabitants are very numerous; forming, in many parts of the country, a continuous town for many miles along the banks of the rivers, and presenting to the inland navigator, as he passes along, the cheerful bustle of a crowded population. The genuine Bengali towns are not arranged into streets, but into divisions of east, west, north, south, and centre. The Hindus, Mahometans, and others not professing either of those creeds, reside each in their own quarter. A Bengal hut has a pent roof constructed of two sloping sides, which meet in a ridge, forming the segment of a circle, so that they have the appearance of a boat turned upside down. The Bengali has one hut for himself and another for his cattle. The framework in general consists entirely of bamboos. The door is the only opening in the hut.

The elevated tracts in Bengal are inhabited by a race of a different origin from the people of the plains. In the northern mountains, beyond the limits of the province, the natives appear to be of a Tartar origin, by which race also the northern parts of Bengal are peopled. The high country which Bengal includes on the west is peopled by several races of mountaineers, who are supposed to be the aborigines of the country, being distinguished by religion, character, language, and manners, as well as by features, from the Hindu natives. Some of them have scarcely emerged from a state of barbarity. In the mixed population of Bengal the Hindus and Mahometans are easily seen to be distinct classes, as among the latter the Mogul, the Afghan, and their immediate descendants, may be distinguished from the naturalized Mussulman. The character of the Bengali has never been held in high esteem. That he is pusillanimous cannot be denied; that he is deficient in a regard for truth and honesty must be readily admitted; but at the same time it ought not

Benguela.

to be forgotten that the peasant of Bengal has been overridden for ages by an uninterrupted rule of priestcraft and oppression, of one or the other of which both his weaknesses and his vices are the genuine offspring. In the enumeration of his good qualities, patient endurance must certainly not be omitted. He is, moreover, acute and intelligent. Under the beneficent rule which is now paramount in India, the defects of character which have been generated by despotism may be expected to lose their universality; those which have had their rise in superstition will probably be of longer duration, and will not, perhaps, give way to the more robust qualities, either of disposition or intellect, until the influential classes who are now being educated in the government colleges shall diffuse European knowledge throughout the masses of the population. A list of the government colleges and schools, in which a complete education in European literature and science is afforded through the medium of the English language, is given below. The names of the Oriental institutions supported by the state are appended, together with the number of pupils attached to each institution, whether British or Oriental.

Institutions.	Christians.	Mahometans.	Hindus.	Other Persuasions.	Total.
Hindu College	...	...	488	...	488
,, ,, Pautshala	...	...	215	...	215
,, ,, B. School	...	...	453	...	453
Sanscrit College	...	...	299	...	299
Calcutta Mudrissa	...	280	...	...	280
Hooghly College	7	5	395	...	407
,, ,, B. School	...	1	165	...	166
,, ,, Mudrissa	1	151	30	...	182
,, Mukhtub	...	22	11	...	33
Seetapore Mudrissa	...	40	...	...	40
Dacca College	32	26	328	...	386
Kishnagur College	1	4	195	...	200
Chittagong School	18	9	98	...	125
Committah ,,	4	10	69	...	83
Sylhet ,,	3	19	110	...	132
Bauleah ,,	2	...	80	...	82
Midnapore ,,	...	4	113	...	117
Cuttack ,,	19	13	89	1	122
Patna ,,	...	...	...	...	61
Bhangulpore ,,	...	15	70	30	115
Moozufferpore ,,	1	22	34	...	57
Gyah ,,	1	19	83	...	103
Jessore ,,	1	5	80	...	86
Burdwan ,,	...	2	64	...	66
Bancoora ,,	...	...	70	...	70
Baraset ,,	...	1	146	...	147
Howrah ,,	2	3	139	...	144
Ooterparah ,,	...	...	208	...	208
Birbhoom ,,	...	...	...	...	87
Barrackpore ,,	...	1	88	...	89
Russapuglah ,,	...	37	14	...	51
Assam (72 schools)	...	...	...	...	4025
Arracan (2 schools)	3	75	...	72	150
Tenasserim (2 school)	9	23	1	74	107
S.W. Frontier (2 schools)	...	9	18	12	39
Vernacular Schools	...	...	...	...	1904
Grand Total	104	796	4153	189	11,319

Of Bengal, prior to the Mahommedan invasion of India, our knowledge is very imperfect. From its conquest by Shahabudin at the commencement of the thirteenth century, it appears to have been ruled in feudal subordination to the empire, until the year 1340, when, during the reign of Mohammed Toghluk, it succeeded in throwing off its allegiance. A few years later, the successor of Toghluk consented to receive an embassy from Bengal, and thus recognised the independence of its ruler. In 1528 the king of Bengal, having been defeated by Baber, consented to terms of peace. Shortly after the province was again brought under the dominion of Delhi by the Afghan monarch Shir Shah; and though subsequently it succeeded in re-establishing its independence, it was finally reunited to Delhi by the Emperor Akbar, who formed it into a soubah or viceroyalty of the empire. Bengal continued to be ruled by governors under the Mogul dynasty, until the breaking up of the empire in the middle of the last century. The attack upon Calcutta by the nabob of Bengal in 1756, and the barbarous treatment of the servants of the East India Company, led to the battle of Plassy, and to the increased power and influence of the British. In 1765, the Emperor of Delhi conferred upon the East India Company the dewanny of Bengal, Bahar, and Orissa, and thus did this part of India form one of the earliest and most important of the acquisitions of the British in the East. (E. T.)

Bengal Bay || Benguela.

Bengal, Bay of, a portion of the Indian Ocean, of the figure of a triangle, having on its western side the coast of Bengal, and on the east the coast of Arracan, Pegu, and the Malayan peninsula. Its two sides, from Bengal to Ceylon on the west, and to Junkseylon on the east, may be estimated at 1120 miles in length, and the whole is comprehended within the latitudes of 8° and 20° N. At the bottom of the bay the breadth from Chittagong to Balasore is not above 250 miles; and at its mouth, from Cape Comorin to the Malayan peninsula, the breadth may be estimated at 1200 miles. The western and eastern coasts of the Bay of Bengal form a singular contrast in all the points most essential to a navigator. On the western coast there are no harbours for large ships, while on the eastern coast there are many excellent harbours, such as Arracan, Cheduba, Negrais, and Syriam, in Pegu; a harbour near Martaban, Tavay river, and King's Island; and several harbours in the Mergui Archipelago, besides Junkseylon, Telebone, and Pula Lada. Off the west coast of Coromandel there are no soundings about thirty miles from the shore, while the east coast has soundings two degrees from it. Coromandel presents an open country: it is often parched with drought from winds blowing over sultry sands; the mouths of its rivers are shallow from bars of sand, and it is often visited by dangerous gales. The east coast, on the other hand, is covered with wood. The climate is always temperate; the rivers are deep and muddy; and the weather is generally calm. The monsoons blow over the Bay of Bengal, though it is remarkable that here, as in many parts of India, strong winds are found blowing directly from the sea, while at some distance from the land it is a dead calm. Thus in Bengal there are strong northerly winds, while at sea calms prevail until May and June; and on the Malabar coast the south-west monsoon does not commence blowing till the beginning of the rainy season, while on shore there are strong westerly winds about and after the time of the vernal equinox. (D. B—N.)

BENGUELA, a considerable country on the western coast of Africa, included in the territory of Angola. Being occupied by the Portuguese, to the exclusion of all other European nations, the knowledge of it is withheld from the latter with the most jealous care. The general observations made upon the coast of Angola will in a great measure apply to Benguela. The air is said to be unwholesome, the water is bad, and the natives are extremely fierce and uncivilized. The mountains contain mines of copper, which is extracted only in very small quantities. The port of St Felipe de Benguela was formed by the Portuguese on the Bahia das Vallas or Cone's Bay, and made the centre of their trade upon this coast, especially of the iniquitous traffic in slaves, which is still clandestinely carried on. The articles almost exclusively in demand among the natives are coral and beads, which are not only used as ornaments, but circulate as

Benicarlo || Benin.

money. The few Portuguese ships which now pass to and from the East Indies touch here for refreshment. Long. 13. 37. E. Lat. 12. 30. S. Pop. of town about 3000.

BENICARLO, a city of Spain, in the province of Castellon de la Plana, on the coast of the Mediterranean. It is celebrated for its red wine, of which large quantities are annually exported to Bordeaux for mixing with clarets and other French wines. Pop. 6060.

BENIN, an extensive country of Western Africa, situated on a bay or bight of the same name, near the eastern extremity of the Gulf of Guinea. Here commences that long chain of estuaries by which the Niger discharges itself into the ocean. See NIGER.

Benin was discovered by the Portuguese about the year 1485. It escaped the observation of Diego Cam when he sailed from El Mina to the mouth of the Congo; but tidings of it having been there obtained, Alfonso de Aveiro sailed thither, and brought the first specimen of the plant called long or Guinea pepper. He came accompanied also by an ambassador from the king of Benin, requesting, it is said, that missionaries should be sent to instruct the people in the Christian religion. The king of Portugal accordingly despatched an expedition under Fernando Po, who discovered and gave his name to a fine island near the mouth of the gulf; and having ascended the river, established a settlement at Gatton. A church was built, and upwards of a thousand persons received baptism. Much interest was excited by the account of a regular embassy sent at the accession of every new prince to the court of a powerful sovereign named Ogané, whose capital lay about 700 miles to the eastward. He was held in almost religious veneration, and his sanction was considered necessary to render valid the title of any new monarch. This mysterious prince maintained himself in retired pomp, and at every audience a silk curtain concealed him from view. At the parting interview, however, his foot was put forth from behind the curtain, and was venerated as a sacred object. He delivered to the ambassador a staff, a helmet, and a cross, all of brass, to be presented to his sovereign. From these circumstances the Portuguese inferred that this was the Prester John or Christian prince whom they expected to find in the interior of Africa; but Major Rennell has more reasonably concluded that he was the king of Ghana or Cano, who then held extensive sway over that continent.

The Portuguese carried on for some time a brisk trade in slaves, who were carried to El Mina, and sold to the natives of the Gold Coast. John III., however, prohibited this nefarious traffic; and as the situation was found very unhealthy, while the conversions were professed only with the view of obtaining military aid against their neighbours, the settlement was ordered to be withdrawn. The Dutch afterwards established factories, and maintained them for a considerable time, chiefly with a view to the slave trade. The English and French have also formed occasional settlements. But all these are at present abandoned, and trading vessels come merely to the mouth of the river. On the whole, the river of Benin has always been, and now is, much less frequented for commercial purposes than that of Bonny and the towns situated at the opening of more southern estuaries.

The coast of Benin presents a succession of river branches, all diverging from one great trunk, connected and interlaced with numerous creeks and channels, which afford easy navigation for boats from one to the other. The whole of this territory consists of an immense swamp, either covered with water or composed of soft mud, out of which rises a dark and impenetrable forest. The waters are so muddy that no fish except eels can subsist in them. The river, called by the Portuguese Formosa, is about two miles wide at its mouth; but it is crossed by a bar of mud, on which there is only twelve feet of water at spring tides. Eighteen miles up is New Town, where vessels can anchor in 3½ fathoms water. It is a mere trading station, consisting of hovels built on a foundation of mud, so soft as to render it necessary to place old canoes with their bottoms upwards to form a passage from house to house.

Benish-Days.

At New Town a branch strikes off on each side, and these are followed by traders in preference to the main trunk. The left or northern branch leads first to Gatton, the port of Benin, to which barks of sixty tons can ascend, and near which dry land first appears emerging out of the morass. Benin, the capital, is forty miles further up the river.

From information obtained on the Gold Coast, M. Dupuis considered Benin as exceeding in importance even Ashantee and Dahomey; possessing an extensive and highly cultivated territory, and capable of sending 200,000 men into the field, 10,000 of whom were armed with muskets. But Captain Adams, who appears to be the last that actually penetrated to Benin, leads us to believe this description exaggerated. The city was indeed found to cover a great extent of ground; but the houses were so scattered that the population did not appear to exceed 15,000. The country around was also fruitful, but by no means highly cultivated. Sheep, goats, pigs, and poultry, were plentiful; but the vegetable food consisted almost entirely of yams. No information, however, is given respecting the districts in the interior. The king is absolute, being revered by his subjects as a species of divinity. It is a crime to believe that he either eats or sleeps; and all offences against him are punished with the utmost severity. At his death, or that of any of his great men, numerous human victims are devoted to attend them in the other world; and every year, at the mouth of the river, three or four are presented as votive offerings, to attract ships and commerce. Yet the practice of human sacrifice does not appear to exist on the same dreadful scale as in Ashantee and Dahomey.

The large channel that branches off to the right from New Town communicates with the Rio de Forcados, and then with another river whose branches inclose the beautiful island of Waree, which is about five miles in circumference, and seems almost like a spot fallen from the clouds in the midst of a desert. Being somewhat elevated above the surrounding swamps, it is dry, verdant, and cultivated. The soil consists of a tenacious red clay, fitted for the manufacture of earthen jars, which form an article of trade. The island contains two towns, the joint population of which is estimated at 5000. The government is monarchical, but mild; and the natives seem to enjoy a considerable degree of freedom and equality. The houses are neatly built of clay, and some of them are ornamented with wooden pillars. Waree carries on a communication with the sea by New Town, which is at present dependent upon it.

The main stream of the Formosa extends upwards in an east-north-easterly direction, but is not navigable for ships of fifty tons burden for more than fifty miles. Europeans have never ascended it, nor received accounts of any town situated on its banks.

Since the abolition of the slave trade, the chief commodities to be obtained in the river of Benin are palm oil and ivory, both at tolerably cheap rates. The imports consist of salt, silk and cotton stuffs, guns and gunpowder, coral, beads, iron, brass, brandy, tobacco, &c. (See Lander's *Travels;* Clapperton's *Second Exped.;* Smith's *Voyage to Guinea;* Adams's *Remarks on the West Coast of Africa.* (H. M.)

BENISH-DAYS, among the Egyptians, a term applied to three days of the week, which are days of less ceremony in religion than the other four, and are so called from the *benish*, a garment of common use, not of ceremony. At Cairo the benish-days are Monday, Wednesday, and Saturday, on which the citizens throw off all business and ceremony, and go to their little summer-houses in the country.

Benjamin || Bennet.

BENJAMIN (Sept. Βενιαμίν), youngest son of Jacob, by Rachel. In Gen. lvi. 21, *sq.*, the immediate descendants of Benjamin are given to the number of *ten*, whereas in Num. xxvi. 38–40, only seven are enumerated, and some even under different names. This difference probably arose from the circumstance that some of the direct descendants of Benjamin died either early or childless.

The tribe of Benjamin, though the least numerous of Israel, became nevertheless a considerable race. In the desert it counted 35,400 warriors, and at the entrance of Israel into Canaan even as many as 45,600. The portion allotted to this tribe was encompassed by the districts of Ephraim, Dan, and Judah, and contained thirty-six towns (with the villages appertaining to them), of which the principal were Jericho, Bethagla, Bethel, Gibeon, Ramah, and Jebus or Jerusalem.

In the time of the Judges, the tribe of Benjamin became involved in a civil war with the other eleven tribes. This war terminated in the almost utter extinction of the tribe; but it eventually revived, and in the time of David it numbered 59,434 able warriors; in that of Asa, 280,000; and in that of Jehoshaphat, 200,000.

This tribe had the honour of giving the first king to the Jews, Saul being a Benjamite. After the death of Saul, the Benjamites declared themselves for his son Ishbosheth; until, after the assassination of that prince, David became king of all Israel. David having expelled the Jebusites from Zion, and made it his own residence, the close alliance that previously existed between the tribes of Benjamin and Judah was cemented by the circumstance that, while Jerusalem belonged to the district of Benjamin, that of Judah was immediately contiguous to it. At the division of the kingdom after the death of Solomon, Benjamin espoused the cause of Judah, and they formed a kingdom by themselves. Indeed, the two tribes stood always in such a close connection as often to be included under the single term Judah.

BENJAMIN *of Tudela*, in Navarre, a celebrated Jewish rabbi of the twelfth century, whose *Itinerary* is a literary curiosity. He visited Constantinople, Egypt, Assyria, and Persia, penetrating to the frontiers of China. Though credulous, and not accurate in discriminating fable from history, his work contains some curious notices of the countries he visited. The Itinerary was translated from the Hebrew into Latin by Arias Montanus in 1575. It appeared in French in 1734, and again in 1830. An English translation was published in 1783, with notes by the Rev. Benjamin Gerrans, from the Hebrew and Latin edition of the Elzevirs of 1633.

BENNET, HENRY, Earl of Arlington, a distinguished statesman in the reign of Charles II., was born of an ancient family in Middlesex, in the year 1618. In the beginning of the civil war he was appointed under-secretary to George Lord Digby, secretary of state. He afterwards entered himself as a volunteer for the royal cause, and did the king good service, especially at Andover in Hampshire, where he was severely wounded. He was made secretary to the Duke of York, received the honour of knighthood from Charles II. at Bruges in 1658, and was sent as envoy to the court of Spain. Upon the return of the king to England, he was called home, made keeper of the privy purse, and principal secretary of state. In 1670 he was of the council distinguished by the title of the Cabal, and one of those who advised the shutting up of the exchequer. In 1672 he was made Earl of Arlington and Viscount Thetford, and soon after knight of the Garter. "Henry Bennet, Lord Arlington (Macaulay's Hist., vol. i. p. 212), then secretary of state, had, since he came to manhood, resided principally on the Continent, and had learned that cosmopolitan indifference to constitutions and religions which is often observable in persons whose life has been passed in vagrant diplomacy. If there was any form of government he liked, it was that of France. If there was any church for which he felt a preference, it was that of Rome. He had some talent for conversation, and some talent also for transacting the ordinary business of office. He had learned, during a life passed in travelling and negotiating, the art of accommodating his language and deportment to the society in which he found himself. His vivacity in the closet amused the king; his gravity in debates and conferences imposed on the public; and he had succeeded in attaching to himself, partly by services and partly by hopes, a considerable number of personal retainers." He died in 1685. His *Letters to Sir William Temple* were published after his death.

Bennet || Benson.

BENNET, *Dr Thomas*, an eminent divine, born at Salisbury on the 7th of May 1673, and educated at St John's College, Cambridge. In 1700 he was made rector of St James's in Colchester; afterwards became lecturer of St Olave's, Southwark, and morning-preacher at St Lawrence, Jewry; and at last was presented to the vicarage of St Giles's, Cripplegate. His writings were chiefly of a controversial character. He died Oct. 9. 1728.

BENOIT, RENÉ, a famous doctor of the Sorbonne, and curate of St Eustace at Paris, was born at Savernières, near Angers, in 1521. He was a secret favourer of the Protestant religion; and that his countrymen might be able to read the Bible in their own tongue, he published at Paris the French translation which had been made by the reformed ministers at Geneva. This translation was approved of by several doctors of the Sorbonne before it went to the press, and Charles IX. had granted a privilege for the printing of it; yet when it was published it was immediately condemned. He had previously been confessor to Mary queen of Scotland during her stay in France, and attended her when she returned to Scotland. Sometime before the death of Henry III., Benoit, or some of his friends with his assistance, published a book, entitled *Apologie Catholique;* in which it was shewn that the profession of the Protestant faith was not a sufficient reason to deprive Henry king of Navarre of his right of succeeding to the crown of France. When Henry IV. had resolved to embrace the Catholic religion, Benoit assisted at the assembly in which the king abjured the reformed religion. In 1597 Henry promoted him to the bishopric of Troyes in Champagne, but he could never obtain the pope's bulls to be installed. He enjoyed however the temporalities of that bishopric for eleven years, when he resigned it. He died in 1608.

BENSERADE, ISAAC DE, an ingenious French poet, born in 1622 at Lions-la-Forêt in Normandy. He made himself known at court by his verses and his wit, and had the good fortune to please the cardinals Richelieu and Mazarin. He wrote, 1. A Paraphrase upon Job; 2. Verses for Interludes; 3. Rondeaux upon Ovid; 4. Several Tragedies. A sonnet of his, which he sent to a young lady with his paraphrase on Job, having been placed in competition with the *Urania* of Voiture, a dispute on their relative merits long divided the whole court and the wits into two parties, who were respectively styled the *Jobelins* and the *Uranists*. Some years before his death, Benserade applied himself to works of piety, and translated almost all the Psalms. According to the Abbé Olivet, he latterly withdrew from court to his residence at Gentilly, where he died on the 19th October 1691, in the eighty-second year of his age.

BENSHEIM, a city of the province of Starkenburg, in the duchy of Hesse-Darmstadt; situated between Darmstadt and Mannheim, about fifteen miles from the former. Pop. 4500, mostly manufacturers, or cultivators of vineyards.

BENSON, GEORGE, a learned dissenting minister, born at Great Salkeld, in Cumberland, in 1699. His mental capacity was so precocious, that at eleven years of age he was able to read the Greek Testament. He afterwards

Bent Grass || Bentham.

studied at Dr Dixon's academy at Whitehaven, from which he removed to the university of Glasgow. In 1721 he was chosen pastor of a congregation of dissenters at Abingdon, in Berkshire; in 1729 he received a call from a society of dissenters in Southwark, with whom he continued eleven years; and in 1740 he was chosen by the congregation of Crutched Friars colleague to the learned Dr Lardner. In 1731 appeared his "Defence of the reasonableness of Prayer, with a Translation of a Discourse of Maximus Tyrius, containing some popular Objections against Prayer, and an Answer to these." Subsequently to this he published Paraphrases and Notes on the Epistle to Philemon, the two Epistles to the Thessalonians, the first and second to Timothy, and the Epistle to Titus; adding dissertations on several important subjects, particularly on inspiration. In 1735 he published his *History of the First Planting of Christianity*, in 2 vols. 4to, a work of great learning and ability. He also wrote the "Reasonableness of the Christian Religion," the "History of the Life of Jesus Christ," a Paraphrase and Notes on the seven Catholic Epistles, and several other works, which procured him great reputation. One of the universities in Scotland sent him a doctor's diploma; and several prelates of the Church of England, as Herring, Hoadly, Butler, Benson, and Conybeare, bestowed on him marks of favour and regard. Dr Benson died in 1763.

BENT GRASS, a species of *agrostis*. It has bent and wiry stems, and is exceedingly difficult to eradicate from the soil.

BENTHAM, JEREMY, was born in Red-Lion Street, Houndsditch, London, on the 15th of February 1748. He received his boyish education at Westminster school, and entered Queen's College, Oxford, in the summer of 1760, when he was little more than twelve years old. It was ever a consolation to him, when he had formed the great leading opinions of his life, that he had been exempted, by his tender age, from the subscription of the Thirty-nine Articles. He had a precocious capacity for acquiring knowledge; and paternal vanity subjected him to a degree of educational forcing, accompanied by occasional displays of the acquisitions of the accomplished youth, which would not, according to ordinary anticipations, have been favourable to the progress of so original and self-constituted a mind as his became. The father, a sagacious attorney, who had realized a considerable sum by practice, brought up his promising son to the bar, as a sphere in which the fortunes of the family might in such hands rise to great state and eminence. There was, however, little permanent geniality between them, for the son turned into a course entirely his own, and disappointed all the glittering hopes of the ambitious father. In his own work, the *Chrestomathia*, Bentham has given a sketch, quite unconsciously, of that paternal ambition which he did not realize. "Of the apothecary," he says, "the ambition is to see his child a physician of the highest eminence; of the attorney, to behold in his son a lord chancellor; of the parish clergyman, to behold in his an archbishop. The Lord Chancellor More makes his reverence and begs a blessing, as in the great hall of Westminster he passes by his father, then sitting in the Common Pleas; but the puisne judge, and not the lord high chancellor, is the great object of envy to a paternal breast."

That the son should turn out a philosopher and a law reformer, instead of realizing his father's practical anticipations, was perhaps the more mortifying, as the attorney, after the death of Jeremy's mother, married, in 1765, the widow of Dr John Abbot and the mother of Charles Abbot, afterwards speaker of the House of Commons and Lord Colchester. The step-brothers were matched against each other; and as young Abbot went straight onwards through a course of practical advancement, the erratic self-will of his own son, destined by the father's ambitious anticipations for the woolsack, became the more mortifying.

Bentham.

With the exception of some trifling youthful efforts, Bentham's earliest publication was his *Fragment on Government*, which appeared in 1776. As of many of his subsequent works, the title contained nothing to lead men to a notion of its object, which in this instance was a political criticism on the fundamental principles of Blackstone's popular commentary on the law of England. Bentham was peculiar in almost everything; and though he was not deficient in an egotism and vanity of his own kind, yet his first publication, so far from being that nervous ordeal which it generally proves to other authors, was a matter of trivial and fugitive thought to him, for he was occupied, when he printed it, in elaborating his great work on the *Principles of Morals and Legislation*. Before it was completed he had been brought into a social circle which offered to him wider views and more genial immediate elements than the dusty inns of court or the money-making cronies who dined with his father. Lord Lansdowne, with the instinctive appreciation of high eminence which has been remarkable in his family, sought out the author of the *Fragment on Government*, and received him as a guest at Bowood. Bentham evidently relished the life he led there; he had the first society of his day to converse with, and could retire to write on ethics and jurisprudence when he pleased. The one romance of his life, indeed, centred in Bowood. Among the young ladies whom he met there, one, who must have been little more than a child when he approached middle age, made so deep an impression on his heart, that, more than twenty years afterwards, and when he had entered his fifty-fourth year, he made her a formal offer of marriage. The lady's answer—a refusal—has been preserved in the memoir of Bentham by Dr Bowring (*Works*, x. 419.) The rejection was conceived in a tone honourable both to the head and heart of the writer; and since death has removed all who were connected with this little incident in the life of a great man, it need, perhaps, no longer be concealed, that Miss Caroline Fox, Lord Holland's sister, was the person on whom Bentham had bestowed his affections.

Almost all the other events of Bentham's life are embodied in the preparation and publication of his books. With the exception of a tour in Russia which he undertook in 1785, and a subsequent visit to France, he lived the life of a hermit, admitting some chosen friends or pupils only to his table and study in Queen Square, Westminster, and generally labouring, through all available hours unnecessary for rest and refreshment, at his varied works. He died on the 6th of June 1832.

It has not been deemed necessary to make this article a critical history of his works, since they are amply noticed under various heads of the *Encyclopædia*. There is especially a full critical history of the fundamental principles of his ethical philosophy in the Introductory Dissertation by Sir James Mackintosh (p. 393 *et seq.*) It is there mentioned, that Bentham's writings on jurisprudence do not come within the scope of the dissertation. These works, which he began with systematic inquiries into the principles of the science, were in his latter years a continuous elaborate application of these fundamental principles to the existing state of the law in Britain, or, in practical language, they were works on law reform. They have had a singular literary fate, of which the *Rationale of Judicial Evidence*—published in five octavo volumes in 1826—may be taken as a type. The object of this work was to show how much more rational it is for the tribunal which examines evidence to decide what is to be believed and what discredited, than for the legislature to separate credible from incredible evidence, and, permitting the tribunals to listen only to the former, exclude the latter class as tainted. His opinions, elaborately maintained, were in his day deemed so paradoxical that very few people would undergo the task of reading what he said. Through the exertions of these few readers,

Bentham || Bentinck.

however, opinion has now been so entirely revolutionized, that, by the abolition of disqualifications, the principles of the *Rationale of Evidence* have been established by statute, and have become so familiar, as the only true and sound principles, that the book in which they are set forth is deemed unreadable, as a string of truisms. The same history attaches to many of his practical suggestions; and it would occupy considerable space to describe those projects first suggested from his utilitarian hermitage, which are now in legal force. He advocated a uniform system of poor-laws under central inspection and superintendence, and an organization for the protection of the public health by sanitary purification. He pleaded for the adoption of local courts, for the cheap conveyance of letters, for a register of merchant seamen, for the protection of savings'-banks and friendly societies as the depositories of the savings of working people, and for many other projects with the realization of which we are now familiar. Bentham's works were chiefly known through the French abridged translation of Dumont, of which a collected edition was published at Brussels in 1829 in three large octavo volumes. A complete edition of his works in English was commenced in 1838, under the superintendence of his literary executor Dr Bowring, and completed in 1842, in eleven volumes, royal octavo. (J. H. B.)

BENTHAM, *Thomas*, bishop of Lichfield and Coventry, was born at Sherbourn, in Yorkshire, in 1513, and educated in Magdalen College, Oxford. On Edward VI.'s accession to the crown, he threw off the mask of popery, which, during the equivocal reign of Henry VIII., he had worn with reluctance. On the accession of Mary he was deprived of his fellowship, and retired to Basle in Switzerland, where for some time he expounded the Scriptures to the English exiles in that city, but returned before the death of the queen, and was appointed superintendent of a private congregation in London. In the second year of Elizabeth, Bentham was consecrated bishop of Lichfield and Coventry. He died in 1578. He had the character of a pious and zealous reformer, and was particularly celebrated for his knowledge of the Hebrew language.

BENTINCK, WILLIAM HENRY CAVENDISH, third Duke of Portland, was born in 1738. During the American war he joined the Opposition; and on the resignation of Lord North he was appointed lord-lieutenant of Ireland, but held that office little more than three months, being recalled when Lord Shelburne came into power. He held the situation of prime minister when the coalition came into power, and went out of office with them. In 1792 he was elected chancellor of the University of Oxford, and shortly afterwards joined Mr Pitt's party. He was home secretary from 1794 till 1801; and in 1807 he succeeded Lord Grenville as first lord of the treasury. He continued in this office till within a short time of his death, October 30. 1809.

The abilities of his Grace were certainly but moderate, and altogether inadequate for the authorship of *Junius's Letters*, of which, absurdly enough, some have endeavoured to prove him the writer; but his understanding was good, and his political integrity has never been questioned.

BENTINCK, *Lord William George Frederic Cavendish*, better known as Lord George Bentinck, second son of the fourth Duke of Portland, by Henrietta, sister to the Viscountess Canning, was born February 27. 1802. He was educated at Eton, and at Christ Church, Oxford; after which he entered the army, and served for several years in the Guards. On retiring from the army, he acted for some time as a private secretary to his uncle Mr Canning, then prime minister; in which capacity he gave proofs of high ability for the conduct of public business. In 1828 he succeeded his uncle Lord William Bentinck as member for Lynn-Regis, and continued to represent that constituency during the remaining twenty years of his life. Till within three years of his death, Lord George Bentinck was little known out of the sporting world. His early attempts at public speaking afforded no indication of the abilities which the subsequent course of political events served to develop so conspicuously. His failures in the House of Commons seem to have discouraged him from the attempt to acquire reputation as a politician. The natural energy of his character, however, found scope in another arena. As one of the leaders on "the turf," he was there distinguished by that integrity, judgment, and indomitable determination, which, when brought to bear upon matters of weightier importance, placed him, with a rapidity almost unexampled, in the foremost rank of British senators. On his first entrance into parliament he belonged to what may be called the moderate Whig party, and voted in favour of Catholic emancipation, as also for the Reform Bill, though he opposed some of its principal details. Soon after, however, he joined the ranks of the Opposition, with whom he sided up to the important era of 1846. When, in that year, Sir Robert Peel openly declared in favour of free trade, the advocates of the corn-laws, then without a leader, after several ineffectual attempts at organization, discovered that Lord George Bentinck was the only man around whom the several sections of the Opposition could be brought to rally. His sudden elevation to so prominent a position took the public mind by surprise; but he soon gave convincing evidence of powers so formidable, that the position of the Protectionist party at once assumed an imposing aspect. Towards Sir Robert Peel, in particular, his hostility was marked and uncompromising. Believing, as he himself expressed it, that that statesman and his political colleagues had "hounded to the death his illustrious relative" Mr Canning, he combined with his opposition as a political leader a degree of personal animosity that gave additional force to the poignancy of his invectives. On entering on his new position, he at once abandoned his favourite pursuits, disposed of his magnificent stud, forsook all connection with the turf, and devoted his whole time and energies to the laborious and trying duties of a parliamentary leader. Apart from the question of the corn-laws, his politics were strictly independent. In opposition to the rest of his party, he supported the bill for removing the Jewish disabilities, and was favourable to the scheme for the payment of the Roman Catholic clergy in Ireland by the landowners. Having held no high office under government, his qualifications as a statesman never found scope beyond the negative achievements of a leader of Opposition; but it may be safely affirmed that nothing but his untimely death could have debarred him from acquiring a distinguished position among the statesmen of Britain. This sudden and melancholy event, caused by the rupture of a vessel in the heart, took place on the 21st September 1848, while his lordship was proceeding on foot to visit a friend in the country. His biography has been written by his friend the Right Hon. B. Disraeli.

Bentinck.

BENTIVOGLIO, GIOVANNI, was born at Bologna in 1443, two years before the murder of his father Annibale, then the chief magistrate of the republic. In 1462 Giovanni contrived to make himself master of the state, which he continued to rule with a stern sway for nearly half a century; but his encouragement of the fine arts, and his decoration of the city by sumptuous edifices, gilded his usurpation. He was finally expelled by Pope Julius II., in 1506, and died in the state of Milan at the age of seventy.

BENTIVOGLIO, *Guido*, Cardinal, an eminent statesman and historian, was born at Ferrara in 1579. After studying at Padua, he went to reside at Rome, where he became universally esteemed. He was sent as nuncio into Flanders, and afterwards to France; and when he returned to Rome he was intrusted by Louis XIII. with the management of the French affairs at that court. He was the intimate friend of Pope Urban VIII., and on the death of Urban public opinion marked out Bentivoglio for his successor. But on

Bentley. entering the Conclave, the excessive heat of the weather threw him into a fever, of which he died on the 7th of September 1644. He has left several works, the most remarkable of which are, *A History of the Civil Wars of Flanders; An Account of Flanders;* Letters, and Memoirs.

BENTLEY, RICHARD, one of the greatest critics of modern times, was born at Oulton in the west riding of Yorkshire, on the 27th of January 1662. His ancestors belonged to the higher class of English yeomen. His father, Thomas Bentley, who was the possessor of a small estate at Woodlesford, married, as his second wife, Sarah, the daughter of Richard Willie, a stone-mason at Oulton; and their first child was the individual who afterwards rendered the family illustrious. For the first elements even of classical learning he is said to have been indebted to his mother, who is described as a woman of an excellent understanding. After having been a day-scholar at the neighbouring hamlet of Methley, he was sent to the grammar-school of Wakefield. On the 24th of May 1676, he was entered as a subsizar of St John's College, Cambridge. Having continued at college for upwards of two years, he became a scholar on the foundation of Dr Dowman; and at the expiration of the third year, he succeeded to one of the Yorkshire scholarships founded by Sir Marmaduke Constable. At the regular period he took the degree of A.B. From a fellowship of his college he was excluded by a provision in the statutes, which prohibited more than two fellows from being chosen from the same county. He was however appointed head master of the grammar-school of Spalding in Lincolnshire. On attaining the age of majority, he disposed of his interest in the Oulton property to his brother; and the money thus procured he devoted to the purchase of books. After an interval of about twelve months, he became domestic tutor to the son of Dr Stillingfleet, dean of St Paul's. In July 1683 he took the degree of A.M. Soon after the Revolution, Stillingfleet, now Bishop of Worcester, sent his son James to Oxford, where both he and his tutor became members of Wadham College.

He now projected editions of Greek grammarians and of Latin poets; he indeed pursued an arduous course of study, which gradually prepared him for any department of classical enterprise. The plan which he contemplated as the foundation of his fame was a complete collection of the fragments of the Greek poets. This plan he never executed; but of his competency for such a task he has left sufficient evidence in his collection of the fragments of Callimachus, afterwards communicated to Grævius. At the suggestion, as is supposed, of the very learned Bishop Lloyd, he undertook the stupendous task of publishing a complete edition of the Greek lexicographers: but the general design, which was too vast to be properly executed by one individual, appears to have been abandoned after a short interval; and it is much to be regretted that he did not at least publish an edition of Hesychius, an author in whom he professes to have made upwards of five thousand corrections. Of his familiarity with this lexicographer he exhibited a sufficient specimen in his earliest publication, his *Epistola ad. cl. v. Joannem Millium, S. T. P.* subjoined to Dr Hody's edition of the chronicle of Joannes Malela Antiochenus, which was printed at Oxford in the year 1691. By the publication of this little work, at the age of twenty-nine, he laid the foundation of a high reputation among men of learning.

His next appearance before the public was in the character of a divine. He had received deacon's orders from Compton, bishop of London, in the year 1690, and soon afterwards had been appointed one of the bishop of Worcester's chaplains. In 1692 the four trustees, one of whom was Evelyn, honoured him with the first nomination to Boyle's lectureship. The eight discourses which he preached in consequence of this appointment, embrace a confutation of atheism: they are in a great degree directed against the principles of Hobbes and Spinoza, which have too certain a tendency to atheism, although they are not professedly atheistical; and Bentley claims the merit of having been the first to display the discoveries of Newton in a popular form, and to explain their irresistible force in the proof of a Deity. His reputation was greatly augmented by the publication of his lectures; of which the sixth edition, including other three discourses, was printed at Cambridge in the year 1735. The lectures were translated into Latin by Jablonski, who was himself a writer of distinguished learning. Nor did the merit of the author remain without its reward: in 1692, soon after he had taken priest's orders, he obtained a prebend in the cathedral of Worcester; and in the course of the following year, he succeeded Henry de Justel as keeper of the king's library. In 1694 he was again appointed to preach the Boyle lectures, and he then selected as their subject the defence of Christianity against infidels; but this series of discourses his friends could not prevail upon him to publish, nor has it been ascertained that the manuscript is still preserved. In the following year, his patron the bishop of Worcester gave him the rectory of Hartlebury, to be held till his old pupil should arrive at the canonical age. The interest of the same worthy prelate had, about this period, procured him the nomination of chaplain in ordinary to the king. It must be recorded as an instance of scandalous ingratitude, that, when the bishop's grandson Benjamin Stillingfleet was left an orphan, and was sent in the humble capacity of a sizar to Trinity College, Bentley refused to give him a fellowship, and preferred several competitors of inferior attainments. At the beginning of the year 1696, he ceased to reside in the bishop's house in Park-street, Westminster, and took possession of the librarian's apartments in St James's Palace; and in the month of July he took the degree of D. D. at Cambridge.

Bentley.

Dr Bentley was now making a rapid approach to the full height of his literary fame; and his principal efforts were more the result of accidental excitements than of his own deliberate plans. In the year 1692 Sir William Temple, one of the most fashionable writers of the age, had published an *Essay upon the Ancient and Modern Learning*, in which he strenuously opposed the opinions of Fontenelle and Perrault, who had given a very decided preference to the moderns. But his own learning was inadequate to so serious an undertaking, and his commendation of the ancients is therefore of very doubtful value. Of his mode of estimating the merit of modern writers, it has been justly mentioned as a curious specimen, that the names of Shakspeare, Milton, Bacon, and Newton, have not found a place in his essay. In confirmation of his position, that the oldest books extant are still the best of their kind, he produces the Fables of Æsop and the Epistles of Phalaris, which he believed to be the most ancient pieces of prose written by profane authors. And in reference to the work which bears the name of the ancient tyrant, he is pleased to remark, "I think he must have little skill in painting, that cannot find out this to be an original." The attention thus directed to Phalaris seems to have suggested the expediency of a new edition; and the dean of Christ Church, Dr Aldrich, committed the task of editing his epistles to the Honourable Charles Boyle, brother to the earl of Orrery; a young gentleman of pleasing manners, and of a relish for learning creditable to his age and station. On his admission at Christ Church, he was placed under the tuition of Atterbury, who, if not a profound, was at least an elegant scholar. In his editorial labours he was aided by his private tutor John Freind,

Bentley. then one of the junior students, and afterwards a physician of no small celebrity. The editor of Phalaris wished to procure a collation of a manuscript belonging to the royal library; but, instead of making any direct application to the librarian, he had recourse to the agency of Thomas Bennet, a bookseller in St Paul's Churchyard, who appears to have executed his commission with no extraordinary degree of zeal or dispatch. In order to conceal his own negligence, he is supposed to have misrepresented the entire transaction to his employers at Oxford; and the preface to Mr Boyle's edition of Phalaris, published in the year 1695, contains a sarcastic reflection on Bentley for his want of civility. To the editor he immediately addressed a letter, explaining the real circumstances of the case; but instead of receiving an answer in the spirit of conciliation, he was given to understand that he might seek redress in any way he pleased. It is however dangerous to take a lion by the beard.

Dr Wotton, his friend and fellow-collegian, had recently engaged in the controversy respecting the comparative excellence of the ancients and moderns; and after he had sent to the press his *Reflections upon Ancient and Modern Learning*, Bentley happened to state, in the course of their conversation, and in reference to the extravagant commendation bestowed by Sir William Temple, "that the Epistles of Phalaris are spurious, and that we have nothing now extant of Æsop's own composition." This casual remark was converted into a promise that he would furnish a written statement of his opinion, to be added to the second edition of the Reflections. To the second edition, which appeared in 1697, was accordingly subjoined Dr Bentley's "Dissertation upon the Epistles of Phalaris, Themistocles, Socrates, Euripides, and others, and the Fables of Æsop." Of the spuriousness of all the productions thus enumerated, his demonstration is by every competent judge admitted to be very complete; but his most vigorous efforts are directed against the Epistles of Phalaris. After having produced the chronological proofs of their spurious origin, he considers the language, and next the matter, of the Epistles, and concludes with an argument drawn from what he calls their late appearance in the world. This work certainly betrays some symptoms of hasty composition; but the number of mistakes or oversights which his adversaries were capable of detecting was surprisingly small. The entire disputation is managed with great learning, and with sagacity not inferior to his learning. The contemptuous strain of Bentley's animadversion excited great indignation in the members of Christ Church; and an answer was speedily prepared by a confederacy, which, however deficient in critical learning, was by no means deficient in self-esteem. The leaders were Francis Atterbury and George Smalridge, both of whom were afterwards elevated to the episcopal bench: Robert Freind, afterwards head-master of Westminster school, his brother John Freind, and Anthony Alsop, all students of Christ Church, are generally understood to have lent their aid. The share of Atterbury is sufficiently ascertained from a passage in one of his letters to Boyle, in which he reminds him that, "in writing more than half the book, in reviewing a good part of the rest, and in transcribing the whole, half a year of his life had passed away."[1]

The motley production, bearing the title of "Dr Bentley's Dissertations on the Epistles of Phalaris and the Fables of Æsop, examined by the Honourable Charles Boyle, Esq." was published in the year 1698; and in the following year Bentley published "A Dissertation upon the Epistles of Phalaris, with an Answer to the Objections of the Honourable Charles Boyle, Esquire." They are both Bentley. in the octavo form; the former extending to about 300 pages, and the latter to 655. The wits of Christ Church were overwhelmed with an immense mass of learning, and that so well digested, and animated with so much spirit, that it would be difficult to mention many critical works worthy of being compared with Bentley's Dissertation. His learning was superior, immeasurably superior, to that of the Oxford combination; nor did they find him inferior in the use of their own weapons of wit and sarcasm. Bentley's wit is not without a certain tinge of rusticity, but it is nevertheless full of poignancy. He everywhere maintains an air of undaunted confidence, and he doubtless felt for his adversaries that contempt which he so strongly expressed. As he has incidentally discussed many different topics of classical erudition, his work is interesting and valuable even to those who may not deem the principal question of much importance. The extent of his learning, and the dexterity with which he applies it to every subject that presents itself, are not more conspicuous than the intuitive sagacity of his conjectural emendations.

This controversy produced an ample number of tracts, which are chiefly anonymous, and have little intrinsic merit. On the side of Bentley's nominal antagonist, prejudice, as well as fashion, was strongly arrayed. It is not a little curious to read the following couplet in Garth's Dispensary, and to compare the partial estimate of contemporaries with the mature decision of posterity.

> So diamonds take a lustre from their foil
> And to a Bentley 'tis we owe a Boyle.

But it is only by himself that an author can be written down. A confederacy of wit and fashion may for a certain time succeed in exalting one writer above, and in depressing another below, his proper standard; but as no large community of men is without a latent sense of justice, no attempt of this nature can be attended with ultimate success; nor is it more certain that heavy or light bodies will sink or float according to their specific gravity, than that the reputation of good and bad writers will finally maintain some perceptible relation to their actual desert.

When Bentley produced this singular work, he was in the thirty-eighth year of his age. His literary merit, though not duly appreciated by the public, was well known to the most competent judges; and on the promotion of Dr Montague to the deanery of Durham, he was recommended to the vacant office of master of Trinity College, Cambridge. To this office he was admitted on the first of February 1700, and was thus placed in a situation of dignity and emolument; but his appointment was unpopular from the beginning, and his administration was marked by a series of the most flagrant acts of rapacity, injustice, and oppression. On the 4th of January 1701, he married Joanna the daughter of Sir John Bernard, Bart. of Brampton in the county of Huntingdon. In the course of the same year, Bishop Patrick bestowed upon him the archdeaconry of Ely, which, being endowed with the two livings of Haddenham and Wilburton, was an office of emolument as well as dignity. The residue of his ecclesiastical history we shall compress within the compass of a few sentences. His stall at Worcester he had resigned in 1700. In 1709 he was an unsuccessful candidate for the bishopric of Chichester. In 1717 he was elected regius professor of divinity. In 1724 he refused the bishopric of Bristol, and in 1730 the deanery of Lin-

[1] Atterbury's *Epistolary Correspondence*, vol. ii. p. 21.

Bentley. coln. If he had not disgraced himself by the indecent violence of his conduct, he would in all probability have attained to one of the highest stations in the church; but the history of his proceedings at Cambridge presents a sickening detail, which is happily unparalleled in the academical annals of the united kingdom. His great prosperity, operating upon the native arrogance of his disposition, and unattended by the salutary restraint of religious feeling, seems to have produced a total disregard of every consideration except those of his own power and interest. His government of Trinity College was that of an unprincipled despot. In the course of three years, he had no fewer than six lawsuits before the court of king's bench; and these animosities and contentions, injurious to the university, and scandalous to the church, commenced in the vigour of his manhood, and were only terminated with his long life.

Some of the fellows of the college made repeated and strenuous attempts to procure his removal from the office of master. Their first petition, dated in February 1709–10, was addressed to Dr Moore, bishop of Ely, as visitor of Trinity College; and among the thirty fellows who subscribed it was the celebrated Conyers Middleton, who afterwards proved the most formidable of his literary antagonists. After many proceedings of a preliminary nature, the cause at length obtained a hearing at Ely House in the year 1714, and was before the court for the period of six weeks. The visitor came to the conclusion that the charges of wasting the goods and violating the statutes of the college had been sufficiently established; and he accordingly directed a sentence of ejectment from the mastership to be prepared in due form; but having caught cold in consequence of his long sittings in the hall, he was seized with an illness which terminated fatally before judgment could be pronounced. To his successor in the see of Ely, Dr Fleetwood, fresh articles of accusation were speedily presented by one of the fellows, Edmond Miller, serjeant at law, subscribed by him "in the name and behalf of many of the fellows;" but the bishop declined to take cognizance of the cause, and a petition, subscribed by nineteen fellows, was in 1716 presented to the king. This attempt likewise proved ineffectual; and Dr Greene having succeeded to the bishopric of Ely, a petition was presented to him in the year 1729. The promoter in this suit was Robert Johnson, B. D., one of the fellows; and the articles of accusation, which are sixty-four in number, embrace almost all the material events in the history of the college for the space of eighteen years.[1] The final decision of the visitor was preceded by much litigation in the king's bench and house of lords; but at length, on the 27th of April 1734, he pronounced sentence of deprivation against the master, for dilapidating the goods and violating the statutes of the college. Bentley's usual intrepidity and address did not forsake him on so critical an occasion; and he placed his chief reliance on the very defective provision of the fortieth statute, according to which a master, convicted before the visitor of any of the greater offences there specified, is immediately to be deprived by the vice-master of the college. Soon after the sentence had been pronounced, his devoted adherent Dr Walker was appointed to this office. Notwithstanding various applications to the court of king's bench, the sentence was never carried into execution; and Bishop Greene dying in the year 1738, the course of nature, and not of law, put a period to the contest. In this protracted and complicated suit the master's share of the expenses amounted to no less than four thousand pounds; and this sum he had no scruple in drawing from the funds of the college. Bentley.

In addition to these disgraceful contentions with his own college, he engaged in a violent contention with the university. During the royal visit of 1717, several doctors of divinity were created by mandate; and on the performance of the ceremony by Dr Bentley as regius professor, he made an unauthorized demand of four guineas from each candidate. One of these was Dr Middleton, who paid the fee, and afterwards brought an action for its recovery in the vice-chancellor's court. The professor was convicted of contempt, and was deprived of all his degrees, which were only restored in consequence of a mandamus from the king's bench.

Soon after the first petition against him had been presented to the bishop of Ely, he had sufficient energy of mind to compose one of his most remarkable works, his *Emendationes in Menandri et Philemonis Reliquias*, in which Le Clerc is treated with the most caustic severity. Under the borrowed name of Phileleutherus Lipsiensis, they were committed to the press by Burman,[2] who was a willing agent on such an occasion. His next literary enterprise was his famous edition of Horace, which was printed at Cambridge, and was completed in the year 1711. In 1713, Anthony Collins published his *Discourse of Free-thinking;* and his work was followed by several answers, but the most effective of these was Dr Bentley's "Remarks upon a late Discourse of Free-thinking, in a Letter to F. H. D. D., by Phileleutherus Lipsiensis." The friend thus designated in the title-page was Francis Hare, D. D., who was then dean of Worcester, and was afterwards successively bishop of St Asaph and Chichester. Collins's superficial learning was exposed with unrelenting severity, and his arrogance was repelled by the most arrogant of mankind. Even the most pious may sometimes do well to be angry; but when a religion, breathing peace and gentleness, is defended in the worst spirit of its enemies, the cause of truth is but imperfectly promoted. Bentley's remarks were however written with much ability, and were received with much applause; nor did he leave his adversary the same power of imposing on the ignorant and unwary. In 1720 he issued proposals for publishing a critical edition of the Greek Testament, which were attacked by Dr Middleton with much ability, and perhaps with virulence not inferior to his ability. There is little or no reason to believe that his scheme was defeated by this angry exposure: he long afterwards reverted to the plan of such an edition; nor were his nerves so infirm, or his mind so unaccustomed to the utmost bitterness of invective, as to render it probable that he could be deterred by any literary opposition, however formidable. His edition of Terence and of Phædrus was published at Cambridge in 1726. At the suggestion of Queen Caroline, he afterwards undertook to prepare an edition of Milton's Paradise Lost;[3] a task for which he was neither qualified by the elegance of his taste nor by the course of his previous studies; and, of all his literary enterprises, this was the most injudicious and most unsuccessful. It greatly contributed to impair his general reputation as a critic; for many readers, unprepared to judge of his violent distortions in the text of Horace, were sufficiently prepared to judge of his violent distortions in the text of Milton; and certainly those who were left to form an opinion of his literary merits from the mere inspection of his lucubrations on the English poet,

[1] See Bishop Monk's *Life of Richard Bentley, D. D.* Lond. 1830, 4to.

[2] *Trajecti ad Rhenum*, 1710, 8vo.

[3] Lond. 1732, 4to.

could not but be astonished at his former renown. He resorts to the extraordinary device of introducing an imaginary editor, whom he chooses to represent as having not merely committed many unintentional errors, but even as having made various additions according to his own judgment or caprice. Another labour of his declining years was a projected edition of Homer; and it is deeply to be regretted that he did not relinquish more unprofitable pursuits, and devote himself to an undertaking so worthy of his name and reputation; but his literary projects were numerous, and his thoughts must often have been distracted by the perpetual succession of his quarrels and contentions. One object to which he directed much of his attention was the poet's versification, of which he proposed to effect a general restoration, derived from ancient manuscripts, the examination of the numerous quotations dispersed in ancient writers, and, beyond all other sources, the systematic insertion of the Æolic digamma. His edition of Manilius, which he had prepared about forty-five years before, was published in 1739, under the superintendence of his nephew, Richard Bentley, D.D.

The death of Bishop Greene, in 1738, had relieved him from the hazard of deposition; and he continued to enjoy his offices till 1742, when he died on the 14th of July, after having completed the eightieth year of his age. His wife had died two years before. His only surviving son, who bore the same name, was educated to no profession; it was one of the many scandalous acts of the father's administration, that the son was elected a fellow of Trinity College at the age of fifteen. The younger Bentley, who was considered as a man of excellent talents, was the author of several works, but is best remembered as the friend of Gray. When his father once found him reading a novel, "Why," said he, "read a book which you cannot quote?" The doctor's two daughters, Elizabeth and Joanna, were both married: the latter was the wife of Denison Cumberland, who was grandson to the learned bishop of Peterborough, and who himself became bishop of Kilmore, and the father of Richard Cumberland, one of the most eminent of the recent English dramatists.

The principal works published during the author's lifetime have already been enumerated; but we must not neglect to mention the posthumous collection entitled "Richardi Bentleii et doctorum Virorum Epistolæ partim mutuæ. Accedit Richardi Dawesii ad Joannem Taylorum Epistola singularis." Lond. 1807, 4to. Of this splendid volume two hundred copies were printed at the expense of the late Dr Burney, not with any view to publication, but as presents from the munificent editor. An enlarged edition of the same collection has very recently been printed in a more accessible form: "Richardi Bentleii et doctorum Virorum Epistolæ partim mutuæ: ex editione Londinensi Caroli Burneii repetiit, novisque additamentis, et Godofredi Hermanni Dissertatione de Bentleio ejusque Ed. Terentii, auxit Frid. Traug. Friedemann." Lipsiæ, 1825, 8vo. The Rev. J. Wordsworth has published an edition of Bentley's Letters, with notes, in 2 vols. 8vo; and a complete edition of his works by the Rev. A. Dyce, has appeared in 3 vols. 8vo. (D. I.)

BENZOIC ACID, BENZAMIDE, BENZINE, BENZYLE. See CHEMISTRY.

BENZOIN, or BENJAMIN, a concrete resinous juice which exudes from incisions made in the *Styrax Benzoin*, a tree of Sumatra, &c. It is a combination of resin and benzoic acid, and is much used by the perfumer on account of its fragrance.

BERAR. See NAGPORE.

BERBERIS, a genus of plants belonging to the nat. ord. of Berberidia, of which the best known is *B. vulgaris*, common barberry. The fruit of *B. aristata* and *B. Nepalensis* is prepared in India like raisins.

BERBICE. The colony of Berbice is described in the article GUIANA, BRITISH.

BERBICE, a river in British Guiana. Lat. at its mouth, 6. 20. N. Long. 57. 11 W. It runs from south to north, and discharges itself into the Atlantic Ocean. The coast on each side of it forms a bay at its entrance, which is nearly a mile in width, having a small island in the middle, called Crab Island, from the number of land-crabs on it. Outside the entrance of the river there is a bar of sand, over which at high tide there is seldom more than eighteen feet of water; but within, the water is of sufficient depth, and the river is navigable for ships of burden 200 miles from its mouth. On account of the bar, however, few vessels anchor here, preferring the port of Demerara.

BERCHEM, or BERGHEM, NICHOLAS, an eminent painter, born at Haerlem in 1624. He received instruction from several distinguished masters; and it was no small addition to their fame that Berchem was their pupil. The pictures of cattle and figures by this master are highly esteemed; and many of them have been finely engraved by John Visscher, an eminent artist in his own line. The distinguishing characters of Berchem's pictures are, the breadth and just distribution of the lights, the grandeur of his masses of shadow, the nature and simplicity in the attitudes of his figures, the just gradation of distances, brilliancy and transparency of colouring, the correctness and true perspective of his design, and the elegance of his composition. He died in 1683.

BERCHETT, PETER, an eminent historical painter, was born in France in 1659, and at the age of eighteen was employed in the royal palaces. He came to England in 1681, to work under Rambour, a French painter of architecture; but after staying a year, he returned to Marli. He revisited this country, however, and was employed by King William to decorate the palace then building at Loo, which occupied him fifteen months. Coming to England a third time, he painted the ceiling of the chapel of Trinity College, Oxford, the staircase at the Duke of Schomberg's in Pall-mall, the summer-house at Ranelagh, and various other works. Towards the close of his life he retired to Marybone, and painted only small pieces of fabulous history. He died there in January 1720.

BERCHTESGADEN, or BERCHTOLSGADEN, a small town, most beautifully situated on the south-eastern confines of Bavaria, and long celebrated for its extensive mines of rock-salt. Fresh water is brought into the mine, which, after acting a certain time upon the salt rock, becomes brine, and in that state is run off in pipes to a reservoir in the vicinity; whence by the aid of two celebrated water column engines, constructed by Reichenbach of Munich, it is raised 1500 feet, and conducted to Traunstein and Rosenheim, about forty miles farther inland. The town contains three old churches, and some good houses. Its inhabitants, amounting to about 1600, are principally employed in the mines and the manufacture of salt. Some few also are engaged in making toys and small articles of stag and chamois horns. Its vicinity comprehends the most picturesque portion of Bavaria; the snow-capped peaks of the Watzman towering over it to the height of 7000 feet, while the Königssee at its foot, one of the wildest lakes among the Alps, is not exceeded by any in beauty and sublimity. The small red trout of the Königssee, called by the common people *schwartzreitic*, are highly prized; and no portion of the Alpine range is better supplied with game, particularly the stag, the chamois, and the steinbok or ibex, an animal elsewhere almost extinct.

BERDASH, a name formerly used in England for a certain kind of neck-dress. The maker or vender of such articles was called a *berdasher*, whence our word *haberdasher*.

BERECYNTHIA, a surname of Cybele, derived from Mount Berecynthus, where she was worshipped.

BERENGARIANISM, a name applied by ancient ecclesiastical writers to the doctrine of those who deny the actual presence of the body and blood of Christ in the eucharist

Berengario || Berenice.

The denomination took its rise from Berengarius, archdeacon of the church of St Mary at Angers, who in the year 1045 publicly maintained the opinion of John Scotus that the bread and wine, even after consecration, do not become the true body and blood of our Lord, but only a figure and sign thereof; which is the distinctive feature of the Protestant doctrine. Berengarius died in 1088.

BERENGARIO, Giacomo, a celebrated anatomist and physician, born at Carpi, near Modena. He was a professor in the university of Bologna from the year 1502 until 1527, and may be considered as one of the chief restorers of anatomy, which he found in a very low state. He made several important discoveries in anatomy, and communicated the result of his researches in his various works. He employed mercurial frictions largely in his practice; but he was not the first who employed mercury, as is often erroneously reported.

BERENICE, daughter of Ptolemy Auletes king of Egypt, and eldest sister of the famous Cleopatra, ascended the throne on the deposition of her father by the Alexandrians, B.C. 58. Berenice, in order to support her authority, married Seleucus the brother of Antiochus XIII. king of Syria; but soon growing weary of her choice, she caused Seleucus to be put to death. She then married Archelaus, whom Pompey had made king of Comana in Pontus; but a few months afterwards Ptolemy was reinstated by the Romans, and Berenice and Archelaus were slain, B.C. 55. (Liv. *Epit.* 109; Dion Cass. xxxix. 55–58.)

Berenice, wife of Ptolemy Euergetes king of Egypt, cut off her hair in pursuance of a vow, and consecrated it in the temple of Venus. This deposit having disappeared, Conon the mathematician, in compliment to the queen, declared that her locks had been conveyed to heaven, and composed the constellation which to this day is called *Coma Berenices*. Callimachus celebrated the hair of Berenice in a poem, of which only a few lines are extant: it still exists however in the translation of Catullus.

Berenice, daughter of Costobarus, and of Salome the sister of Herod the Great, was first married to Aristobulus, son of the same Herod and of Mariamne. The cruel Herod having put his son to death, Berenice married a second time; and again became a widow, but whether or not by similar means it is not said. She accompanied her mother to Rome, where she enjoyed the favour of Augustus, and the friendship of Antonia the wife of Drusus, which ultimately proved of great service to her son Agrippa.

Berenice, or *Beronice*, grand-daughter of the preceding, and daughter of Agrippa I. king of Judæa, acquired a discreditable celebrity by her amours. She was betrothed to one Marcus, but he died before the marriage was consummated. Soon after she married her uncle Herod, who, at the desire of Agrippa, his brother and father-in-law, was created king of Chalcis by the Emperor Claudius. On the death of her husband, A.D. 48, she lived for a considerable time with her brother Agrippa, with whom it was rumoured that she committed incest. To avoid this scandal, she offered herself in marriage to Polemon, king of Cilicia, provided he would change his religion. He accepted her offer, was circumcised, and married her. But Berenice soon left him, and returned to Agrippa, with whom she was still living when St Paul appeared before him at Cæsarea, A.D. 62. She seconded her brother in his attempt to prevent the desolation of Judæa, and at the risk of her own life interceded with Florus to spare her miserable countrymen. This artful woman drew Titus into her snares; but the murmurs of the Roman people opposed an obstacle to their contemplated marriage, and she became the concubine of the emperor.

Berenice, the name of several cities, particularly of a celebrated seaport in the Sinus Arabicus, near Ras-Benas. Lat. 23. 50. N. Long. 35, 34. E.

Beresina || Bergamo.

BERESINA, or Berezina, a river of Russia, rising in the north of the province of Minsk, and falling into the Dnieper, after a course of 200 miles. It is connected with the Dwina by a canal, which thus establishes a communication between the Black Sea and the Baltic. The passage of the Beresina is celebrated as one of the most disastrous events in the retreat of Napoleon from Moscow. See France.

BEREWICHA, or Berewica, in our old writers, denotes a village or hamlet belonging to a town or manor. The word frequently occurs in Doomsday-book: e.g. *Istæ sunt berewichæ ejusdem manerii.*

BEREZOV, a Russian town of Siberia, on the river Soswa, 18 miles from its confluence with the Obi. It contains three churches and a chapel. Its northern situation forbids all kind of agricultural industry: the inhabitants subsist by hunting and fishing; and the furs which they procure are exchanged with the Russian merchants for such articles as they require. They also supply Tobolsk and other places on the Irtisch with dried fish in summer, and with frozen fish during winter. The inhabitants are chiefly Cossacks, and are much addicted to drinking. This town has afforded a place of exile to several distinguished statesmen. Berezov is 400 miles N.N.W. of Tobolsk. Lat. 63. 30. N. Long. 65. 55. E.

BEREZOVSKOI, a town and fortress of Asiatic Russia, in the government of Orenburg, on the river Oural. In the vicinity are several productive gold mines.

BERG, formerly a duchy of Germany, on the right bank of the Rhine, and bounded on the north by the duchy of Cleves, on the east by the county of Mark and the duchy of Westphalia, and on the south by the Westerwald. It contained about 1188 square miles. It was formerly subject to the elector palatine, but since 1815 has been included in the grand duchy of the Lower Rhine. The duchy of Berg was taken from Bavaria in 1806, and bestowed upon Murat, afterwards king of Naples, who derived from it the title of Grand Duke of Berg. It is a populous and flourishing district, very fruitful along the Rhine, but mountainous and woody towards the county of Mark. The principal rivers, besides the Rhine, are the Wipper, Agger, and Sieg.

BERGA (ancient *Bergium*), a town of Spain, province of Barcelona, in a mountainous district, 14 leagues N.N.W. of the city of Barcelona. It has a garrison, several churches and convents, and a hospital founded A.D. 1290. Pop. 6999, principally engaged in cotton weaving. It is a place of considerable industry and commerce.

BERGAMO, a province, or, as it is usually termed, a delegation, of the Austrian kingdom of Lombardy. It is bounded on the north by the delegation of Valtelino, on the east by those of Tyrol and Brescia, on the south by Cremona, Lodi, and Crema, and on the west by Milan and Como. The extent is about 1615 square miles, or 1,033,600 acres. It is divided into 18 districts, and these into 372 communes or parishes, and comprehends one city, 22 market-towns, and 333 villages. Pop. (1851) 378,123.

The whole northern part of the delegation is filled with the Alpine mountains, whose spurs extend to the capital; but the southern division forms part of the plain of Lombardy. The country is deficient in corn; but the surplus of cattle, with iron from the mines in the northern part, and the silk produced in the southern, are exchanged for the grain required by the inhabitants. There are manufactures of silk, and of woollen goods. There are some quarries of marble, and of other kinds of stone from which grindstones and whetstones are cut and prepared for export ation.

The capital of the province is the city of the same name, laid out on several elevations in the form of an amphitheatre, surrounded with walls and ditches, and defended by two insignificant forts. It is the see of a bishop, and the seat of the provincial courts of law; and comprehends, besides the

Bergamo ‖ Bergen-op-Zoom.

cathedral, fourteen churches, four hospitals, six orphan-houses, a number of monasteries and nunneries, town-hall, college, athenæum, public library, &c. Its principal manufactures are silk, woollen, cotton, and linen goods, hardware, &c. The largest fair in northern Italy is annually held here in the month of August, and continues for a fortnight. Pop. 32,000. Bernardo Tasso, the father of the illustrious Torquato was born here in 1493.

Bergamo (the ancient *Pergamus*), a city of Anatolia, on the river Mendere-Chai (ancient *Simois*), in Lat. 39. 4. N. Long. 27. 12. E. It is still a place of some importance, with a mixed population, estimated at 14,000. The houses are mostly small and mean, but it still preserves many remains of its former magnificence. See Pergamus.

BERGAMOT, a species of citron, *Citrus limetta*, distinguished from the orange and lemon by having wingless leaf-stalks. It is a native of the south of Europe, and is produced abundantly in the neighbourhood of Nice. The fruit has a delicious taste and smell, and its essential oil is highly esteemed as a perfume. The essence of bergamot is also called *essenzia di cedro*. It is extracted from the yellow rind of the fruit by cutting it in small pieces, and expressing the oil, or by distilling it from water. One hundred bergamots of Nice yield, by expression, 2½ ounces of oil.

Bergamot is also the denomination of a coarse tapestry, manufactured with flocks of silk, wool, cotton, hemp, cow's or goat's hair, and supposed to have been invented at Bergamo in Italy.

BERGEN, a fortified city and seaport of Norway, capital of the province of South Bergen. It is situated at the head of a deep bay, on the Atlantic, has a fine harbour with two good entrances, and is surrounded by hills, some of which attain the height of 2000 feet. The appearance of the town is picturesque; it rises in the form of an amphitheatre, and is generally well built, though some of the houses are of wood. Pop. (1845) 25,611, employed chiefly in the fishery. The export trade, which consists of stock-fish, lobsters, timber, rock-moss, skins, horns, fish-roes, herrings, oil, &c., is chiefly carried on with the northern countries of Europe. In 1842 the number of ships that entered the port was 1078, with a tonnage of 80,545.

Bergen contains a cathedral, several churches and hospitals, a national museum, diocesan college, naval academy, several public libraries, various charitable institutions, and a theatre. It is the seat of a tribunal of secondary jurisdiction, and of one of the three public treasuries of Norway. This city was founded in the eleventh century by one of the kings of Norway, and joined at an early period the Hanseatic League. Long. 5. 20. 33. E. Lat. 60. 24. N.

Bergen, a town of Prussian Pomerania, circle of Stralsund, and capital of the Isle of Rügen. It contains a castle, a court of justice, and a convent for noble ladies; and has some woollen manufactures. Pop. 3024.

BERGEN-OP-ZOOM, a maritime town of Holland, province of North Brabant, situated on the river Zoom, near its confluence with the Scheldt. The houses are well built, the market-places and squares handsome and spacious. It contains a town-house, grammar-school, a school of design and architecture, and has numerous earthenware manufactures, besides a considerable trade in anchovies. Pop. (1846) 8000. It is so strongly fortified, both by nature and art, as to be deemed almost impregnable. The fortifications are reckoned the masterpiece of the celebrated Cœhorn, the rival and contemporary of Vauban. In 1586 it was unsuccessfully besieged by the famous Duke of Parma; and afterwards, in 1622, it defied the utmost attempts of Spinola, who was forced to abandon the enterprize, after a siege of ten weeks, with the loss of 12,000 men. In 1747, however, it was taken by stratagem by the French under Count Lowendahl, and in 1814 was again rendered famous by an unsuccessful attempt of the British troops under Lord Lynedoch, then Sir Thomas Graham, to take it by a *coup de main* on the night of the 8th of March. The troops destined for this attack amounted to 3950, and were divided into four columns, two of which, after most desperate efforts, succeeded in establishing themselves on the ramparts; but the other two were completely unsuccessful, and driven back with prodigious loss. Above two-thirds of the whole assailing force were killed, wounded, or taken in this attempt. A marble tablet recording the names of the brave men who fell on the occasion, has been erected in the church by the British officers. The place, however, was given up at the treaty of peace in May 1814. Bergen-op-Zoom is fifteen miles north of Antwerp, and twenty-two W.S.W. of Breda.

Bergerac ‖ Bergman.

BERGERAC, the capital of an arrondissement of the same name, in the department of Dordogne, in France. It is situated in a fertile plain, 27 miles S.S.W. of Perigueux, and on the right bank of the Dordogne, which is here crossed by a magnificent bridge of five arches. The town is well built, and has a communal college, tribunals of primary jurisdiction and commerce, a public library, and manufactures of paper, iron and copper ware, serges, hats, hosiery, leather, &c. It has an active trade with Bordeaux and Libourne in wines, grain, &c. The fortifications by which it was once surrounded were demolished in 1621, by order of Louis XIII. Pop. (1851) 9971. The arrondissement contains 13 cantons and 174 communes: pop. (1851) 118,247.

BERGHEM. See Berchem.

BERGMAN, Sir Torbern, a celebrated chemist and natural philosopher, born in 1735, at Catharineberg, in West Gothland. His father was receiver-general of the finances, and had destined him to the same employment; but nature had designed him for the sciences. His first studies were confined to the mathematics and physics; and the efforts that were made to divert him from science having proved ineffectual, he was sent to Upsal, with permission to follow the bent of his inclination. The fame of Linnæus at that time filled the whole kingdom; and Bergman was attracted by the splendour of his renown. He applied himself at first to the study of insects, and made several ingenious researches into their history, particularly into that of the genus of *tenthredo*, so much preyed on by the larvæ of the ichneumons, which nestle in their bowels. He discovered that the leech was oviparous; and that the *coccus aquaticus* is the egg of this animal, from which issue ten or twelve young. Linnæus, who had at first denied this fact, was struck with astonishment when he saw it proved. *Vidi et obstupui*, were the words he wrote at the foot of the memoir when he gave it his sanction. Bergman not only distinguished himself as an astronomer, naturalist, and geometrician: when the chair of chemistry and mineralogy became vacant by the resignation of Wallerius, he appeared as a competitor; and without having before this period paid any particular attention to chemistry, he published an able memoir on the preparation of alum. His dissertation was warmly attacked in the periodical publications, and Wallerius himself criticized it without reserve. The Prince Gustavus, afterwards king of Sweden, and then chancellor of the university, took cognizance of the affair; and after consulting two persons most competent to give him advice, and whose testimony went in favour of Bergman, he addressed a memorial, written with his own hand, in answer to all the grievances alleged against the candidate, to the consistory of the university and to the senate, who in consequence confirmed the wishes of his royal highness.

Bergman had now a hard duty to fulfil. He had to satisfy the hopes which had been conceived of him, to fill the place of Wallerius, and to put envy to silence. Accustomed to precision, he applied himself to experiments without paying any attention to theories; and he was the first to introduce

Bergmote || Berkeley.

into chemistry that process of analysis which is the essential antecedent of scientific system.

The continual application which Bergman bestowed on his studies proved ruinous to his health. He died in June 1784. The university of Upsal paid the most distinguished honours to his memory; and the academy of Stockholm consecrated to him a medal to perpetuate the recollection of his merits. His *Physical and Chemical Essays* were translated by Dr Edmund Cullen, and published in 2 vols. 8vo, in 1788; to which a third volume was added, published at Edinburgh in 1791.

BERGMOTE (Saxon *beorg*, a hill, and *mote*, a meeting), a term still applied to an assembly or court held upon a hill in Derbyshire for deciding controversies among the miners.

BERGOMUM, in *Ancient Geography*, a town of the Transpadana, built by the Gauls on their incursions into Italy; now *Bergamo*, in Lombardy.

BERIA, BERIE, BERRY, signifies a large open field; and hence those cities and towns in England, the names of which end with that word, are built on plain and open places, and do not derive their names from boroughs, as Sir Henry Spelman imagines. Most of our glossographers, in the names of places, have confounded the word *berie* with that of *bury* and *borough*, as if it had been the appellative of ancient towns; whereas the true sense of the word *berie* is a flat wide champaign, as is proved from sufficient authorities by Dufresne, who observes that *Beria Sancti Edmundi*, mentioned by Matthew Paris, 1174, is not to be taken for the town, but for the adjoining plain.

BERING, VITUS, of Copenhagen, a Latin lyric poet and historian, who flourished about 1650.

BERJA, a town and *partido* of Spain, province of Almeria, pleasantly situated in a valley of the Sierra de Gador, in the centre of the mining district, nine leagues from Almeria. It is well built, and contains one church, several monasteries, and three primary schools. Pop. 8709, chiefly employed in agriculture and mining. The principal traffic consists in the conveyance of the lead to the neighbouring port of Adra. One mine in the neighbourhood yielded from 1820 to 1841, 3,000,000 arrobas of ore.

BERKELEY, GEORGE, celebrated as the bishop of Cloyne, by which title he is almost as often referred to in philosophical writings as by his family name, was born at Kilcrin, near Thomastown, in the county of Kilkenny, and was the eldest son of William Berkeley, a cadet of the family of Earl Berkeley. On his monument it is stated that the year of his birth was 1679; and as he died in 1753, his life would thus be exactly contemporaneous with that of the great German philosopher Christian Wolf. In truth, however, he was born five years later, namely, on the 12th of March 1684. Sent very young to Kilkenny school, where Swift had already received his early education, he at the age of fifteen followed Swift to Trinity College, Dublin, and obtained a fellowship in 1707. It was there probably that he first became acquainted with his great Irish contemporary, who seems to have patronized him in some degree, and to have been the means of introducing him at a later period to Steele and Addison, Arbuthnot, and Pope.

He not only became a fellow in 1707; he also became an author, publishing a tract, *Arithmetica absque Algebra aut Euclide demonstrata*, which, however, appears from the preface to have been written three years before, at the age of twenty. But far more important, and indeed so important as to form an epoch in science, was the work which made its appearance in 1709, *An Essay towards a New Theory of Vision*, in which he is considered to have established the doctrine that the eye, no more than the ear, has any natural perception of space; all its perceptions of distance, of magnitude, and of situation, being acquired from the sense of touch. Mr Stewart has, in his Preliminary Dissertation, dwelt upon this theory at such length, that here it is only necessary to record that a great living authority in optics, Sir David Brewster, has questioned the truth of it; and that the question is interesting not only to the optician, but also far more to the psychologist, suggesting, as it does, many inquiries into the origin of our ideas generally. It may also be added, that twenty-four years afterwards (1733), Berkeley published a pamphlet in vindication of his theory, which is not, however, collected in his works.[1] Its title is, *The Theory of Vision, or Visual Language, showing the immediate Presence and Providence of the Deity, vindicated and explained. By the author of Alciphron, or, the Minute Philosopher.* Berkeley.

From this title it will be seen, that his early essay on the nature of vision contains the germs which afterwards fructified into the Berkeleian philosophy; and, especially, it will be seen that his speculations were not merely speculations, but had a noble practical object in view—the service of religion. The common opinion of him would seem to be, that he was a dreamer, who wrote romances in philosophy, and acted romances in religion. Judged by the standard of his own time, judged by any ordinary standard, his missionary zeal was certainly romantic; but in philosophy he was no romancer. The premises with which he starts, premises almost universally accepted amongst philosophers until the time of Reid, drag absolute idealism after them by a chain of the most irresistible logic; and the distinguishing characteristic of Berkeley's system is, that it is more reasonable than all previous ones, while it is at the same time applied to a more practical end.

This system was first promulgated (1710) in *A Treatise concerning the Principles of Human Knowledge, wherein the chief causes of error and difficulty in the sciences, and the grounds of scepticism, atheism, and irreligion, are inquired into.* We have quoted this title in full, that we may again call attention to the end which young Berkeley had in view,—it was to erect a polemic against the infidelity of the age. And he did so by denying, on the received principles of philosophy, the reality of an external world; thence arguing, that as there is no such world, we must, in order to account for the phenomena of sense, postulate a Deity continually acting on the minds of men, and necessitating certain perceptions. This scheme of objective or theistic idealism, it will be seen, is essentially distinct from the subjective or egoistic idealism of Fichte and the later German schools; it fraternizes with the idealism of Malebranche (to a certain extent), of Collier, and, in later times, of Schelling. (But for a more explicit statement of Berkeley's position, we must refer to Sir William Hamilton's *Discussions*, No. VI. p. 187, and to his *Dissertations* affixed to Reid's Works, pp. 816–819.)

Three years later, Berkeley went to London, and published a defence of his system in *Three Dialogues between Hylas and Philonous.* This was in 1713, a date which ought to be remembered, as it was in the same year that Arthur Collier first published in the *Clavis Universalis* his demonstration of the existence of the impossibility of an external world. So that, although Collier's speculations are quite independent of Berkeley's, they were published three years after; and Berkeley is thus the first philosopher who proposed a scheme of absolute idealism.

These dialogues, without making many converts, procured Berkeley many friends. He became intimate, chiefly

[1] This pamphlet seems to have been utterly unknown until it was lately discovered by Sir William Hamilton, who is in possession of a copy which he has kindly shown to the present writer, at the same time pointing out a footnote in the works of Berkeley (vol. i. p. 145, ed. 1784) where the existence of this pamphlet is expressly indicated.

Berkeley. through Swift, with the great wits of the time, contributing several essays to the *Guardian;* and before the end of the year accompanied the Earl of Peterborough to Italy, as chaplain and secretary of legation,—this also, on the recommendation of Swift, who seems to have taken a fancy to him. Berkeley's letters from the Continent are interesting in themselves, and as showing the sociability of his nature; he writes like a poet to Pope; he writes like a naturalist to Arbuthnot; he writes like a boon companion to Thomas Prior—his dear Tom. He returned next year to England, but soon again departed on a continental tour with a Mr Ashe. It was on this tour that he paid the celebrated visit to Malebranche, which ended in the death of the reverend father. On his former trip to Paris, he wrote to Prior,—"To-morrow I intend to visit Father Malbranch, and discourse him on certain points;" so that probably the present was not his first visit. On this occasion "he found the ingenious father in his cell, cooking in a small pipkin a medicine for a disorder with which he was then troubled, an inflammation in the lungs. The conversation naturally turned on our author's system, of which the other had received some knowledge from a translation just published. But the issue of the debate proved tragical to poor Malebranche. In the heat of disputation, he raised his voice so high, and gave way so freely to the natural impetuosity of a man of parts and a Frenchman, that he brought on himself a violent increase of his disorder, which carried him off a few days after." And no wonder, for Berkeley must easily have demolished the peculiar system of the father. The principles of Malebranche lead directly to absolute idealism, and Berkeley followed them to that result. But if absolute idealism be true, what becomes of the doctrine of transubstantiation? To save himself from heresy, the Catholic father had to bolster up his philosophy with an hypothesis, a mere hypothesis, which was, after all, but a vain attempt to frustrate the logical result of his speculations.

Berkeley returned to London in 1721. During his absence he had been elected senior fellow of his college, and on his return he took the degrees of bachelor and doctor in divinity. In the year following his fortune received a considerable accession from a very unexpected bequest. On his first going to London (1713), Swift introduced him to the family of the celebrated Vanessa, Mrs Esther Vanhomrigh, and took him often to dine at her house. It was the intention of this lady to have made the dean of St Patrick's her heir, but—her story is well known—she was disappointed in him, and left the whole of her fortune, about L.8000, to be divided equally between her near relation, Mr Justice Marshall, and Dr Berkeley. If money were an object to the philosopher, he shortly afterwards (1724) received a deanery, the value of which, about L.1100 a-year, his more worldly friends constantly, wonderingly, pityingly, contrasted with the paltry L.100 for which his missionary zeal very soon prompted him to exchange it. He resigned his fellowship, and became dean of Derry.

The scheme on which he had set his heart, and which the ease and comparative wealth of his deanery could not make him forego, was that of erecting a college in the Bermudas, to train pastors for the colonial churches, and missionaries for the American Indians. His position is thus described by Swift in a letter of recommendation to Lord Carteret, which we quote entire, as it conveys a very lively idea of what Berkeley's contemporaries thought of him:—"September 3. 1724. There is a gentleman of this kingdom just gone for England; it is Dr George Berkeley, dean of Derry, the best preferment among us, being worth about L.1100 a year. He takes the Bath in his way to London, and will, of course, attend your excellency, and be presented, I suppose, by his friend my Lord Burlington; and because I believe you will choose out some very idle minutes to read this letter, perhaps you may not be ill entertained with some account of the man and his errand. He was a fellow in Berkeley. the university here, and going to England very young, about thirteen years ago, he became the founder of a sect there, called the Immaterialists, by the force of a very curious book on that subject: Dr Smallridge and many other eminent persons were his proselytes. I sent him secretary and chaplain to Sicily, with my Lord Peterborough; and upon his lordship's return, Dr Berkeley spent above seven years in travelling over most parts of Europe, but chiefly through every corner of Italy, Sicily, and other islands. When he came back to England, he found so many friends that he was effectually recommended to the Duke of Grafton, by whom he was lately made dean of Derry. Your excellency will be frighted when I tell you, all this is but an introduction; for I am now to mention his errand. He is an absolute philosopher with regard to money, titles, and power; and for three years past, hath been struck with a notion of founding a university at Bermuda, by a charter from the crown. He hath seduced several of the hopefullest young clergymen and others here, many of them well provided for, and all of them in the fairest way of preferment; but in England his conquests are greater, and I doubt will spread very far this winter. He showed me a little tract which he designs to publish, and there your excellency will see his whole scheme of a life academico-philosophical (I shall make you remember what you were), of a college founded for Indian scholars and missionaries, where he most exorbitantly proposeth a whole hundred pounds a-year for himself, forty pounds for a fellow, and ten for a student. His heart will break if his deanery be not taken from him, and left to your excellency's disposal. I discourage him by the coldness of courts and ministers, who will interpret all this as impossible and a vision, but nothing will do. And therefore I do humbly entreat your excellency either to use such persuasions as will keep one of the first men in the kingdom for learning and virtue quite at home, or assist him by your credit to compass his romantic design, which, however, is very noble and generous, and directly proper for a great person of your excellent education to encourage." With much importunity, and after a tedious attendance, Berkeley at length obtained from the minister an assurance that his scheme would be supported, and it was in the happiness of this prospect that he penned these well-known lines:—

> "Westward the course of empire takes its way,
> The four first acts already past;
> A fifth shall close the drama with the day;
> Time's noblest offspring is the last."

Being now certain of success, Berkeley prepared to depart, and his first step was to marry. In August 1728, he married Anne, eldest daughter of the Right Hon. John Forster, speaker of the Irish House of Commons; and next month he set sail for Rhode Island. But in vain; the promises of the government were never fulfilled; he was left alone to fight his own battle; and after years of weary waiting beyond the sea, worried to death by creditors, all his expectations baffled, he returned to England sick at heart, having spent seven years of his prime, and the greater part of his fortune, in attempting to establish a scheme which, with all its simplicity, was yet too grand and too pure for the powers that then were to appreciate. His only earthly comfort seems to have been in his wife and child. In his wife he must have been very happy. When he married her, he wrote to his dear Tom, with a beautiful simplicity, "Her humour and turn of mind pleases me beyond anything I knew in her whole sex." Perhaps he was easily pleased; at least we gather as much from the way in which he talks of her painting and singing. Of her painting he says: "For my part, I think she shows a most uncommon genius;" the worthy bishop being then more than sixty years of age, and his wife having never handled a brush till six months before. Then of her singing: "My wife, I am told, is this

Berkeley. day inferior to no singer in the kingdom;" the bishop not being himself able to judge as having no ear for music, but seeming to take great delight in the music lessons, and summoning his family at four in the morning to the bass-viol and the Italian master.

By this time, however, Berkeley was settled in the bishopric of Cloyne, which he received in 1734 as a special mark of favour from the queen. It will be remembered that Queen Caroline was fond of listening to metaphysical conversations, and debates often arose in her presence between Clarke and Berkeley as principals, Hoadly and Sherlock as seconds. Hoadly had no sympathy whatever with Berkeley, blasting his philosophy and his Bermuda project as the reveries of a visionary. Sherlock, on the other hand, we are told, warmly espoused his cause, and particularly when *The Minute Philosopher* made its appearance, carried a copy of it to the queen as a triumphant testimony in favour of Berkeley. Her Majesty gave Berkeley the first bishopric that fell vacant. And so we find him happy and content as ever at the little village of Cloyne, admiring his own portrait painted by his wife after six months' lessons, and enjoying her singing without understanding a note of the music.

The Minute Philosopher was written against freethinkers of the Shaftesbury class. Soon after he became bishop of Cloyne, Berkeley wrote another polemic, *The Analyst*, against the mathematical sceptics, and especially against Halley, who had in conversation hazarded the remark, that the doctrines of Christianity are incomprehensible, and the religion itself an imposture; and he showed in this work that mysteries in faith are unjustly objected to by mathematicians, who admit much greater mysteries in science—the doctrine of fluxions for example. The most important of his remaining treatises are, *Queries proposed for the good of Ireland* (1735); a letter addressed to Roman Catholics during the rebellion of 1745; another to the Catholic clergy, entitled *A Word to the Wise* (1749); *Siris, a Chain of Philosophical Reflections and Enquiries concerning the Virtues of Tar-Water* (1744); and *Farther Thoughts on Tar-Water*, published 1752. This was his last performance for the press, and he did not survive it long. His health was delicate, he was somewhat of a hypochondriac, and drenched himself, perhaps hurt himself, with copious draughts of tar-water, the receipt of which he was constantly sending to his friends: "Give a heaped spoonful of common rosin, powdered in a little broth, &c. &c." Hypochondriac in his later days, tar-water was the absorbing idea of his mind; to drink it seemed to be in his eyes a moral obligation incumbent on all mankind. He advises a friend, in one letter, to shun late hours and drink tar-water; again he announces in another, that a spoonful half tar half honey is the remedy for cold. "My cholic," he says in a third letter, "is changed to gout and sciatica, the tar-water having drove it into my limbs." What a horrible complication of maladies campaigning it through his poor body,—stormed out of this fastness only to be driven into some out-of-the-way limb! So entirely did tar-water at this time seem to engage his highest intellect, that in the above-mentioned treatise entitled *Siris* he not only appears to regard it as the infallible all-heal of creation, but easily and naturally passes from the contemplation of it to the contemplation of the loftiest mysteries, so that, beginning with tar, he ends with the Holy Trinity.

In 1751, feeling the infirmities of age, and wishing to retire from the care of his diocese to superintend the education of his son, then nominated a student of Christ Church, that the revenues of the church might not be misapplied, nor the interest of religion suffer by the absence of the pastor from his flock, he sought to resign his bishopric, the annual income of which was not less at that time than L.1400. Failing of success in this application, he let the lands of his demesne at Cloyne on very easy terms, at the rent of L.200, which he directed to be distributed every year until his return among the poor housekeepers of Cloyne, Youghal, and Aghadda. He removed to Oxford in July 1752, being then in a very feeble state of health. "On Sunday evening, January 14. 1753, as he was sitting in the midst of his family, listening to a sermon of Dr Sherlock's, which his lady was reading to him, he was seized with what the physician termed a palsy of the heart, and instantly expired. The accident was so sudden, that his body was quite cold and his joints stiff before it was discovered, as the bishop lay on a couch, and seemed to be asleep, till his daughter, on presenting him with a dish of tea, first perceived his insensibility."

Berkeley || Berkshire.

The best edition of Berkeley's works is that published in London in 1784, 2 vols. 4to. (See Life of Berkeley, prefixed to his works. Tenneman says that it was written by Dr Arbuthnot. It was really drawn up by Dr Joseph Stock, most of the particulars having been furnished by the bishop's brother, the Rev. Robert Berkeley, D.D.) (E. S. D.)

BERKELEY, a market-town in the county of Gloucester, near the river Severn, on the Bristol and Gloucester railway. It is pleasantly situated on a gentle eminence, in a rich pastoral vale to which it gives name, and which is celebrated for its dairies, producing the famous cheese known as "double Gloucester." The town has a handsome church, a grammar-school, town-hall, market-house, and some trade in timber, malt, and cheese, by means of the Gloucester and Berkeley canal. Berkeley was the birthplace of the celebrated Dr Jenner, whose remains are interred in the church. Market-day Wednesday. Pop. (1851) 949.

Berkeley Castle, on an eminence S.E. of the town, is still in good preservation. This magnificent structure was built in the reign of Henry I., but it suffered considerably during the civil wars of the seventeenth century. It is still one of the noblest baronial castles extant in England. It is noted as the scene of the most barbarous murder of Edward II.

BERKHAMSTEAD, GREAT, a market-town of England, in the county of Herts, 26 miles N.W. of London, on the Junction canal and the London and Birmingham railway. It has a church, three chapels, an old market-house, a grammar and a free school, several almshouses, gaol, &c. Pop. (1851) 3395, chiefly engaged in straw-plaiting.

BERKSHIRE, one of the midland counties of England, bounded on the north by Oxfordshire and Buckinghamshire, from which it is separated by the Thames; on the east by Surrey; on the south by Hampshire; and on the west by Wiltshire. At the north-eastern corner this county comes slightly in contact with Gloucestershire. It is of a very irregular figure, its whole northern and eastern side being bounded by the sinuosities of the Thames. From east to west it extends about forty-two miles; from north to south, in its widest part, it is about thirty miles; but in its narrowest it is not more than seven. Area 451,040 acres.

The surface is generally level, diversified with undulations, though in some parts, as in the vicinity of the Thames, the hills rise rather abruptly, and give diversity and beauty to the scenery. This is especially the case near Farringdon, and on the opposite corner of the county near Windsor. Windsor forest was immortalized by Pope, at a time when its beauties were even less conspicuous than at present. The south and east sides of the county are well wooded, but the trees are not generally of great size, nor of the most valuable or picturesque kind. A line of chalk hills, a continuation of the Chilterns, runs east and west through the county at its broadest part, separating the two fertile valleys of the Kennet and the Thames. The highest land in the county is a range of chalk downs which extend from the banks of the Thames, between Reading and Wallingford, towards the north of Wiltshire, the highest point being White-Horse Hill, 893 feet high. The western and most elevated part is devoted to the pasture of sheep. The most celebrated breed is the well-known Southdown, which, together with a cross from

Berkshire. the old Notts and Leicester breeds, has almost entirely superseded the native stock.

The agriculture of the county varies much according to the locality. Wheat and beans are well cultivated: and a species of peat found on the banks of the Kennet yields ashes that are of great value to the soils near that river. More than one-half of the land is calculated to be under tillage, about one-quarter is pasturage, and the remainder consists of woodlands or uncultivated heaths. In the two valleys already mentioned, namely the vales of Kennet and White-Horse, dairy farming predominates. There is a large proportion of woodland in the south and east parts of the county. The district to the south of Reading, which has a mixed soil of clay, gravel, and sand, together with the fertile tract to the east of Wantage, yield rich crops of corn. Near Farringdon pigs are extensively reared, and the breed is celebrated. The eastern part of the county, though picturesque, is, with some exceptions, the most backward in its agriculture. The estate of Mr Pusey, M.P. for Berks, situated in the N.W. of the county, may be cited as one of the best examples of the improved system of farming. The farms are generally held from year to year. The condition of the labouring population is considered to have improved, and cottage rents are moderate.

Few parts of England are better supplied with the facilities of water communication than the county of Berks. It is connected by means of the Thames, which runs round or through it, on one hand with London and the sea, and on the other with the Severn at two separate points on that river; one through the Thames and Severn canal, with Gloucester; the other through the river Kennet and the Kennet and Avon canal, with Bath and Bristol. Besides the navigable rivers, it enjoys the benefit of the Wilts and Berks canal, which connects the Thames at Abingdon with the Avon at Trowbridge in Wiltshire, and comunicates with the Kennet and Avon canal. The other rivers, which all finally fall into the Thames, are the Ock, the Loddon, the Auburn, and the Lambourn.

The turnpike roads are generally good. The principal of these are the roads from London to Bath and Oxford, both of which enter the county at Maidenhead, and soon afterwards separate, the former running S.W. to Reading, the latter nearly due west to Henley. The Great Western railway passes through Berkshire from Maidenhead to near Swindon. The branch lines pass from Didcot to Oxford, from Reading to Newbury and Hungerford, from Reading to Basingstoke, on the South-Western railway, and from Reading to Guildford and Reigate, on the South-Eastern and Brighton railways. Besides these there is a branch of the South-Western line to Windsor, and another branch to that town from the Great Western.

The woollen manufacture was introduced into this county under the Tudors; and the story of the celebrated clothier, Jack of Newbury, has been handed down to the period when the establishments founded by him passed to the northern parts of the kingdom. At Abingdon some linen manufactures still linger. The copper smelted in Wales is conveyed to some large mills near Marlow, where it is rolled into sheets for coppering vessels. There are some few paper-mills near Newbury. The chief commerce of the county consists in the sale of its agricultural produce, and some transit trade, from being in the way of inland navigation between the two greatest English rivers, the Thames and the Severn.

The county is divided into twenty hundreds, containing twelve market-towns and 142 parishes, besides fourteen others chiefly or partially included in Berks. The county is in the diocese of Oxford and the ecclesiastical province of Canterbury. It forms an archdeaconry by itself, and is divided into the four rural deaneries of Abingdon, Newbury, Reading, and Wallingford. It is on the Oxford judicial circuit, and the assizes are held alternately at Reading and Abingdon. County courts are held at Abingdon, Farringdon, Hungerford, Maidenhead, Newbury, Reading, Wallingford, Wantage, Windsor, and Wokingham. Berlin.

Berkshire returns nine members to parliament, three for the county, two each for Reading and New Windsor, and one each for Abingdon and Wallingford.

At the five decennial enumerations the population of the county was as follows:—

Year.	Males.	Females.	Total.
1811.....	57,936	61,494	119,430
1821.....	65,832	66,807	132,639
1831.....	72,983	73,251	146,234
1841.....	80,582	81,177	161,759
1851.....	84,927	85,138	170,065

From the vicinity to the metropolis, the salubrity of the climate, and the general beauty of the country, few counties have more numerous seats of the nobility and gentry than are to be found in Berkshire. Among these stands pre-eminent the royal castle of Windsor, the favourite residence of our monarchs during many centuries; for although chiefly rebuilt in the reign of Edward III., it was originally constructed by William the Conqueror. See Windsor.

Antiquities, both Roman and Saxon, are numerous in various parts of this county. The Watling Street road of the former enters Berkshire from Bedfordshire at the village of Streatley, and leaves it at Newbury. Another Roman road passes from Reading to Newbury, where it divides into two branches, one passing to Marlborough in Wiltshire, and the other to Cirencester in Gloucestershire. A branch of the Icknield Street road passes from Wallingford to Wantage. Near Wantage is a Roman camp, of a quadrangular form; and there are other remains of encampments at East Hampstead near Wokingham, on White-Horse Hill near Pusey, and at Sinodun Hill near Wallingford. At Lawrence Waltham there is a Roman fort, and near Denchworth a fortress said to have been built by Canute the Dane, called Cherbury Castle. Dragon Hill is supposed to have been the burying-place of a British prince called Uter Pendragon, and near to it is Uffington Castle, supposed to be of Danish construction. On White-Horse Hill, in the same vicinity, is the rude figure of what is called a horse, although it bears a greater resemblance to a greyhound. It has been formed by cutting away the turf and leaving the chalk bare. It is said to occupy nearly an acre of land, and to have been executed by Alfred to celebrate a victory over the Danes in the reign of his brother Ethelred, in the year 872.

Berkshire comprehended the principality inhabited by the *Atrebates*, a tribe of people who originally migrated from Gaul before the island was divided into Roman provinces. Under that nation it formed part of *Britannia Prima*, and during the Saxon heptarchy was included in the kingdom of West Saxony. When Alfred divided the country into shires, hundreds, and parishes, it obtained the name of *Berocscire*, which was subsequently changed to that which it now bears. It was frequently the scene of military operations from the time of Offa down to the troubles in the reign of Charles I. During the civil war two battles were fought at Newbury. In 1643, after a siege, Reading was taken by the parliament forces, and the royalist party were expelled from the whole of the county except Wallingford.

Mineral springs are found at Cumnor and Sunninghill, and at the latter there are establishments for the reception of visitants. There is a strong chalybeate called Gorrick Well, near Luckley House, and some springs near Windsor of the nature of the Epsom waters.

The following are the principal towns in this county:—Reading, Newbury, Thatcham, Wokingham, Wallingford, Windsor, Abingdon, Wantage, Farringdon.

BERLIN, the capital of Prussia, and one of the most beautiful towns in Europe, is situated in the province of Brandenburg, regency of Potsdam, in Lat. 52. 30. N. and

Berlin. Long. 13. 24. E., in the middle of a sandy plain on both banks of the Spree, and is twelve miles in circumference. It is the ordinary residence of the king, and seat of the principal authorities.

It is divided into five large parts or quarters, which in German are called towns: Berlin, properly so called; Cologne, divided into Old and New Cologne; Friederichswerder, Friedrichstadt, Dortheenstadt or Neustadt. These are divided into 22 quarters or sections, which altogether comprehend 280 streets and 20 public places. The streets are broad and straight, crossing at right angles; the houses and even the greater part of the public buildings are of brick and plaster; and, from the flatness of the ground, the water in the drains stagnates, causing disagreeable and noxious odours, and the foot pavements are so narrow that two persons can scarcely walk abreast. Among the streets the principal are the Friederichstrasse, 4068 paces in length, and the magnificent street called Unter den Linden, 1032 paces long and 161 feet in breadth, planted with four rows of trees, and lined with superb edifices. This fine street is terminated on the west by the magnificent Brandenburg gate, erected in 1790, of colossal size, designed as an imitation of the Propylæum at Athens, and surmounted by a car of Victory drawn by four horses, which was carried away by the French in 1807, and brought back in triumph in 1814, when the Prussians bestowed upon the goddess the eagle and the iron cross which she now bears. Among the places or squares may be mentioned the Wilhelmsplatz, bordered with lime trees and ornamented with statues of the celebrated warriors of Prussia; the Lustgarten, planted with poplars and chestnut trees, and adorned by a statue of Prince Leopold of Anhalt-Dessau; the square of the Opera, with the statue of Blucher and other military heroes.

Berlin is encircled by a wall with sixteen gates, besides two *portes d'eau*. The ramparts serve for the purposes of police, but are useless as means of defence. There are 41 bridges, the most remarkable of which are the Lange-Brüche, adorned by a statue of Frederick William, and the Kœnigs-Brüche.

The city is embellished with many splendid buildings. Among the principal of these is the royal palace or schloss, imposing by its magnitude. In the White Hall, fitted up at an expense of L.120,000, the first meeting of the Prussian parliament was held (April 1847). The museum, begun in 1823 and finished in 1830 from designs by the architect Schinkel, is the finest edifice in the city. Opposite the entrance is a gigantic basin of polished granite, 22 feet in diameter, which was formed out of a vast isolated boulder which lay at Fürstenwald, about 30 miles from Berlin, and was conveyed in a flat-bottomed boat along the Spree to the city. The royal library is a tasteless heavy-looking building: it contains about 500,000 volumes, and nearly 5000 manuscripts, the former including Luther's Hebrew bible. This library is entitled to a copy of every work printed in the Prussian dominions. The arsenal, erected in 1695, forms a square each side of which is 268 feet in length, and previously to the revolution of 1848 contained a large store of warlike ammunition. When taken possession of by the mob it was plundered. The churches are numerous, but by no means handsome. Among these are the cathedral, an unsightly building; the Lutheran church of St Nicholas, the most ancient in the town; that of St Mary, with a steeple or tower 286 feet high; the Reformed church; the French church. Among the other buildings are the bourse, the opera-house, the charity and maternity hospitals, the invalid hotel, the custom-house, the mint, the post-office, the barracks, &c. The Thiergarten promenade is renowned throughout Germany.

It was not till 1851 that a monument was raised in honour of Frederick the Great. In that year an equestrian statue in bronze, modelled by Rauch, was erected in the Unter den Linden, opposite Prince William's palace and the university; the statue is 17 feet 3 inches in height, and stands on a granite pedestal 25 feet high. The monarch is represented in the costume he usually wore, and on each face of the pedestal are represented the great military commanders in the Seven Years' War, with other figures. This is one of the most magnificent monuments in Europe. A little out of the town, near the Halle gate, is a Gothic spire in bronze, raised to the memory of the brave men who fell in the campaigns of 1813–14–15. Berlin.

The university, founded in 1819, ranks among the first in Germany, especially as a medical school, and has the largest number of pupils next to that of Vienna. Before the late disturbances it was attended by nearly 1800 students. The number of professors, regular and extraordinary, amounts to 156, besides 8 teachers of languages and gymnastics. The number of students for the session ending June 1852 was 1409 (exceeding that of the previous year by 81), classed as follows:—

Theology	Natives,	128	
	Foreigners,	41	
			169
Law	Natives,	497	
	Foreigners,	123	
			620
Medicine	Natives,	210	
	Foreigners,	65	
			275
Philosophy	Natives,	210	
	Foreigners,	106	
			345
Total (besides unmatriculated auditors, 762),			1409

Berlin may be regarded as the principal centre of the intelligence of Germany, and it possesses to a great extent the means of intellectual advancement. Besides the university, there are six royal gymnasiums or high schools, numerous inferior academies, schools for trade, the fine arts, architecture, &c. All these institutions are under the direction of men of distinguished merit. The benevolent establishments, which are no less numerous, include seventeen hospitals, institutions for the deaf and dumb and for the blind, hospitals for orphans, &c.

Berlin is one of the first manufacturing towns in Germany. Its principal branches of industry—which supply the simplest wants as well as the delicacies of the most refined luxury—are porcelain, silks, linen and cotton stuffs, hosiery, ribbon-weaving, gunpowder, paper, tobacco, jewellery, clock-making, Berlin iron, &c. Cast-iron goods of all kinds are manufactured at the foundry outside the Oranienburg gate. The finer kinds of ornamental iron-work of Berlin are very celebrated. The navigation of the Spree, which communicates by means of canals with the Elbe and the Oder, and the numerous railroads and the different routes of which Berlin is the centre, promote the commerce of this town with the interior of the country and with Europe.

In 1688 the population of Berlin was about 18,000; in 1775 it had increased to 135,900; in 1816 it was 182,381; in 1838, 290,797; and in 1849, 423,902—of whom, 22,748 were military, 220,874 males, 203,028 females, 398,727 Protestants, 15,532 Roman Catholics, and 9604 Jews. The number of dwelling-houses at this date was 9155. The denseness of the population arises from the custom of different families dwelling in the separate stories of the same house. In May 1852 the population was 446,931, exclusive of military. The total number of deaths in 1852 was 11,614. Of these 226 were by violence (of which 107 were suicides), and 2389 by bronchial affections and consumptions.

Among the many celebrated men to whom Berlin has given birth, may be mentioned the philosopher Baumgarten, the chemist Achard, the lawyer Albrecht, the diplomatist Ancillon, Tieck the poet, and the two Humboldts.

Berme || Bermudas.

The history of Berlin is very obscure. According to the most common opinion, Albert the Bear, Count of Anhalt, who took the title of Margrave of Brandenburg, founded the city. It increased and acquired importance under Waldemar of Anhalt, who died in the year 1319. It declined, however, considerably under the reign of the princes of the house of Luxembourg; but under Frederic of Hohenzollern, elector of Brandenburg, Berlin entered on a new era of prosperity. Lutheranism, adopted by the house of Brandenburg under the reign of Joachim II. (1535–1570), gave an increasing impulse to arts and sciences, trade, commerce, and everything which makes towns flourishing and a people happy. In spite of a terrible pestilence which ravaged the town in 1582, and the disasters of the Thirty Years' War, Berlin continued to advance in prosperity. It is to Frederick William, and especially to Frederick the Great, that the capital of Prussia is indebted for its prosperity and magnificence. The two most remarkable events connected with the history of the town are its occupation by the Austrians in 1760, and by the French in 1806, after the battle of Jena. It contains no remains of the mediæval period, but is entirely indebted to modern art for its present magnificence.

BERME, in *Fortification*, a space of ground left between the rampart and the fosse, designed to receive the ruins of the rampart, and prevent their filling the fosse. It is sometimes palisadoed, and in Holland it is generally planted with a quickset hedge. It is also called *liziere, relais, foreland, retrait, pays de souris*, &c.

BERMUDAS, or SOMERS'S ISLANDS, a cluster of small islands in the Atlantic Ocean, about four hundred in number, but for the greater part so small and barren that they possess neither inhabitants nor name. The north part of these islands is situated in Long. 62. 28. W. Lat. 32. 34. N. Their discovery resulted from the shipwreck of Juan Bermudas, a Spaniard (whose name they now bear), when on a voyage from Old Spain to Cuba with a cargo of hogs, about the year 1522. Henry May, an Englishman, suffered the same fate in 1593; and lastly, Sir George Somers shared the destiny of the two preceding navigators in 1609. Sir George was the first who established a settlement upon them, but he died before he had fully accomplished his design. A company of 120 persons was formed in Virginia, sixty of whom, under the command of Mr Henry More, proceeded to the island; and an accession of inhabitants was gained during the civil wars, many having sought a refuge from the tyranny of the ruling party in this distant sanctuary.

Of the vast number of islands composing this archipelago, not above twelve are inhabited. The names of the principal of these are St George, Hamilton, St David, Cooper, Ireland, Somerset, Nonsuch, and Long and Bird Islands. These are closely connected, and in their characteristic features so similar, that they may be considered and described as one island. The coast is of the most dangerous description, being thickly studded with rocks, which appear and disappear with the ebb and flow of the tide. A landing is never attempted without a pilot. The extreme length of the colony, from St Catherine's Point on St George's to the western extremity of Bermudas, is not more than twenty miles; but the road continues round the Great Sound to the N.E. point of Somerset, making the distance 24 miles. The greatest breadth from north to south by land is about one mile and a half, and the whole superficies is 12,161 acres. The harbour of St George's Island has water and space enough to accommodate the whole British navy; yet until, by the labour of the convicts and submarine blasting, the entrance was deepened and enlarged, it was so obstructed by rocks that the harbour was almost unapproachable. The appearance of Bermudas at first sight is highly romantic; but a closer inspection does not justify the first impression, and the prospect becomes very monotonous. Broad fields of barren rock, and tracts of evergreen cedar, are scattered over the whole island, which is traversed by numerous sheets of salt water. There are a great number of caves, some of which pierce far into the land. Beautiful varieties of stalactites and stalagmites fret these subterranean halls. Bermudas is still greatly behind in agriculture, although capable of producing all varieties of vegetables. In 1827 there was only one plough in the whole colony, the spade being in more general request. Since 1843, however, the produce of the land has largely increased. The neglect of internal resources may be ascribed to the facility with which supplies are received from America, and also to the great variety of excellent fish with which the shores abound, withdrawing the attention of numbers of the lower orders from the cultivation of the soil. The whale is an annual visitor of the coast; the fishing of which being a lucrative employment, is another inducement to neglect the spade. The soil is very fertile in the growth of esculent plants and roots, such as potatoes, onions, cabbages, carrots, turnips, pease, French beans, &c. The citron, sour orange, lemon, and lime, grow spontaneously in great luxuriance; but the apple and the peach arrive at no perfection. Medicinal plants, such as castor, aloe, and jalap, grow to great perfection without culture; and coffee, indigo, cotton, and tobacco, are also spontaneous products. A great quantity of arrow-root is raised, which is considered of first-rate quality. Few oxen or sheep are reared in the colony, these being supplied from North America. Bermudas possesses no fresh-water streams, and only a few wells, the water of which is brackish; but there are a great many tanks, which fill during the rainy season, and afford the principal supply of water. Vegetation is very rapid on these islands, there being but little variety of temperature in the different seasons. Spring may be said never to forsake them, and accordingly the fields and forests are clad with a mantle of perpetual green. The climate, however, is by no means healthy, and only a short residence is necessary to foster the germs of constitutional disease. The yellow fever and typhus are often destructive. In 1853 the former of these diseases made dreadful ravages.

Bermudas.

There are only two small towns in Bermudas, St George's and Hamilton, each of which has a mayor and other civic officers. The former was the capital until Sir James Cockburn removed the senate and courts of justice to Hamilton, which, being centrally situated, is much more convenient. There is little display of architectural taste in these places, the buildings being both disproportioned and irregularly huddled together. They are built of sandstone, veins of which are everywhere found. Limestone is also abundant. There are three signal stations, one at St George's, another at Mount Langton, and a third at Gibb's Hill. At each of these a small party of soldiers is stationed. A dockyard, prisons, a lighthouse, a mansion for the naval commissioner, and several other public works, have been built, for the erection of which about 1700 convicts are employed. The annual cost of the maintenance of these people is about L.20 a-head. The churches and schools are numerous. Government has made great efforts to encourage education in the colony; but these have been feebly seconded by the inhabitants, especially the whites. In the admiralty school at Ireland Island, the white and coloured children are instructed together; but in other parts of the colony prejudice as yet runs too high for such a combination. The result is, that the children of the poorer class of whites, who will not associate with the coloured class, are either sent to small schools badly conducted, or not sent to school at all. It has been found that the coloured people are not only more eager to procure a good education for their children, but are better able to pay for it, than the lower class of whites.

The revenue in 1849 was L.11,914; in 1850, L.12,630; to which is to be added the annual parliamentary grant of L.4049. The expenditure in 1849 was L.17,426; in 1850,

Bernadotte || Bernard.

L.16,227. The military expenditure in 1850 was L.70,160. The charge for 1566 prisoners during 1850 was L.34,595. The value of imports in 1849 amounted to L.132,733; in 1850, to L.130,501: of these the larger proportion was from the United States. The exports for 1849 amounted to L.15,315; for 1850, to L.19,960.

The population in October 1843 was 9934; on the 1st January 1851, 11,092,—consisting of 4669 whites; males 1965, females 2704. The coloured population amounted to 6423; males 2832, females 3591. The increase of white population since 1843 has been at the rate of one-eighth per annum; the increase of the coloured population at two-eighths. The great disproportion between the males and the females among the whites is attributed to the increasing emigration of the young men.

BERNADOTTE, afterwards CHARLES XIV., king of Sweden and Norway, was the son of a lawyer at Pau in Béarn, and was born Jan. 26. 1764. His original name was Jean-Baptiste-Jules Bernadotte. He was destined by his parents for the law; but he chose the profession of arms, and enlisted in 1780 as a private in the royal marines. When the revolution swept away the arbitrary distinction of classes, and opened up to all alike the path of preferment, the abilities of Bernadotte were speedily acknowledged. In 1792 he was made a colonel; in the following year a general of brigade; and soon after a general of division. In the campaigns of the Rhine and of Italy his military talents found ample scope for display; and his diplomatic abilities had also been tested as ambassador at the court of Vienna. During Buonaparte's absence in Egypt, Bernadotte was appointed minister of war. He re-organized the whole army, and prepared the way for the conquest of Holland. Notwithstanding the rivalry that all along existed between him and Napoleon, Bernadotte was made a marshal on the establishment of the empire. He was also nominated to the government of Hanover, and took part in the campaign of 1805 at the head of a force of 20,000 men. At the battle of Austerlitz he covered himself with glory; and in 1806 he was created prince of Ponte-Corvo. In 1810 the assembled states of Sweden nominated him as successor to Charles XIII. of Sweden, a distinction for which he was scarcely less indebted to his nobility of character than to his military talents. The jealousy exhibited by Napoleon on that occasion, and Bernadotte's politic rebuke, are characteristic of the two men. "What!" said Bernadotte, "would you make me greater than yourself, by compelling me to refuse a crown?" Napoleon could only reply, "Go—our fates must be accomplished."

As crown-prince of Sweden, Bernadotte devoted his whole energies to the welfare of his adopted country. Owing to the infirmities of the king, he was intrusted with the entire conduct of the government. On the death of Charles XIII., in February 1818, Bernadotte ascended the throne. The events of his administration, so conducive to the prosperity of that country, are given in the article SWEDEN. He died at Stockholm, March 8. 1844, at the age of seventy-nine; and left an only son, Oscar, who succeeded him. See SWEDEN.

BERNARD, ST, the first abbot of Clairvaux, was the third son of Tescelin of Fontaine in Burgundy, where he was born in 1091. He acquired so great a reputation by his zeal and abilities, that all the affairs of the chuch appeared to rest upon his shoulders, and kings and princes seemed to have chosen him as general arbitrator of their differences. It was owing to him that Innocent II. was acknowledged sovereign pontiff, and that, after the death of Peter Louis the anti-pope, Victor, who had been named his successor, voluntarily abdicated the dignity. Bernard convicted Abelard at the council of Sens, in the year 1140; he opposed the monk Raoul; he persecuted the followers of Arnold of Brescia; and, in 1148, he caused Gilbert de la Porvicé, bishop of Poitiers, and Eonde l'Etoile, to be condemned in the council of Rheims. By such zealous behaviour he verified, according to Bayle, the interpretation of his mother's dream. She had dreamed, when with child of him, that she should bring forth a white dog, whose barking should be very loud. Astonished at this dream, which she was unable to unriddle, she consulted a monk, who said to her, "Be of good courage; you shall have a son who shall guard the house of God, and bark loudly against the enemies of the faith." But St Bernard went far beyond the prediction; for he barked sometimes against chimerical enemies, and was more successful in exterminating the heterodox than in putting down infidels, although he attacked the latter, not only with the ordinary arms of his eloquence, but also with the extraordinary weapon of prophecy. He preached the crusade under Louis the Younger, and added greatly to the troops of the crusaders. But all the splendid visions with which he had flattered the people were disappointed by the event; and when it was alleged that he had hurried a vast number of Christians to slaughter without sharing the dangers himself, the saint alleged in his defence that the sins of the crusaders had destroyed the efficacy of his prophecies. He is said to have founded 160 monasteries, and to have wrought a prodigious number of miracles. He died August 20. 1153, aged sixty-three. Of the numerous editions of his works, the best is that of Father Mabillon, printed at Paris in 1690, in 2 vols. folio, which also contains the biography of St Bernard written by his secretary and disciple Geoffrey.

Bernard.

BERNARD, *Dr Edward*, a learned astronomer, linguist, and critic, was born at Perry St Paul, near Towcester, May 2. 1638, and educated at Merchant-Tailors' school, and St John's College, Oxford. On entering the university, he was already master of all the elegancies of the Greek and Latin tongues, and not unacquainted with the Hebrew. He there applied to the study of history, philology, and philosophy, and mastered the Hebrew, Syriac, Arabic, and Coptic languages; after which he studied mathematics under Dr Wallis. Having taken the degrees of bachelor and master of arts, and afterwards that of bachelor of divinity, he went to Leyden to consult several Oriental manuscripts left to that university by Joseph Scaliger and Levinus Warnerus. On his return to Oxford he collated and examined the most valuable manuscripts in the Bodleian library, and became engaged in a very extensive correspondence with the learned of most countries. In 1669, when the celebrated Christopher Wren, Savilian professor of astronomy at Oxford, was appointed surveyor-general of His Majesty's works, and obliged to spend much of his time in London, he obtained leave to name Bernard as his deputy at Oxford. In 1676 he went to France as tutor to the dukes of Grafton and Northumberland, sons of Charles II. by the duchess of Cleveland, and then living with their mother at Paris; but the simplicity of his manners not suiting the gaiety of the duchess's family, he returned about a year after to Oxford. He composed tables of the longitudes, latitudes, right ascensions, and declinations of the fixed stars; Observations in Latin on the Obliquity of the Ecliptic; and several other pieces inserted in the *Philosophical Transactions*. He also wrote, 1. A Treatise on Ancient Weights and Measures; 2. *Chronologiæ Samaritanæ Synopsis*, in two tables; 3. Testimonies of the Ancients concerning the Greek Version of the Old Testament by the Seventy; and several other learned works. This learned and pious man died January 12. 1696, in the fifty-eighth year of his age, leaving behind him a number of manuscripts which are now deposited in the Bodleian library. His biography has been written by Dr Smith.

BERNARD, *James*, professor of philosophy and mathematics, and minister of the Walloon church at Leyden, was born at Nions, in Dauphiné, September 1. 1658. Having studied at Geneva, he returned to France in 1679, and was chosen minister of Venterol, in Dauphiné, whence he was

Bernard ‖ Bernay.

removed to the church of Vinsobres. The persecution against the Protestants obliging him to abandon his native country, he retired to Holland, where he was well received, and appointed one of the pensionary ministers of Gauda. In July 1686 he commenced his *Histoire Abrégée de l'Europe*, which he continued monthly till December 1688. In 1692 he began his *Lettres Historiques*, containing an account of the most important transactions in Europe; and he carried on this work till the end of 1698. It was afterwards continued by other hands, and consists of a great number of volumes. When Le Clerc discontinued his *Bibliothèque Universelle* in 1691, Bernard wrote the greater part of the twentieth volume, and the five following volumes. In 1698 he collected and published *Actes et Négociations de la Paix de Ryswic*, in four volumes 12mo. In 1699 he began the *Nouvelles de la Republique des Lettres*, which continued till December 1710. Having acquired great reputation by his works, as well as by his sermons at Gauda and the Hague, he was unanimously elected in 1705 one of the ministers of the Walloon church at Leyden. About the same time he succeeded M. de Valder in the chair of philosophy and mathematics at Leyden; and the university presented him with the degrees of doctor in philosophy and master of arts. In 1716 he published a supplement to Moreri's Dictionary, in two volumes folio. The same year he resumed his *Nouvelles de la Republique des Lettres*, and continued it till his death, which happened on the 27th of April 1718. Besides the works above mentioned, he was the author of two excellent treatises, one on a late repentance, the other on the excellency of religion.

BERNARD, *Simon*, a celebrated French general of engineers, and aide-de-camp to Napoleon, was born at Dôle in 1779. Subsequently to the emperor's fall he emigrated to the United States, where he executed a variety of works, unequalled for magnitude, consisting of vast canals, numerous forts, and 1400 leagues of frontier fortifications. He returned to France, and in 1836 was secretary at war. He died in 1839.

BERNARD, *The Great St*, a celebrated mountain pass of the Pennine Alps, upwards of 8000 feet in height, between the Swiss canton of Valais and the valley of Aosta. Near the summit is the famous hospice, said to have been founded by St Bernard of Menthon in Savoy in 962, for the succour of travellers crossing the mountain. In their philanthropic labours the monks inhabiting the hospice have valuable assistants in their dogs, which are known as the St Bernard breed, and are noted for their extraordinary size and sagacity. In 1800 Napoleon crossed the Alps here at the head of an army of 30,000 men, with cavalry and artillery.

BERNARDINE, ST, of Siena, was born at Massa in Tuscany, in 1380. In 1404 he entered into a Franciscan monastery near Siena, and was afterwards sent to Jerusalem as commissary of the Holy Land. On his return to Italy, he preached with such applause that Ferrara, Siena, and Urbino applied to Pope Eugenius IV. to appoint him their bishop; but Bernardine declined the honour, accepting only the office of vicar-general of the Friars of the Observance for all Italy. He repaired and founded above 300 monasteries in that country, died in 1444, and was canonized by Nicholas V. in 1450. His works were published at Venice, 1591, 4 vols. 4to.; and at Paris, 1636, 2 vols. folio.

BERNARDINES, an order of monks founded at Citeaux in 1098, by Robert abbot of Molême, and reformed by St Bernard.

BERNAY, capital of an arrondissement of the same name in the department of Eure, France, is agreeably situated on the left bank of the Charentonne, 26 miles W.N.W. of Evreux. It is a town of great antiquity, and was at one time a fortified place. It was besieged by Duguesclin in 1378, taken by the English in 1418 and in 1421, and by the Admiral de Coligny in 1563. The fortress was razed in 1589. It has two fine old churches, a communal college, an hospital, and some precious remains of mediæval architecture. It has manufactures of woollen, linen, and cotton goods, and is noted as being the seat of the greatest horse fair in France, frequently attended by upwards of 40,000 persons. Pop. (1851) of town 7233, of arrondissement 77,202.

Bernburg ‖ Berne.

BERNBURG, a city, the capital of the duchy of Anhalt-Bernburg. It is situated on the river Saale, by which it is divided into two parts. It is the seat of the ducal courts of judicature, revenue, and other branches of administration. The sovereign residence or castle is on an elevation, surrounded with deep ditches, below which are the gardens and a fine orangery. It is a neat well-built capital in miniature, with a college, a mint, a gymnasium, orphan-house, and other public buildings. It has some trade in brewing, in snuff-making, earthenware, and ironmongery. Pop. 6100. Long. 11. 39. 23. E. Lat. 51. 47. 55. N.

BERNE, a canton in the centre of Switzerland, is situated between Lat. 46. 19. and 47. 30. N. Long. 6. 50. and 8. 28. E. It is bounded by the cantons of Soleure, Argau, Lucerne, Unterwalden, and Uri on the east; the Valais on the south; the cantons of Vaud, Fribourg, and Neufchatel on the west; and by the canton of Soleure and France on the north and north-west. Berne is the largest canton in Switzerland: its surface is estimated at 2562 square miles. The population in 1851 amounted to 457,921, of whom 403,769 were Protestants, and 54,044 Catholics. Nature has divided this canton into three regions, in which the climate varies with the elevation. In the southern part, called the Oberland, rise the Alps, and rich valleys lie stretched beneath them. Of the mountains, the highest are the Finsteraarhorn, the Schreckhorn, the Wetterhorn, the Eiger, and the Jungfrau. Of all Switzerland this region is the most interesting and attractive to travellers; below are fertile plains, a little above are green pastures, and higher still are gigantic glaciers, roaring waterfalls, and precipices with lofty peaks lost in the sky; below there is the temperate heat of southern climates, and above the coldness of the pole. Towards the north the ranges of the Jura are considerably lower. The central part is a fertile and carefully cultivated plain, abounding in corn and all sorts of fruits; the corn raised, however, is insufficient for the inhabitants, and large quantities require to be imported. The pastures in the Oberland and Emmethal are excellent, and produce the finest cattle: the latter valley is celebrated for its breed of horses, many of which are exported to France for draught and heavy-armed cavalry. It also produces cheese of excellent quality: the quantity made is estimated at 50,000 cwt. a-year, a great part of which is sent into Germany and Italy.

The principal river in the canton is the Aar, which receives numerous tributaries, the chief of which are the Emmat, the Birs, and the Doubs: the Emme forms the lakes of Bienne and Thun. The industrial productions are cotton, woollen, and flaxen stuffs, leather, watches, lace, and wood-work of all kinds. The rivers and roads which traverse the canton are favourable to commerce. The exports consist of hides, stuffs, *kirschwasser* cheeses, horses, and cattle. Iron, lead, and copper mines are wrought; there are also quarries of marble, lime, grit-stone, &c.; and the numerous forests furnish wood in abundance.

The canton of Berne is divided into 28 bailiwicks or prefectures. Its capital is Berne: the other chief towns are Bienne, Burgdorf, Thun, Porentruy, and Délemont. In the year 1798, 30,000 French invaded the canton, at which time Berne was deprived of nearly the half of its territory. A portion of it was restored in 1814; and there was likewise added to it the larger part of the bishopric of Bâle.

The canton of Berne occupies the second rank in the confederation, and returns twenty-three members to the national council. Its federal contingent is 104,080 Swiss francs, and 5824 men. For an account of the government and ju-

Berne ‖ Berners.

dicial system, in which great changes were made on the adoption of the new federal constitution in 1848, see SWITZERLAND.

BERNE, capital of the canton of the same name, and since 1849 the permanent seat of the Swiss government and diet, and the residence of the foreign ministers. It stands on a sandstone promontory formed by the winding of the river Aar, which nearly surrounds it, at an elevation of 1710 feet above the sea. Lat. 46. 57. N. Long. 7. 25. E. Berne was founded A.D. 1191 by Duke Berchtold of Zähringen, and gradually became a refuge for those who were oppressed by feudal exactions. In 1218 it was declared a free and imperial city by the Emperor Frederic. It thenceforward increased in importance, and excited the jealousy of the neighbouring states. They combined against it with the nobility of Berne, but were completely defeated in the battle near Laupen, June 21. 1339, by the Bernese, under Rodolph Von Erlach, to whose memory a bronze statue has been erected in the Münster-platz. In 1352 it joined the Swiss confederation. A fire destroyed the city in 1405; but it was afterwards rebuilt on the same plan. The Aar is here crossed by two fine stone bridges, one of which is 900 feet long, with a central arch 150 feet wide, and 93 feet high.

Viewed from a distance Berne presents a striking appearance. Situated within view of the snowy range of the Bernese Alps, the landscape is one of indescribable sublimity. The interior of the town itself is imposing. "It is impossible," says Stapfer, "for a stranger not to be struck with the breadth of the streets, and with the equal height and beautiful appearance of the houses, all of hewn stone, adorned with arcades, the pillars of which support the first floor; but he cannot help feeling a kind of sad solitude which pervades the almost deserted streets, the tide of passengers who traverse the thoroughfares being concentrated under the arcades. A very small number of striking edifices interrupt this row of singular habitations, all constructed on the same plan, and presenting in their general aspect the appearance of a large convent. Among these are the cathedral and the guild-hall in the middle of the city, on the southern and northern sides of the declivity on which Berne is situated; two magnificent hospitals; an asylum for orphans; a large corn-granary; a mint, and two towers for public uses. These are the only buildings which break the line of perfect republican equality which reigns in the rest of the town."

Berne possesses a university (founded in 1834), a great number of educational establishments and admirable charitable institutions, a valuable museum, a public library of 40,000 volumes, and several literary and scientific societies. Although, properly speaking, not a commercial city, it carries on some trade in cloth, printed calico, muslin, silk stuffs, silk and cotton stockings—articles fabricated in the manufactories of the town. The climate is severely cold in winter, the town being situated at so considerable an elevation above the level of the sea. The population, comprehending that of the villages under the town's jurisdiction, is reckoned at 27,000.

BERNE Machine, the name of an engine for rooting up trees, invented by Peter Sommer, a native of Berne.

BERNERA, an island on the western coast of Lewis, from which it is separated by Lochs Bernera, Burglow, and Roag. It is about 5 miles in length by 3 in breadth, and has a number of large upright stones, remains of a druidical structure. A small island off its north coast is called Little Bernera.

BERNERS, JULIANA, prioress of Sopewell nunnery, near St Albans, was the daughter of Sir James Berners, who was beheaded in the reign of Richard II. She was celebrated for her beauty, her spirit, and her passion for field sports. To her are attributed the treatises on "Hawkynge, Huntynge, and Fysshynge with an Angle; also a right noble Treatyse on the Lygnage of Cot Armours, endynge with a Treatyse which specyfyeth of Blasynge of Armys," printed in folio by Wynkyn de Worde in 1496. The first and rarest edition, printed at St Albans in 1486 does not contain the treatise on fishing. Juliana Berners is noticed by Ames and Wharton; and Hazlewood, who published an edition of the work (in facsimile of that of Wynkyn de Worde) in 1811, folio, London, has more lately examined, with industry and ability, the fair author's claims to figure as the earliest female writer in the English language.

Berneville ‖ Bernon.

BERNEVILLE, GILEBERT DE, a celebrated trouvère of the thirteenth century, is supposed to have been a native of Berneville, a small village near Arras. Twenty-six of his songs are preserved.

BERNHARDI, AUGUST FRIEDRICH, a learned German philologist, was born at Berlin in 1768, and died there in 1820. His *System of Language* (1801–3), and *Elements of the Science of Language* (1805), are works of great merit, as philosophic attempts to develop the science of vocal expression.

BERNI, FRANCESCO, an eminent writer of Italian jocose poetry, in very pure Tuscan, though often disfigured by licentious equivoques. His humour is broad, and his satire often cutting, though generally good-natured. He is best known in this country for his remodelling of the *Orlando Innamorato* of Boiardo, which was introduced to the English reader by the analyses and specimens by W. S. Rose in 1823. The best edition of Berni's *Rifaciamento* is that of 1545, which has been followed by Molini of Florence, in 1827.

BERNICLE. See ORNITHOLOGY, *Index.*

BERNICLE *Shell.* See MOLLUSCA, *Index.*

BERNIER, NICHOLAS, an eminent French musician, born at Mantes in 1664; died at Paris in 1734. He has left various works, and was esteemed one of the ablest composers of his time.

BERNIER, *François*, surnamed the *Mogul* on account of his travels and residence in the dominions of the Mogul, was born at Angers in France. After taking his degree of doctor of medicine at Montpellier in 1654, he visited Syria, Egypt, and the kingdom of the Mogul, where he became physician to Aurung-Zebe, and remained twelve years. Upon his return to France, he published the history of the countries he had visited, and spent the remainder of his life in composing various other works, particularly an abridgment of the philosophy of Gassendi, in 8 vols. 12mo. He died at Paris in 1688.

BERNIER'S ISLAND, a small island near the mouth of Shark's Bay, on the western coast of New Holland. This island consists of regular horizontal beds of sand and limestone, containing shells which sometimes appear at the height of 150 feet above the level of the sea. Vegetation is languid; the chief production being a species of cyprus, the long roots of which spread over the soil like net-work. Cormorants and sea eagles in small numbers are found in the island; and there are three species of lizards, one of which measures between four and five feet in length. A beautiful kangaroo is peculiar to this and two neighbouring islands, which, though timid, makes a vigorous resistance in defence of its young, few animals being more conspicuous for maternal affection. Lat. 24. 50. S. Long. 113. 5. E.

BERNINI, GIOVANNI LORENZO, commonly called the *Cavalier Bernin*, an Italian artist, born at Naples in 1598, was not only an architect and a sculptor, but also a painter and a mechanician. He was patronized by Pope Urban VIII. He lived during nine pontificates, and the works he executed at Rome are numerous, though of very questionable taste. He died in that city in 1680.

BERNON, elected abbot of Reichenau, on the lake of Zell, near that of Constance, in the year 1014, was celebrated as a poet, rhetorician, musician, philosopher, and divine. Besides other works, he wrote several treatises on music, particularly *De Instrumentis Musicalibus*, and *De*

Bernoulli. *Mensura Monochordæ;* but his most celebrated work is a treatise *De Musica seu Tonis.* This latter tract is part of the Baliol manuscript, and follows the Enchiridion of Odo. Bernon was highly esteemed by the Emperor Henry II., and succeeded so well in his endeavours to promote learning, that the abbey of Reichenau was as famous in his time as those of St Gal and Cluni. He died in 1048.

BERNOULLI, a name illustrious in the annals of the exact sciences, and belonging to a family of respectability, originally of Antwerp. During the oppressive and bigoted government of Spain, when the Flemings, like the expatriated Greeks with their stores of ancient learning, carried their arts, industry, and genius, to the less enlightened portions of Europe, this exiled family, driven from their liberties and soil for their attachment to the reformed religion, sought first an asylum at Frankfort in 1583, and afterwards at Basel, where they ultimately obtained the highest professional and civic distinctions. In the course of a single century not less than eight of its members successfully cultivated different branches of the mathematics, and by their personal labours contributed much to the extension of science and to the diffusion of correct knowledge over a great portion of Europe. The most celebrated of these distinguished men were James, John, and Daniel; but, for the sake of perspicuity, it may be proper to consider them nearly in the order of family succession.

I. BERNOULLI, *James*, was born at Basel on the 27th December 1654. He was educated at the public school of Basel, and, preparatory to his philosophical course in the university of the same city, he received private instruction from the learned lexicographer Hoffman, then professor of Greek. At the conclusion of his philosophical studies, some geometrical figures, which fell in his way, excited in him so ardent a passion for mathematical pursuits, that it was not to be checked even by the opposition and entreaties of his father, who wished him to be a clergyman. Like Pascal, whom he also resembled in intensity of religious feeling, he applied himself in secret to his favourite science, and by his unaided exertions became one of the most distinguished mathematicians of his time. In these forbidden labours he chiefly cultivated astronomy; while, with classic propriety, he chose for his device Phaethon driving the chariot of the sun, with the motto, *Invito patre sidera verso.*

In the spring of 1676 he visited Geneva on his way to the south of France, and subsequently extended his travels to England and Holland, without however relinquishing the studies of his choice. While at Geneva he taught a blind young lady several branches of science, and also how to communicate her ideas in writing; and he afterwards gave to the public, under the title of *A Method of teaching Mathematics to the Blind*, an account of the plan he had followed, which consisted in having recourse to the sense of touch, instead of that of sight.[1] At Bordeaux his Universal Tables on Dialling were constructed; and at London he had the happiness and advantage of being introduced into the philosophical meetings of Boyle, Hooke, Stillingfleet, and other learned and scientific men worthy of the age of Newton.

On his final return to Basel in 1682, he devoted himself to physical and mathematical investigations; and, in order to make the knowledge which he had acquired in travelling available, he opened a public seminary for experimental physics or mechanical philosophy,[2] which, from the interest of the experiments and the eloquence of the lecturer, became a source of attraction to his fellow-citizens. In the same year he published his essay on comets, *Conamen novi systematis Cometarum*, occasioned by the appearance of the comet of 1680, which had excited the attention of all the astronomers of Europe. This essay, and his next publication, entitled *De Gravitate Ætheris*, though both deeply tinged with the philosophy of Descartes, contain some truths not unworthy of the more correct philosophy of the *Principia.* But these, and several interesting papers in the *Journal des Savans* and *Acta Eruditorum* of that period, were only the preludes to greater labours and higher achievements. Bernoulli.

The pleasure which Pythagoras and Archimedes derived from their respective discoveries, was perhaps as vividly felt by the discoverers of the differential calculus. Newton and Leibnitz being independent discoverers, may be allowed to have had an equal share in that refined pleasure, as well as an equal claim to the merit of an invention which forms an epoch in mathematical science. But James Bernoulli, having had both the aid of his younger brother John, and the perusal of Leibnitz's new method of tangents and of maxima and minima, previously published in the Leipsic Transactions,[3] cannot be strictly called an independent discoverer; but, from his extensive and successful application of the calculus, he is well deserving of a place by the side of Newton and Leibnitz. As an additional claim of merit, he was the first to solve Leibnitz's problem of the isochronous curve, and to determine a curve mistaken by Galileo for a parabola—the catenarian (*la chainette*) or the curve formed by a chain suspended by its two extremities, and which he also showed to be the same as the curvature of a sail filled with wind. This curve, though proposed at first as a trial of Leibnitz's skill, is of much practical utility in regard to the nature of arches, and particularly of those of suspension.

These inquiries, like step following step, led to another interesting and useful curve, which, from being formed by an elastic plate or rod fixed at one end and bent by a weight applied to the other, he called the elastic curve, and which he also showed to be the same as the curvature of an impervious sail filled with a fluid such as water. In his investigations respecting cycloidal lines and different spiral curves, his attention was particularly directed to the loxodromic and logarithmic spirals; and his discoveries regarding the last, which possesses the remarkable property of reproducing itself under a great variety of conditions, induced him afterwards to make it the monument of his labours and the emblem of his hopes.

Whether in the frailty of envying the scientific honours of his younger brother, or in the better spirit of noble emulation, which then urged the torch of truth into brighter animation, he proposed to geometers in general, and to his brother in particular, the famous problem of isoperimetrical figures, with a promised reward for its solution. This problem engaged the attention of the British as well as continental mathematicians; and however little we may be prepared to expect such a result in the calm researches of abstract truth, it gave rise to a most unfortunate family quarrel. His brother John's solution being too hasty, and not quite satisfactory, a discussion arose, which, after much altercation, became a lasting feud, to be ended only by death.

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[1] *Journal des Savans*, 1685. Jacobi Bernoulli *Opera.*

[2] "Collegium Experimentale Physico-Mechanicum publice aperuit." *Vita Jac. Bern.* a Bat.

[3] Nova Methodus pro Maximis et Minimis, itemque Tangentibus, quæ nec fractas nec irrationales quantitates moratur, et singulare pro illis calculi genus; per G. G. L. *Act. Erud.* 1684.

Bernoulli. As the reward of merit, the mathematical chair of the university of Basel, vacant by the death of the learned Megerlin, had been conferred upon James not long after his return from his travels; and, in the discharge of the duties of his office he was so successful as to attract students from foreign parts, and to have pupils who became afterwards professors in some of the most celebrated universities of Germany. He was once made rector of the distinguished university of which he was a member, and he had other honourable distinctions bestowed on him. He and his brother John were the first two foreign associates of the academy of sciences at Paris; and, at the earnest request of the discriminating Leibnitz, they were both made members of the academy of Berlin. His fame, too, was increased by his posthumous work *De Arte Conjectandi*, which embraces the application of the doctrine of probabilities to moral, political, and economical subjects.

Three years previous to his official appointment at Basel, he had been offered a professorship at Heidelberg; but his union with an accomplished lady of his native city led him to decline the invitation. In this marriage he was happy; but his family, consisting of a son and daughter, though highly respectable in life, possessed little of the characteristic genius of their father. Intense application brought on infirmities, and a slow fever, of which he died on the 16th of August 1705, with all the resignation of a Christian, and all the firmness of a philosopher. Like another Archimedes he requested, previous to his death, that the logarithmic spiral should be engraven on his tombstone, with these words, *Eadem mutata resurgo;* elegantly alluding, by the properties of the curve, to the Christian's hope of the resurrection of the body.

In James Bernoulli were united many of the highest powers of the understanding with some of the best qualities of the heart. From a regard to truth he chose rather to be silent than eloquently wrong; and in religion he was equally removed from superstition and from free-thinking. With a bilious temperament, inducing that "philosophic melancholy" which is so often the attendant of true genius, his mind was peculiarly marked by elegance and simplicity, and by retentiveness rather than quickness. Like Plato, he combined the elegant exercises of the imagination with the more severe labours of the understanding; poetry with mathematics, and eloquence with philosophy.[1] He wrote elegant verses in Latin, in German, and in French; but although these were held in high estimation in his own time, it is on his mathematical works that his fame now rests. These are, 1. Jacobi Bernoulli Basiliensis Opera, Genevæ, 1744, 2 tom. 4to; 2. Jacobi Bernoulli Ars Conjectandi, opus posthumum: accedunt tractatus de Seriebus Infinitis, et epistola (Gallice scripta) de Ludo Pilæ Reticularis, Basiliæ, 1713, 1 tom. 4to. (See also Mémoires de l'Acad. de Paris, from 1702 to 1705; Journal des Savans; Acta Eruditorum; Eloges de Fontenelle; and Biographie Universelle.)

II. Bernoulli, *John*, was born at Basel on the 7th August 1667. His education was begun at six years of age; and his progress was such as to give a fair promise of future greatness. Having finished his literary studies, he was sent to Neufchâtel to learn commerce and acquire the French language. But at the end of a year, renouncing the enriching pursuits of the merchant for the less lucrative investigations of the philosopher, he returned to the university of Basel, where he was admitted to the degree of bachelor in philosophy. In a year after, at the age of eighteen, he obtained that of master of arts. His Bernoulli. thesis on the one occasion was *De Igne lambente*, written in Latin verse; and, on the other, *Que le Prince est pour les Sujets*, written in Greek verse.

In his mathematical education, it was his good fortune to have the able instruction of his elder brother James, whom he ultimately equalled in this congenial department of science. Chemistry, however, as well as mathematics, seems to have been the object of his early attention. In the year 1690 he published a chemical dissertation on effervescence and fermentation,[2] in which he endeavours to explain the phenomena of chemical action by the different figures of what he calls *active* and *passive* particles. But to have made a juvenile failure where so many have erred, and where some uncertainty yet remains, can scarcely infer any disgrace.

In the same year he went to Geneva, where he gave some instructions in the differential calculus to Fatio de Duiller, and afterwards proceeded to Paris, where he enjoyed the society of Malebranche, Cassini, De la Hire, and Varignon. With the Marquis de l'Hôpital he spent four months at his country residence in the study of the higher geometry, and the resources of the new calculus, of which he was an ardent promoter, and which he had the honour of imparting to his distinguished host. But his independent discoveries in mathematics are numerous and important. Of these it may be proper to mention the exponential calculus, and the curve called by him the *linea brachystochrona*, or line of swiftest descent, which he was not only the first to determine, but at the same time to point out the beautiful relation which this curve bears to the path described by a ray or particle of light passing through strata of variable density, such as our atmosphere.

On his return to his native city he studied medicine, a pursuit in some degree allied to his now favourite study of mathematics; and in 1694 he took the degree of M. D. On this occasion he maintained an ingenious thesis on muscular motion,[3] in which, however questionable may be the theory which he adopts respecting the contraction of the muscles, he displays a happy application of mathematical principles to the investigation of their motive power.

At this period he formed a connection by marriage with one of the oldest and most respectable families in Basel; and although he had already declined a professorship in Germany, he now accepted an invitation to be professor of mathematics[4] at Groningen. By his learned instructions he endeavoured to re-animate the then decayed state of mathematical science in that university; and in order to excite a taste for such pursuits, he gave a course of experimental physics to the public of that city.[5] During a residence of ten years in Groningen, his controversies were almost as numerous as his discoveries. An incidental expression regarding the resurrection, founded on the anatomical doctrine of a constant change in the particles of the body during life, brought on him a charge of heresy, which was preferred by a theologian of more zeal than wisdom.[6] Both his voice and pen, however, were exerted against his opponents in vindication of "his reputation, his religion, and his honour;" and in a medical dissertation *De Nutritione*, published at the time, he fully states his sentiments on this subject, and triumphs over his enemies with the resolution of *living down* such accusations.

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[1] "Poeta suavis et ingeniosus, orator copiosus et elegans." *Vita Jac. Bern.* a Bat.
[2] *Dissertatio de Effervescentia et Fermentatione nova hypothesi fundata.* Basil. 1690; *iterum*, Venetiis, 1721; *tertium*, Neapoli, 1734.
[3] *Dissertatio Inauguralis Physico-Anatomica de Motu Musculorum.* Basil. 1694.
[4] See *Commercium Philosophicum*, epist. xi. and xii.
[5] *Hist. de l'Acad. des Sciences*, an 1748.
[6] *Commer. Phil.* ep. 73; and *Disputatio Medico-Physica de Nutritione.* Groningæ, 1699.

Bernoulli. An electrical appearance of the barometer first observed by Picard, and considered by John Bernoulli under the name of mercurial phosphorus, or mercury shining in vacuo,[1] procured for him the notice of royalty, and engaged him in controversy. Through Leibnitz he received from the king of Prussia a gold medal for his supposed discoveries; while Hartsœker and some of the French academicians disputed the fact. If we could suppose the calm breast of his brother James to have been in any respect ruffled by this mark of royal favour, it might perhaps be considered as the remote cause of the family quarrel about the problem of isoperimetrical figures above mentioned. But be this as it may, the problem was proposed on this occasion; and we have no desire to use any softening when truth forbids it. Indeed his most ardent admirers must allow that, in his dispute with his brother, in his controversies with the English and Scottish mathematicians, and in his harsh and jealous bearing to his son Daniel, he showed a temper no less unfortunate for its possessor than calculated to impair the lustre of his character, and detract from the respect otherwise due to it. Having declined, during his residence at Groningen, an invitation to Utrecht, he however accepted, in 1705, the mathematical chair in the university of his native city, vacant by the death of his brother James; and here he remained till death, though flatteringly invited to higher emoluments in other distinguished universities.[2] His inaugural discourse was *De Fatis Novæ Analyseos et Geometriæ Sublimis*, which he himself so successfully applied in investigating the solid of least resistance, the problem of orthogonal trajectories, and various others both in pure and mixed mathematics. Successful in his official labours, at the request of the magistracy of Basel he applied himself to correct the relaxed discipline of the university, which was not indeed the least difficult task which he achieved.

He was several times a competitor for the prizes given by the academy of sciences of Paris; and his essays crowned with success were, on the laws of motion,[3] on the elliptical orbits of the planets, and on the inclination of the planetary orbits.[4] This last honour his son Daniel, the pupil of a better philosophy than the Cartesian, had the merit to divide with him; though the ambitious sensibility of the old man seems to have been hurt with what in other circumstances would have afforded him pleasure.

Some years after his return to Basel he published a valuable essay, entitled *Nouvelle Théorie de la Manœuvre des Vaisseaux*, which was occasioned by the questionable principles advanced by Renau on the same subject. But his works in pure mathematics are the permanent monuments of his fame, and must be studied to be fully appreciated. D'Alembert indeed acknowledges in gratitude, that "whatever he knew of mathematics he owed to the works of John Bernoulli." If his *Hydraulica*, one of the latest of his productions, was written, as has been supposed, in rivalry of the more original work of his son Daniel, it can only be considered as a proof of that infirmity from which great minds are not always free.

His health had at one period suffered much, as he says,[5] from those midnight hours of mental labour stolen from sleep; yet such was the vigour of his constitution, that he continued to pursue his usual mathematical studies till the age of eighty. He was then attacked by a complaint at first apparently trifling; but his strength daily and rapidly declined till the 1st of January 1748, when he fell asleep, Bernoulli. and thus expired without agony, or even a discomposing pang;[6] a death not unlike that of the illustrious chemist Black, who died with his usual meal of milk balanced in his hand, as if to show by an experiment how easy his exit from life had been.

He was a member of almost every learned society in Europe, and one of the first mathematicians of a mathematical age. With great warmth of temperament, he was as keen in his resentments as ardent in his friendships: a tender husband, though a severe brother; fondly attached to his family, yet disliking a deserving son; giving full praise to Leibnitz and Euler, yet blind to the surpassing excellence of Newton; sincere in his religion, though attacked by a theologian, and eulogised by a freethinker. The graphic if not faultless pencil of Voltaire has thus drawn his character:

> Son esprit vit la vérité,
> Et son cœur connut la justice.
> Il a fait l'honneur de la Suisse,
> Et celui de l'humanité.

His various writings were collected under his own eye by Cramer, professor of mathematics at Geneva, and published under the title of *Johannis Bernoulli Opera Omnia*, Lausan. et Genev. 4 tom. 4to; and his interesting correspondence with Leibnitz under the title of *Gul. Leibnitii et Johannis Bernoulli Commercium Philosophicum et Mathematicum*, Lausan. et Genev. 1745, 2 tom. 4to.

III. Bernoulli, *Nicholas*, the eldest of the three distinguished sons of John Bernoulli, was only a few months old when his father went to Groningen in the autumn of 1695.[7] His early indications of genius were cherished with all the fond attention usually bestowed on a firstborn. At the age of eight he could speak German, Dutch, French, and Latin. When his father returned to Basel he went to the university of that city, where, at the age of sixteen, he took the degree of doctor in philosophy, and four years after the highest degree in law.

During these pursuits the study of mathematics had not been neglected, as appears not only from his giving instructions in geometry to his younger brother Daniel, but from his writings on the differential, integral, and exponential calculus, and from his father considering him, at the age of twenty-one, worthy of receiving the torch of science from his own hands.[8]

Gladly embracing his father's permission to travel, he visited Italy and France. In the one he formed a friendship with Varignon, and in the other with Riccati, one of the first mathematicians of Italy, and the father of a family in some degree talented like the Bernoullis themselves; but ill health precluding him from reaping the advantages of more extended travelling, he returned to his native city.

The invitation of a Venetian nobleman, however, induced him again to visit Italy, where he resided two years, till his return to be a candidate for the chair of jurisprudence in the university of Basel. Disappointed in this object by the rather singular mode of election by lot, he was soon afterwards honourably appointed to a similar office in the university of Berne. Here he resided three years, respected and beloved, and with no other regret than what he felt on account of his separation from his brother Daniel; an attachment of kindred minds united

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[1] *Diss. Physica de Mercurio lucente in vacuo.* Basil. 1719.
[2] *Commer. Phil.* ep. 214.
[3] *Discours sur les Loix de la Communication du Mouvement.* A Paris, 1727.
[4] *Essai d'une Nouvelle Physique Céleste.* A Paris, 1735.
[5] *Commer. Phil.* ep. 14.
[6] *Hist. de l'Acad.* 1748.
[7] *Commer. Phil.* ep. 17.
[8] "Lampada nunc tradam filio meo natu maximo, juveni xxi. annorum, ingenio mathematico aliisque dotibus satis instructo." (*Com. Phil.* ep. 223.)

Bernoulli. in sentiment and pursuit, and deserving, in truth, the appellation of "par nobile fratrum." Both seemed fortunate in being appointed at the same time professors of mathematics in the academy of Petersburg; but this important office Nicholas enjoyed for little more than eight months. In the end of July 1726 he was cut off by a lingering fever, in the prime of life, and in the opening career of useful labour.

Sensible of the loss which the nation had sustained by the death of Nicholas Bernoulli, the Empress Catherine ordered him a funeral at the public expense; and, waiting at the academy, she presented her condolence in person to his surviving brother.[1]

Some of his papers are published in his father's works, and the others in the *Acta Eruditorum*, and the *Comment. Acad. Petropol.*

IV. Bernoulli, *Daniel*, second son of John Bernoulli, was born 9th February 1700, during his father's residence in Groningen. Like his father, Daniel was intended for a mercantile life; but, preferring a learned profession, he studied medicine, became a physician, and, following with hereditary ability and ardour his paternal steps, he rose to an eminence and fame worthy of his first and favourite appellation, "Son of John Bernoulli."

Taught by his father to regard mathematical learning as the sure foundation of all science and all practical art, his attention was early directed to geometrical studies, though the severity of his father's manner was ill calculated to encourage the first efforts of one of so sensitive a disposition; but fortunately, at the age of eleven, he became the pupil of his affectionate brother Nicholas.[2] Mathematics and medicine were equally the studies of his youth, and these he had the means of cultivating with particular advantage in Italy under Michelotti and Morgagni; the former being an able geometer, and the latter well skilled in several branches of physical science, as well as in anatomy. In such society he breathed a kindred element; and when he left Italy, he returned to his native country with well-won literary and scientific honours.

About this time, though only twenty-four years of age, he was invited to become president of an academy then projected at Genoa; but, declining this honour, he was, in the following year, appointed professor of mathematics at Petersburg. In this situation, although he enjoyed a competent salary, he still looked back with fond regard to the humble but equal lot of his native country. And on his resolving to leave Russia, the court of Petersburg not only augmented his salary, but granted him the half as a retiring pension, with the liberty of returning if he chose. This truly generous conduct made him for a time forego the gratification of a desire so peculiarly strong in a native of Switzerland. His health, however, allowing him only to remain three years longer, he returned to Basel, where in a short time he was appointed professor of anatomy and botany, and afterwards of experimental and speculative philosophy. In the useful and honourable labours of this office he spent the remaining years of his life, which are scarcely marked by any other events than the calm conquests of intellect, and the communication of valuable knowledge and good deeds to mankind.

He had previously published some medical and botanical dissertations, besides his *Exercitationes quædam Mathematicæ*, containing a solution of the differential equation proposed by Riccati, and which now bears the name of that celebrated geometer. In 1738 his *Hydrodynamica* appeared; and whatever may be its defects, it must be allowed to be at once an original and useful work. The equilibrium, the pressure, the re-action and varied velocities of fluids, are considered, not merely theoretically, but practically, with reference to the conveyance of water in pipes and canals, to machines for raising water, and also as a moving power in different mechanical operations. The concluding problem, illustrated by experiment, embraces an ingenious mode of propelling vessels by the reaction of water ejected from the stern.—*Hydrodynamica*, p. 30. Some of his experiments on this subject were performed in the presence of Maupertuis and Clairaut, whom the fame of the Bernoullis had attracted to Basel—a city famed for learning, and which had then, as D'Alembert remarks, become to the philosophers of France what Egypt had been to the philosophers of ancient Greece. Bernoulli.

With a success equalled only by Euler, his fellow-citizen, his friend, and successor at Petersburg, Daniel Bernoulli gained or shared no less than ten prizes of the Academy of Sciences of Paris. The first, on the construction of a clepsydra for measuring time exactly at sea, he gained at the age of twenty-four; the second, on the physical cause of the inclination of the planetary orbits, he divided with his father; and the third, on the tides, he shared with Euler, Maclaurin, and another competitor, whose only merit consisted in making a last effort to support the system of Descartes.

The problem of vibrating cords, which had been some time before resolved by Taylor and D'Alembert, became the subject of a long dispute between Daniel Bernoulli and his illustrious friend Euler. This discussion, however, was conducted with that generous spirit which soars above personalities, and with almost equal claims to praise; the one, in support of D'Alembert, displaying all the force of analysis; and the other, in defence of Taylor, using all the address of a mind fertile in resources.

In one of his early investigations on mechanics, he has given an ingenious though indirect demonstration of the problem of the parallelogram of forces; and in other papers, contained also in the Petersburg Memoirs, he has published researches of a higher character and of equal utility. His labours in the decline of life were chiefly directed to the doctrine of probabilities in reference to practical purposes, and in particular to economical subjects; to inoculation as an object of national interest, and to the duration of married life in the different sexes, and the relative proportion of male and female births. But in such speculations the premises often do not embrace all the existing circumstances; so that we need not be much surprised to find the results sometimes at variance with nature. His great object however was, in the spirit of true philosophy, to employ theory only as a means to investigate the secrets of nature, and to apply mathematics to explain with accuracy and certainty the phenomena of the universe.

By a regular and calm tenor of life, though of a delicate constitution, he retained his usual vigour of understanding till near the age of eighty, when his nephew James relieved him of his public duties. Being afflicted with a troublesome asthma, his retirement was confined to the society of a few chosen friends. In the spring of 1782 all his complaints were increased, and, after some days illness, this excellent man and true philosopher died like his father, in the repose of sleep.[3]

He was never married, owing, it is said, to a misplaced affection in youth. His manners were unaffected, and his society agreeable. His house, his table, and his dress, had nothing inconsistent with simplicity. Frugal without parsimony, and benevolent without ostentation, the wealth which might have been expended in selfish pleasure or

[1] See *Vita N. Bernoulli*, *Com. Acad. Petrop.* vol. ii.

[2] *Vita Nic. Bern.*

[3] See *Mém. de l'Acad. an* 1782.

Bernoulli. idle show was judiciously employed in forming an endowment for poor students at Basel. Excluded by his professional character from the councils of the republic, he however received all the deference and honour of a first magistrate. He indeed enjoyed an esteem and respect seldom accorded to living worth. One of the first lessons which a parent taught his child was to bow to Daniel Bernoulli. Gratified as he must have been by this flattering regard of his fellow-citizens, he was yet wont to mention two incidents in his life as having afforded him the greatest pleasure; the accidental meeting and indirect approbation of Newton, and the solving of Kœnig's difficult problem, while he did the honours of the table for him.

Like his father, he was a member of almost every learned society of Europe, and he succeeded him as foreign associate of the academy of Paris. Several of his interesting investigations are contained in the earlier volumes of the Petersburg Memoirs; and his separately published works are, 1. *Dan. Bernoulli Dissertatio Inaugur. Phys. Med. de Respiratione.* Basil. 1721, 4to. 2. *Positiones Anatomico-Botanicæ.* Basil. 1721, 4to. 3. *Exercitationes quædam Mathematicæ.* Venetiis, 1724, 4to. 4. *Dan. Bernoulli Hydrodynamica.* Argentorati, 1738, 4to.

V. Bernoulli, *John*, the youngest of the three distinguished sons of John Bernoulli, was born at Basel on the 18th May 1710. He studied law and mathematics, and, after travelling in France, was appointed professor of eloquence in the university of his native city. In this office he continued five years, till the death of his father, whom he succeeded as professor of mathematics. He was thrice a successful competitor for the prizes of the academy of sciences of Paris. His prize subjects were, on the capstan, on the propagation of light, and on the magnet. The friendship of Maupertuis, who died under his roof while on his way to Berlin, was esteemed by him not the least of his honours. He himself died in 1790, at the age of eighty. His two sons, John and James, are the last noted mathematicians of the Bernoulli family.

VI. Bernoulli, *Nicholas*, cousin of the three preceding, and son of Nicholas Bernoulli, one of the senators of Basel, was born in that city on the 10th October 1687. He is frequently mentioned with approbation both by his uncle and Leibnitz in their epistolary correspondence. He visited England, where he was kindly received by Newton and Halley,[1] previously to his appointment at Padua to the mathematical chair which Galileo had once filled. But neither the classical recollections, nor the superior wealth of Padua, were sufficient to prevent his return to the freedom and happy mediocrity of his native city. At Basel he was successively professor of logic and of law, where he died on the 29th of November 1759. He was editor of the *Ars Conjectandi* of his uncle James. His own works are not published separately, but are contained in the *Acta Eruditorum*, the *Giornale de' Letterati d'Italia*, and the *Commercium Philosophicum*.

VII. Bernoulli, *John*, grandson of the celebrated John Bernoulli, and son of the second of that name, was born at Basel on the 4th December 1744. He studied at Basel and at Neufchâtel, and when thirteen years of age he took the degree of doctor in philosophy. His Thesis, *De Variolarum Insitione*, is still preserved in Haller's *Letters*. It gives a short history of inoculation, as well as the method of operation and manner of treatment which had recently and successfully been practised on himself.

The kindred studies of mathematics and astronomy were his early pursuits. When only nineteen years of age he was appointed astronomer royal of Berlin. Some years after, obtaining leave to travel, he visited Germany, France, and Bernoulli. England; and subsequently Italy, Russia, and Poland. On his return to Berlin he was appointed director of the mathematical department of the academy of that city. Here he died on the 10th July 1807, being, at the time of his death, a member of several of the learned academies of Europe.

He is a very voluminous and varied writer. His writings consist of several volumes of travels, besides astronomical, geographical, and mathematical works. In 1774 he published a French translation of Euler's Elements of Algebra at Lyons, in 2 vols. 8vo. He was a conductor of some of the periodical works of Berlin, and in the academical memoirs of that city are several of his papers on astronomical subjects. Those for the years 1803 and 1804 contain his observations and experiments on the cultivation of *zea mays* or Indian corn in Switzerland and Germany, and on its advantageous application to various economical purposes.

VIII. Bernoulli, *James*, younger brother of the preceding, and the second of this name, was born at Basel on the 17th October 1759. He displayed early talents, which were cultivated with the greatest care. Having finished his literary studies, he was, according to custom, sent to Neufchâtel to acquire the French language. On his return to his native city he studied law and took a degree.

The study of law, however, had neither alienated nor checked his hereditary taste for geometrical pursuits. The early mathematical lessons which he had received from his father were continued by his uncle Daniel, so as to give new vigour to his native predilection for the exact sciences. Such, indeed, was his progress in these studies, that at the age of twenty-one the directors of the university of Basel committed to him the duties of the chair of experimental physics, which his uncle's advanced years rendered him unable to discharge. But although he filled this important office with satisfaction, both to the directors and to his auditors, he did not succeed on his relative's death. The lot was capricious, and the voice of public opinion (by which almost all the important appointments at Basel were then decided) unfavourable. He had been formerly, too, an unsuccessful candidate for the chair of eloquence; so that, with perhaps a conscious feeling of unmerited neglect, he published on the present occasion a thesis *De Sublimi*.

This repeated disappointment, combined with the desire of travelling, so natural and so powerful in youth, induced him to accept the situation of secretary to Count de Brenner, which afforded him an opportunity of seeing a great part of Germany and Italy. In Italy he formed a friendship with Lorgna, professor of mathematics at Verona, and one of the founders of the Italian society for the encouragement of the sciences. He was also made corresponding member of the Royal Society of Turin; and, while residing at Venice, he was, through the friendly representation of Fuss, admitted into the academy of Petersburg, with the promise of promotion in the course of a year. In 1788 he was accordingly made one of the mathematical professors of that flourishing seminary, and in the following year he married a daughter of Albert Euler, son of the illustrious Euler. This marriage, which united names equally dear to science, and, from congeniality of sentiment, promised much happiness, was almost tragically dissolved in the space of two short months. Residence in the country, and the opportunity of bathing in the Neva, had given him a taste for that healthful but sometimes fatal exercise. Being an excellent swimmer, he was fearlessly enjoying this recreation, when at once he sunk without any appearance of danger or expression of pain. He was instantly

[1] *Com. Phil.* ep. 199.

Beroe || Berthollet

taken out by his brother-in-law, and every means of resuscitation applied, but without success. The opinion of the physicians was that his death had been occasioned by a shock of apoplexy. His constitution indeed was naturally delicate, and two years before he had suffered much from a nervous fever. His premature death at the age of twenty-nine was a source of deep regret, not only to his relatives, but to many whom he had attached to him by a character open, obliging, gentle, and modest.

Several of his papers are contained in the first six volumes of *Nova Acta Acad. Scien. Imper. Petropol.*, in the *Acta Helvetica*, in the *Memoirs of the Academies of Berlin and Turin*, and in his brother John's publications. He also published separately some juridical and physical theses, and a German translation of *Mémoires du Philosophe de Merian.* (T. A.)

BERNSTADT, a town of Prussian Silesia, twenty-two miles east of Breslau. It has a ducal castle, and manufactures of woollen and linen stuffs. Pop. 3600.

BEROE, a genus of ciligrade acalephous animals. See MOLLUSCA.

BERŒA, an ancient city of Macedonia, S.W. of Pella, on the river Astræus, a tributary of the Haliacmon. It is now known by the name of *Boor*. The Berœans are commended in Scripture for their reception of the Gospel. There was another Berœa in Syria, called also *Beroe*, and by the inhabitants *Berœa*. It is supposed to be identical with the modern Aleppo, or *Haleb*, so called from Chalep, the name given to Berœa by the Byzantine writers. There was a third town of this name in Thrace, between Philippopolis and Nicopolis.

BEROSUS, a priest of the temple of Belus at Babylon in the time of Ptolemy Philadelphus, and author of the History of Chaldæa, a work often cited by the ancients, and of which Josephus gives some curious fragments. The best editions of these fragments are by Richter, Lipz. 1825, and in Didot's *Fragm. Historicorum Græcorum*, vol. ii. Paris, 1848.

BERRE, a town of France, in the department of the Bouches-du-Rhone, and on a lake of the same name. It is remarkable for the quantity and excellence of the salt made there. Long. 5. 9. E. Lat. 43. 22. N. Pop. 1871.

BERRETINI DA CORTONA, PIETRO, historical and landscape painter, was born at Cortona in 1596, and, according to some writers, was a disciple of Andrea Commodi, though others affirm that he was the disciple of Baccio Ciarpi. This distinguished artist died in 1669. Some of his best works are in the Barberini Palace at Rome, and the Palazzo Pitti at Florence.

BERRETONI, NICOLO, historical painter, born at Montefeltro in 1637, was a disciple of Carlo Maratti, under whom he studied design and colouring, and attained such excellence that he excited the jealousy of his master. He died in 1682. (Lanzi.)

BERSARII (from *bersare*, to shoot with a bow, or from *bersa*, a fence), in writers of the middle ages, a term for hunters or sportsmen.

BERTHOLLET, CLAUDE LOUIS, one of the most distinguished chemists of the French school, was not a native of France, but born at Talloire, near Annecy, in Savoy, in 1748. He received his education first at Chambery, and subsequently in the provincial college at Turin, where he took his degree as a physician. On arriving at Paris, he soon became the medical attendant of Philip Duke of Orleans; and by the publication of a volume of chemical essays, which gained him such reputation that he was admitted, in 1781, into the Academie des Sciences. Through the interest of his royal patron he was appointed government superintendent of the establishment for the improvement of dyeing; and the result was the production of his very valuable essay *Sur la Teincture*, a work that first systematized and chemically explained the principles of the art of dyeing. This work has been well translated into English by Dr Wm. Hamilton, in two vols., 1791. Berthol-letia.

Berthollet early adopted the chemical views of Lavoisier, which he illustrated with great ingenuity, and contrasted with the phlogistic hypothesis of Stahl; and to the two former, assisted by Morveau and Fourcroy, we owe that beautiful system of chemical nomenclature to which subsequent philosophers have been so much indebted. Berthollet confirmed and extended the discoveries of Priestley on ammonia; discovered, among other curious substances, fulminating silver; and greatly extended our knowledge of that important substance the dephlogisticated marine acid of Scheele, for which the name of oxymuriatic acid was then proposed, and which is now termed chlorine. It was he who first proposed to apply it to bleaching—in 1785. During these researches he discovered the remarkable salt now called chlorate of potassa; and we owe to him also an excellent essay on the chemical constitution of soaps. But we cannot here attempt an enumeration of all the contributions to chemistry by this estimable philosopher: they are scattered through between eighty and ninety memoirs in the *Journal de Physique, Annales de Chimie, Memoires de l'Institut, and Memoires d'Arceuil*, from which they have been copied into all the philosophical journals of Europe.

At the commencement of the French Revolution the scarcity of saltpetre for the manufacture of gunpowder was much felt; and Berthollet was placed at the head of a commission for improving the processes for obtaining this important product within the territory of France. In this vocation he visited almost all France, and greatly improved and simplified the modes of obtaining and purifying saltpetre. Soon afterwards we find him one of a commission for improving the processes in the smelting of iron, and converting it into steel. The government fully appreciated his merits; and in 1792 he was appointed a director of the mint, in which he introduced several important improvements. In 1794 he was an active member of the committee on agriculture and the arts; while he filled the office of teacher of chemistry in the Polytechnic and Norman Schools of Paris, and was an active member in the remodelling of the National Institute in 1795.

When the victories of Buonaparte prostrated Italy, Berthollet and Monge were appointed by the convention as the heads of a commission to select from the spoils of Italy the choicest specimens of ancient and modern art, for the national galleries of Paris. This circumstance introduced Berthollet to the victorious general; and, in after years, led to his accompanying Buonaparte in the expedition to Egypt, where he was one of the most distinguished members of the Institute of Cairo. On the overthrow of the executive directory, Berthollet was made a senator, and a grand officer of the Legion of Honour. Under the empire he was created a count, and sat as a peer on the restoration of the Bourbons.

His last work was his curious essay on *Chemical Statistics*, in which he endeavoured to show that other causes than the mere force of elective attractions, as explained by Bergman, aided in producing chemical combinations; and he particularly showed how certain decompositions could be explained without the supposition of what was termed predisposing affinities, by the influence of insolubility, of aggregation, and of the mass of one of the ingredients. This ingenious theory was never generally adopted by chemists, the theory of definite proportions, and of opposite electric states, being supposed sufficient to explain chemical phenomena.

Berthollet was a man of great modesty and unostentatious manners. For some years he lived rather retired at Arceuil, especially after his grief for the misconduct and suicide of his only son. In 1822 he was attacked with a painful and lingering malady, which he bore with manly fortitude, and which ended in an enormous gangrene that put a period to his sufferings on the 6th of November of that year. (T. S. T.)

BERTHOLLETIA, a genus of plants of the nat. ord. of

Berthoud ‖ Bertinoro.

Lecythideæ. The lofty tree that produces the *Brazil or Para nut* is a Bertholletia. The kernels are contained in a spheroidal shell or case as large as a man's head, with four cells, in each of which are six or eight kernels. See *Plantæ Æquinoxiales* of Humboldt and Bonpland.

BERTHOUD, FERDINAND, chronometer-maker to the French admiralty, member of the Institute of France and of the Legion of Honour, was born near Neufchâtel in 1727. His father was an architect, and the son was intended to be bred to the church; but, having shown a taste for clockwork, an experienced workman was engaged to instruct him in its principles, and young Berthoud was afterwards sent to Paris to improve himself in the knowledge and practice of the art. He settled in Paris in 1745, and applied himself to the making of chronometers, an art which was then in its infancy. A chronometer is an accurately-made watch, whose chief peculiarity consists in a piece of mechanism intended to render the number of vibrations of the balance equal in equal times, at all the degrees of temperature to which the instrument is exposed; and the chronometer being a portable instrument, which can be used on ship-board, is by this mechanism made to move at a constant rate—say at the rate of mean solar time—so that it shows what hour it is at the meridian of Greenwich, if the chronometer, at the commencement of the voyage, was set to Greenwich time; whilst the observation of the height of the sun or of a star gives the hour, angle, and the hour at the place where the ship is; and the difference between these two times is the longitude of the ship. Fleurieu and Borda, by order of the French government, made a voyage from La Rochelle to the West Indies and Newfoundland for the purpose of trying the chronometers of Berthoud, and found that they gave the longitude with only a quarter of a degree of error, after a cruise of six weeks. Satisfactory results were also obtained in the expedition of Verdun, Borda, and Pingré, which was appointed to try his chronometers and those of Le Roy. An account of this expedition is published.

Sully, an English watch-maker established in Paris, was the first who in that city attempted the construction of chronometers for finding the longitude; and this he did in 1724. In 1736 the chronometers of the English artist Harrison were tried at sea. In France there were no chronometer-makers of note, from the first attempts of Sully, till Pierre le Roy and Ferdinand Berthoud, between whom there was some discussion about the priority of their discoveries and improvements. Ferdinand Berthoud's chronometers were long the most esteemed of any in France. Louis Berthoud, his nephew and successor, improved upon the machines of his uncle, and made them generally of a smaller size, so as to become more portable. Many further improvements have been made by the English chronometer-makers.

Berthoud was regular in his habits, and retained the use of his faculties to the last. He died of hydrothorax, at his country house, in the Valley of Montmorency, in 1807, at the age of eighty. The principal of his published works are *Essai sur l'Horlogerie*, 1786, 2 vols. 4to; two Tracts on Chronometers, 1773; *De la Mésure du Temps*, 1787, 4to; *Les Longitudes par la Mésure du Temps*, 1775, 4to; a Tract on Chronometers, 1782, 4to; *Histoire de la Mésure du Temps par les Horloges*, 1802, 2 vols. 4to; *L'Art de conduire et de régler les Pendules et les Montres* 1760, 12mo. This tract contains directions suited to general readers for regulating clocks and watches: it has gone through several editions. (W. A. C.)

BERTINORO, a city in the delegation of Forli in Italy, in the papal dominions, the seat of the bishop of the united dioceses of Forlempopoli and Bertinoro. It stands on a hill, below which the river Ronco flows, and is celebrated for the excellence of its wine. It contains about 4000 inhabitants. Long. 12. 2. 30. E. Lat. 44. 8 34. N.

Berwick ‖ Berwickshire.

BERWICK, THE DUKE OF, was a natural son of James II. by Arabella Churchill, sister to the great Duke of Marlborough. "The youth, named James Fitzjames (Macaulay's Hist. of Eng., vol. ii. p. 326), had as yet given no promise of the eminence which he afterwards attained; but his manners were so gentle and inoffensive that he had no enemy except Mary of Modena, who had long hated the child of the concubine with the bitter hatred of a childless wife. A small part of the Jesuitical faction had, before the pregnancy of the Queen was announced, seriously thought of setting him up as a competitor of the Princess of Orange. It does not appear that this absurd design was ever countenanced by the king. The boy, however, was acknowledged; and whatever distinction a subject not of the royal blood could hope to attain were bestowed on him. He had been created Duke of Berwick; and he was now loaded with honourable and lucrative employments, taken from those noblemen who had refused to comply with the royal commands." At the revolution of 1688, he became an exile with his father in France, where he was recommended to the court by his superior merit. He was created marshal of France, knight of the Holy Ghost, duke and peer of France, grandee of Spain, and commander-in-chief of the French armies; nor were these honours and employments greater than his services merited. He lived in an age when the Prince of Orange and many other great generals commanded against him; yet his reputation as a warrior suffered no eclipse by the comparison; while the victory of Almanza, which secured Spain to the Bourbon dynasty, stamped his character as a great and successful commander. His courage was cool and steady; and he was eminently remarkable for entire self-possession in all circumstances, even the most critical;—watchful, cautious, and persevering; ever ready to take advantage of a fault or an oversight committed by an antagonist, yet, throughout his whole career, frugal of the blood of his soldiers, and anxious that it should not on any occasion be wantonly or unnecessarily shed. The system of discipline he maintained was rigid; and although the wants of the soldier were scrupulously attended to, no commander ever punished excesses with greater severity.

The Duke of Berwick was much blamed by the more zealous and violent adherents of the Stuart family for not being sufficiently attached to the Jacobite party, which was that of his own family. But on a cool examination of his actions it will appear that his behaviour in this particular was, like the rest of his conduct, equally sensible and just. When he accepted of employments, received honours and dignities, and became naturalized in France, he considered it his duty to become a Frenchman in reality, and to be regulated in regard to the cause of the Stuarts according to the will and pleasure of the sovereign whom he served. But when commanded by his king to promote the views of the Stuart family, he acted with the greatest sincerity, and took the most sensible and effectual methods to serve his unhappy house. In a word, the Duke of Berwick was a man of high principle and honour; and he showed by his life and actions that moral integrity is compatible and consistent with the life of a statesman and a great general. He was killed by a cannon-ball at the siege of Philipsburg on the Rhine, in 1734, in the sixty-fourth year of his age.

BERWICKSHIRE, a county situated at the S.E. extremity of Scotland, is bounded by the German Ocean on the E.; by East Lothian on the N.; by a part of Mid-Lothian, but chiefly by Roxburghshire, on the W.; by the river Tweed, and that part of Roxburghshire which lies to the N. of the same river, on the S.; and by the township of Berwick on the S.E. On the S., the Tweed, in a winding course of about 35 miles, divides it, first, from the part of Roxburghshire which lies south of the river; secondly, from Northumberland; and thirdly, from North Durham. Its northern extremity is situated in N. Lat. 55. 58. 30.; and its southern

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point upon the Tweed is in 55. 36. 30. Dunse, its principal town, is situated nearly in the centre of the county. The extreme length of the county is 31¼ miles, and its extreme breadth 19½ miles. Its superficies is 446 square miles, or 285,440 acres, of which more than one-half is supposed to be arable, the remainder consisting of upland pasture and unreclaimed moor.

The county consists of two divisions distinguished from each other by well-marked natural features. The first comprises the Lammermuirs, a portion of that range of graywacké hills which, commencing with the bold promontory of St Abb's Head in this county, stretches quite across to the opposite coast of Scotland. The second consists of the level district which fills up the space between the base of the Lammermuir hills and the river Tweed. This comparatively level tract is called the *Merse*, a name which in various printed accounts is said to be derived from its ancient name the *March* or Border district. There is, however no derivation in the case, as *Merse* (mepɪc) is simply the old Saxon spelling of *Marsh*, a term which, however inapplicable to the district as we now see it, must have been singularly appropriate to it in its natural state. The valley of the Leader, called Lauderdale, forms a subdivision of the Lammermuir district.

The Lammermuirs present the well-known aspect of graywacké hills, viz., a succession of round-backed ridges with long unbroken slopes covered for the most part with a stratum of peat of varying thickness, bearing a rough herbage of heather, bents, and mosses. Their general aspect is uninviting, and the whole range is bleak and unfertile. The summit level is about 1000 feet above the sea, and rises at one point, Criblaw, to 1615 feet. Along the base of these hills, and in the numerous hollows which run into them, a red soil prevails, overlying the old red sandstone, which in general is fertile and admits of profitable cultivation. The higher grounds are fit only for sheep-walks, and are with slight exceptions entirely devoted to that purpose. It is strange, however, to notice how large a portion of these elevated grounds has at some remote period been subjected to the plough. Some of these furrows obviously bear date from the close of the eighteenth and beginning of the present century, when the exorbitant price of grain tempted many of the hill farmers to cultivate an increased breadth of their lands. But these comparatively modern ploughings can at once be recognised by the straightness and uniform width of the ridges, whereas the really ancient ones are invariably serpentine and irregular. The present occupiers of these hills are in general fully alive to their unfitness for arable husbandry, and accordingly confine themselves to pastoral pursuits. These elevated grounds have been much improved for this purpose by judiciously disposed fir plantations, and other artificial means of shelter from the snow storms to which the district is much exposed, and still more by a wholesale system of surface draining. By these simple and inexpensive means, the health and well-doing of the flocks has been very greatly enhanced. These consist of Cheviot and blackfaced sheep; both of which mountain breeds are here cultivated with eminent success.

To a spectator looking from the summit of any of the front-lying eminences of the Lammermuirs, the whole of the lower valley of the Tweed, with the Merse in the foreground, is seen spreading out in an apparently unbroken plain, from the base of the hill on which he stands to that of the opposite Cheviot range. And hardly anywhere can a lovelier landscape of the kind be met with, presenting as it does a wide expanse of richly wooded and highly cultivated country, surrounded by a natural barrier of picturesque hills which inclose it on all sides, except at the narrow opening through which the Tweed empties itself into the German Ocean. This apparently level plain has in reality a very undulating surface; the whole valley being traversed lengthwise by a succession of parallel wave-like ridges. It has this peculiarity in addition, that the land has a considerable slope from the coast inwards. An obvious proof of this latter fact is presented by the rivers Till on the Northumberland side, and Leet in Berwickshire, which fall into the Tweed near Coldstream after a course from the coast inland. The traveller finds also that the roads which traverse the Merse from east to west are comparatively level, whereas on those which run from south to north he is harassed by a perpetual rise and fall. The streams which drain the district flow through these hollows, for the most part in deep and narrow ravines, where they make little show in the general landscape, although rich in secluded nooks of exquisite beauty. The ancient marshiness of the district was not therefore owing to its flatness, but to the prevalence of land-locked hollows in which water stagnated. That very undulation of surface which occasioned its swampiness has in fact afforded peculiar facilities for its artificial drainage. This has been so effectually accomplished, that the county is now as remarkable for the absence of water as it once was for its presence. The salubrity of the district, as well as its fertility, has been greatly enhanced by this wholesale drainage. Ague, once the scourge of its inhabitants, has absolutely disappeared; and its flocks are now exempt from the rot.

Berwickshire

Berwickshire is strictly an agricultural county, as—with the exception of its fisheries, a gingham factory (at Earlston), some small woollen mills, and two considerable paper mills—there are no branches of industry pursued but such as are either directly connected with or subservient to the culture of the soil. Its agriculture, however, is of the first order. For this it is chiefly indebted to natural advantages of soil and climate, but in no small degree also to its proximity to England. To the latter circumstance it owes the early introduction of improved varieties of grain and other crops, of improved modes of cultivation, of valuable breeds of live stock, and of good markets in which to dispose of its produce. In common with the neighbouring county of Roxburgh, it bears a striking resemblance in the style of its agriculture to several of the midland counties of England. The most marked features in its husbandry are the great extent and excellence of the turnip crops, and of the flocks and herds by which they are consumed. Until a comparatively recent date the cattle and sheep reared in this county were, after being brought to a fair state of flesh, transferred to England, where the fattening process was completed; but now, owing to the increased cultivation of turnips, the tide has completely turned, and immense herds of growing cattle are annually brought from the northern counties of England into the valley of the Tweed, where they are fully fattened and then returned to the butcher markets of the south. This great increase in the extent and weight per acre of the turnip crops is due in part to tile-draining, but still more so to the liberal use of extraneous manures, such as guano and bones. These improvements in the cultivation of the arable parts of the county have led to corresponding ones in the pastoral district. Formerly the sheep farmers brought their stock to market as full-grown wedders; but now their grounds are stocked almost entirely with ewes, the lambs from which are sold at weaning-time to the low-country farmers, and by them are sent to the butcher markets when from sixteen to twenty-four months old. The most of these lambs are a cross breed between Cheviot or blackfaced ewes and Leicester rams. These yield a larger price to the breeders than they could obtain from the pure mountain stock, while the increased size and propensity to fatten which they derive from the mixture of Leicester blood, adapts them to the purposes of their low-country purchasers.

The agriculture of the county has recently derived considerable advantages from the railways by which it is now intersected and skirted. This at once led to the establishment of a weekly grain market at Dunse, in the centre of

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the county, and of a fortnightly cattle market at Berwick-on-Tweed. Nearly the whole produce of the county is now sent to market by this rapid and economical mode of conveyance. The facilities which it affords for obtaining draining and building materials, lime, extraneous manures, and fuel, have greatly furthered the agricultural improvement of the whole county, but especially of its more inland parts.

The arable farms usually contain from 300 to 500 acres, lying compactly together, and divided by well-kept thorn hedges into fields of from 20 to 40 acres each. Each farm has its substantial homestead, placed as near its centre as possible. They invariably possess thrashing machinery, which, when water is not available, is propelled by a steam-engine. Another feature of these homesteads is that they always comprise as many cottages as are required to accommodate the whole of the labourers statedly employed on the farm, which is at the rate of about one family for every 50 acres of arable land. Until a very recent period, these cottages were for the most part of the very rudest construction —mere hovels, in fact, with low unplastered walls, earthen floors, a single small window, the interior open to the rafters, and unpartitioned except by the box-beds of the occupants. A thorough reformation has, however, been in rapid progress during the past ten years. These cottages are now made higher in the walls, have good slated roofs, brick floors, partitions dividing them into two or more apartments below, and a deal floor and chambers above. The windows are large and made to open, and conveniences conducing to cleanliness and external neatness are usually provided. The establishment on a 400 acre farm of good land usually consists of a steward, a shepherd, five ploughmen, a man of all work, and perhaps a female cottar. These labourers are engaged for a year from Whitsunday to Whitsunday, and are paid for the most part in stipulated quantities of farm produce. The wages of an ordinary ploughman, or *hind*, as he is here called, consists of the following items: 54 bushels of oats, 21 do. of barley, 9 do. of peas, the keep of a cow (viz., grass in summer, turnips and straw in winter), L.4 in money, food for himself and wife in harvest, and some gratuities when sent to market with grain. This constitutes the hind's own wages; but, as he engages to provide at all seasons a young woman or lad for the lighter work of the farm, he receives at the rate of 10d. a-day for the actual time that this young person is employed; and to compensate him for her board, he gets one-third of an imperial acre of land on which to plant potatoes. The farmer furnishes manure and horse-labour for this crop, and the hind supplies the sets and undertakes the hoeing and digging. The farmer also provides a cottage and small garden for each hind, and the cartage of what fuel he requires; for which the latter pays rent by giving the labour of a female reaper (usually his wife or daughter) to assist in cutting down the crop of the farm. The money value of a hind's wages varies, of course, with the price of grain; but it usually keeps very near the rate currently paid in the district to day-labourers employed at job-work. The hind has this important advantage, however, that, being engaged for the year, his pay is not interrupted by occasional sickness or by bad weather. Farm-stewards and shepherds receive the same quantities of grain, &c., as the ploughmen; but the money wages of the former are greater by from L.6 to L.8, and the latter have the grazing of from eight to twelve sheep in lieu of the money wage. This had, indeed, formerly been the case with the ploughmen also, as they still speak of the money part of their wages as their "*sheep siller*." This hind system has undoubtedly wrought well for all concerned. The payments in produce guard the labourer from the injurious effects of excessive fluctuations in prices; they tend to encourage habits of thriftiness and sobriety; and the possession of a cow, a pig, and plenishing for a cottage, constitutes the hind a little capitalist, and furnishes at once a motive and guarantee for his good behaviour. The farmer and his labourers, from living together as a distinct community, take an interest in each other's family affairs, and interchange a variety of good offices which exercise a most wholesome influence on all. The plan of engaging *families* rather than individuals, and giving them a cottage on the farm, has the effect of preserving intact that blessed relationship, and of retaining the young under its hallowing influences to a later period than would otherwise obtain. The most plausible objection urged against the system has reference to that feature in it that the hind is taken bound to keep a young person (hence called a *bondager*) for the lighter work of the farm. When a hind has no grown children of his own it is said to be a hardship to him to have to hire in a stranger for this purpose, and that the young person so hired suffers by removal from under parental superintendence, and by being usually necessitated to sleep in the same apartment with the hind and his wife. It must, however, be remembered that these young persons are just the children of other hinds, and that they live in all respects as they would do in their parents' houses, and are usually treated as if they were members of the family. What is an inconvenience to individuals thus becomes a benefit to the class, and the manner in which they are too often lodged is an argument rather for improving the cottages than for interfering with the system. The admirable conduct, intelligence, and general good condition of the peasantry of this county affords the best possible proof that the hind system is a wise and beneficial one.

Berwick-shire.

The rivers of the county are, the Tweed, which skirts it for about 27 miles, and falls into the sea at Berwick; the Whitadder and the Blackadder, both taking their rise in different parts of the Lammermuir hills, and after uniting falling into the Tweed; the Eye, running into the sea at Eyemouth; the Leader, which gives its name to Lauderdale; of smaller note, the Dye, the Leet, and (for a short part of its course, before it enters Roxburghshire) the Eden. The most of these rivers flow with a rapid current, and so afford an abundant water-power, which is extensively employed in propelling corn and other mills. The value of this power has, however, been seriously impaired by the recent extensive drainage of the district. The rapidity with which rain-water is now discharged gives rise on the one hand to floods of unwonted vehemence, and, on the other, to such a diminished stream in fair weather, that scarcely a season now occurs in which many mills are not occasionally idle for lack of water.

The salmon-fishery of the river Tweed is very valuable, and has been the subject of many royal grants. For a number of years past a steady decrease has occurred in the quantity of these fish sent to market. This is due, perhaps, in some measure to the contamination of the waters by the influx of refuse from an ever-increasing number of woollen, paper, and other mills on the higher streams, but chiefly to an excessive capture of the fish by the proprietors, and to the enormous destruction of breeding fish by poachers during the annual close-time. Several attempts are at present in progress for multiplying these fish by the use of artificial spawning beds and rearing ponds. It is a curious fact, that during the past thirty years the sea or bull trout has increased greatly in numbers in the Tweed, as compared with the salmon proper, and has even taken possession of some of its tributaries, to the entire exclusion of the more valuable species. A similar and contemporaneous phenomenon in the natural history of the county has occurred in the Lammermuirs, where the common brown grouse have to a considerable extent been supplanted by the black game.

The sea-fishings at Eyemouth, Burnmouth, and Coldingham, are now of great and rapidly-increasing value. For a long time the inhabitants of these villages were much demoralized by being constantly engaged in a contraband trade in foreign spirits. The establishment of an efficient coast-

Berwick-shire.

guard entirely suppressed this pernicious traffic, and compelled the fishermen to apply themselves steadily to their legitimate calling. They are now an exceedingly industrious and prosperous class of people. No branch of industry in the county has benefited so much as theirs has done by the introduction of railways. Formerly they sold their fish, either to hawkers, who disposed of them in the neighbouring district; or to curers, who, by a process of salting and drying, prepared them for more distant markets. Now a large proportion of the fish is bought up by the agents of fishmongers in the great towns of England, to whom they are despatched by railway as soon as they are brought to shore.

Although Berwickshire has benefited in many ways by its proximity to England, there are other respects in which its Border position exposes its inhabitants to serious evils. The higher duty levied on Scotch whisky on its passage into England tends to encourage smuggling. The vigilance of the excise-officers, however, is such as to render this traffic extremely hazardous to those who engage in it: it is now almost totally discontinued. Another and more serious evil has grown out of a difference in the marriage law of the two countries. In Scotland a simple declaration, before witnesses, by the parties, that they are husband and wife, constitutes a valid marriage. Out of this has arisen the practice of couples from England crossing the Border, and being married by unauthorized persons who make this their trade. To impart something of formality to their proceedings, these men are in the habit (often when in liquor) of profanely making use of a form of prayer borrowed from the liturgy of the Church of England, and of filling up, with dates to suit the parties, a printed certificate of marriage, of which they have blank copies in readiness. Gretna Green has long possessed an unenviable notoriety for such proceedings; but the same irregular practice goes on at all the toll-bars and similar places situated on the borders betwixt Berwickshire and Northumberland. Nor is it confined to parties from England; for a very large proportion of the marriages among the working classes in Berwickshire take place at these tolls. The facilities thus presented for taking the most important step in life in a clandestine manner, necessarily tend to foster innumerable evils.

The county is not rich in the more valuable minerals. Thin seams of coal are known to exist in the S.E. corner of it. On the sea-coast at Lamberton several attempts have recently been made to work these, but hitherto without success. Beds of clay suitable for the manufacture of bricks and draining tiles are scattered over the county, and are in numerous instances used for this purpose. Good building materials are obtained from numerous quarries in the rocks, both of the old red sandstone formation, and of the coal measures. At Ordweel on the Whitadder, and some other places, copper ore has been found, and attempts made to work it, but hitherto without any encouraging success.

The antiquities of Berwickshire consist in the remains of military works, tumuli, and cairns; and in the ruins of many peel-houses and castles, the memorials of those incessant feuds and forays of which in the olden time this Border district was the scene. Until the beginning of the present century, there lingered among its inhabitants many traditionary reminiscences of the exciting events, fierce manners, and precarious tenure of life and property with which the Border clans were once so familiar. These popular traditions have disappeared with the progress of modern civilization, even more thoroughly than the physical memorials have done under the effects of time and agricultural improvement. Of the religious houses once so numerous, few now remain. Coldingham Priory, the most famous of them, was burned by the Earl of Hertford in his barbarous inroad into Scotland in the year 1545. The abbey of Dryburgh shared the same fate by the same hands, but its ruins yet remain to delight the eye of the traveller. The deep glen of the Pease Burn, in the N.E. angle of the county, is notable in history as one of the natural defences of Scotland. The bridge of four arches by which it is spanned, used to be, from its great height and romantic situation, an object of some curiosity; but the stupendous railway works, with which the public eye is now familiar, have quite eclipsed the honours of such objects as the Pease Bridge.

North Berwick || Berwick on-Tweed

Among the principal family seats in Berwickshire are the following: Thirlstane Castle (Earl of Lauderdale); the Hirsel (Earl of Home); Lennel House (Earl of Haddington); Dryburgh Abbey (Earl of Buchan); the Retreat (Earl of Wemyss); Mertoun House (Lord Polwarth); Nisbet (Lord Sinclair); Dunse Castle (Hay); Bemerside (Haig); Jerviswood (Baillie); Wedderburn (Home).

Berwickshire is divided into thirty-two parishes. The population, which in 1801 was 30,621, had increased in 1841 to 34,345, and in 1851 to 36,287. The parliamentary constituency in 1850 was 1062. It returns one member to parliament.

Its towns and villages are few and inconsiderable. Berwick, from which the county takes its name, forms no part of it, but yet is virtually its chief market-town. The other towns are Dunse, Lauder, Eyemouth, Coldstream, and Greenlaw. The latter is the county town, but from its inconvenient position, the sheriff-court business has, by a recent act of parliament, been transferred to Dunse. The valued rent of Berwickshire is L.178,366 Scots. The annual value of real property, as assessed in 1815, was L.245,379, and in 1842, L.252,945. In 1849 the number of enrolled paupers was 1315, and the assessment for relief of the poor L.9403, 9s. 11d. (J. W—N.)

BERWICK, *North*, a parliamentary burgh and parish of Scotland, county of Haddington, situated on the coast of the Firth of Forth, with a small harbour, but little or no trade. The town was constituted a royal burgh by James VI. Pop. of parish (1851) 1643, of whom 498 resided in the town. Distance from Haddington 9 miles, east from Edinburgh, by railway, 22¾ miles. It unites with Haddington, Dunbar, Jedburgh, and Lauder, in sending a member to parliament. It is governed by a chief magistrate, two bailies, and twelve councillors. The people are chiefly engaged in agriculture. Fishing and quarrying afford employment to a limited number. The town consists of one principal street, and contains a parish church, Free church, and a United Presbyterian place of worship. North Berwick is frequented in the bathing season. The surrounding scenery is interesting. About 2½ miles to the east of the town stand the ruins of Tantallon Castle, so graphically described in *Marmion*. The parish of North Berwick contains about 4000 acres, mostly arable. The geological formation is red sandstone and trap. North-Berwick Law, a conical hill, 940 feet high, stands close to the town.

BERWICK-ON-TWEED, a seaport town of England, situated at the mouth of the river Tweed, on its northern bank. Pop. (1851) 16,008. The townships of Tweedmouth and Spittal, on the opposite bank, are included in the borough of Berwick, and, with Berwick itself, are described in all law documents as "in the county of the borough and town of Berwick-upon-Tweed." By 2d and 3d Will. IV., cap. 64, sec. 29, it was appointed one of the polling stations for the county of Northumberland. It now constitutes an integral portion of that county, and is under English law. The borough and its liberties (commonly known as "Berwick Bounds,") forming one parish, occupy an area of nearly 8 square miles, and extend about 3½ miles northward along the coast, and about the same distance westward. The point on the north road at which they terminate is the village of Lamberton (in Berwickshire), a place of some celebrity as another Gretna Green. A toll-house adjoining the village of Paxton marks the western boundary; and to this place a similar interest attaches. By 7th and

Berwick-on-Tweed.

8th Vict., cap. 61, that small detached portion of the county palatine of Durham called Islandshire, which lay on the south side of the river, reaching to the centre of the stream, was, on account of the inconvenience resulting from the old division, included in the district of Berwick.

The town is encircled by fortified walls, bastions, and a ditch, constructed during the reign of Queen Elizabeth. These ramparts, which are under the custody of the corporation, form a delightful promenade, and might, if required, be put into a state of defence. Of the five old gates, namely, the Scotch gate, the Cow-port, the Shore-gate, the Pier-gate, and the English gate, the last has been removed. About half a mile to the north of the existing walls, the remains of the ancient fortifications are to be seen, including the Bell Tower, and a portion of Lord Soulis' Tower. The castle was situated at the W.N.W. extremity of these walls, and a portion of it still remains, including the barbican (in good preservation), which faces the west, and extends to the margin of the Tweed. The old courtyard of the castle is now occupied by the station of the North British railway. A viaduct of 28 arches, 2000 feet in length, and 120 in height, crosses the Tweed here, forming a striking feature in the landscape. This bridge was opened by Queen Victoria in person in 1850. The old bridge of Berwick, which stands about a quarter of a mile farther down the river, has 15 arches: it was completed in 1634. The internal appearance of the town is pleasing, and when viewed from the high ground on the south side of the river is exceedingly striking. It has scarcely any suburbs outside the fortifications, the river and the sea inclosing it on the south and east. The entrances to the town are on the W.N.W. by the Scotch gate leading into the High Street, and on the S. by the old bridge. Among the principal public buildings is the town-hall, a massive three-storied structure, with a portico supported by four Tuscan columns, and surmounted by a spire of 150 feet, with a chime of eight bells. The ground floor contains the exchange, which is used as a market-place for dairy produce. In the second story the quarter-sessions, county-court, and corporation meetings are held. The upper story, formerly used as a jail, is occupied by the superintendent of police. The new jail, opened in 1849, stands on the east side of Wallace's Green. The church of the Holy Trinity, at the N.E. angle of the town, was rebuilt in 1648. Like other structures of the Puritan period, it has no pretension to architectural elegance. The benefice is a vicarage in the patronage of the dean and chapter of Durham. The annual value of the tithes is L.2300. There are two places of worship in connection with the Established Church of Scotland; four United Presbyterian, and Independent, Baptist, Methodist, and Roman Catholic chapels. At Tweedmouth there is a curacy, a Scotch Established, and a Free church. The barracks stand opposite the church, and between them and the churchyard wall is the military parade.

The educational institutions are the following:—The corporation's academy for the gratuitous education of burgesses' children, averaging 300 pupils; the grammar-school, which is also free to the children of burgesses; a charity school; a Lancasterian school; a school of industry for girls; an infant school, &c. &c. Berwick possesses a public subscription library (6000 volumes), a reading-room, a mechanics' institute, a natural history society, a dispensary, a workhouse, and assembly rooms. There are two banks, branches of the Northumberland and Durham, and of the Union Bank; and also a savings-bank. Two weekly newspapers are published here, the *Berwick Warder* and *Berwick Advertiser*.

Berwick, since the time of Henry VIII., has returned two members to parliament. Constituency 676, 380 of whom are burgesses. The burgh, including Tweedmouth and Spittal, is governed by a mayor, six aldermen, and seventeen councillors, a recorder, sheriff, &c. The only article of manufacture is iron: there are several foundries and boiler manufactories at Tweedmouth and Spittal. The chief exports are corn, wool, game, and salmon. Most of the fisheries between the sea and Norham belong to, or are rented by, the Berwick Shipping Company. The average number of boxes of red fish exported during the season (15th Feb. to 15th Oct.) is 4000. Most of the fish goes to the London market. The entrance to the harbour is rocky, and has a bar, within which there is good anchorage. It is protected by a pier, with a lighthouse and two fixed lights, in Lat. 55. 46. N. Long. 2. 0. W. Distance from London by railway, 369 miles, from Edinburgh 58, and from Newcastle 64. Corn-market every Saturday; cattle-market every alternate Monday. The fair is held on the last Friday of May; there are also four hiring-markets annually.

Beryl.

Of the early history of Berwick, the Scottish chartularies supply the only records. It belonged to Scotland, as part of the Lothians, in the reign of Kenneth II.; and about 870 was in possession of the Danes, from whom it was wrested by Gregory. It thereafter remained in the custody of Scotland until towards the close of the eleventh century, when Edgar in pious gratitude bestowed it on the see of Durham; but again resuming it, it became a portion of the appanage of David; after whose accession in 1124 it was constituted one of the four royal burghs, and was long the chief seaport of Scotland. On the threshold of the two kingdoms, it suffered greatly during their wars. It was acquired in 1174 by Henry II., and for a pecuniary consideration was restored to the Scots by Richard Cœur de Lion in 1189. During the reign of Alexander III. the customs of the port amounted to L.2197, 8s.—about one-fourth that of all England. In 1292 Edward I. sat in Berwick Castle as umpire of the disputed claim to the crown of Scotland, declaring in favour of John Baliol. In 1296, having obtained a victory over the Scots and captured Berwick, Edward I. held a parliament there to arrange the future government of Scotland, and to receive homage. The heroic defence of the Red Hall—a strong building in the town—by thirty Flemish merchants who had received it from Alexander II. on condition of their never yielding it to the English, forms a well-known feature in the history of this siege. In 1297, Wallace—who had routed the English near Stirling—made his way into Berwick; but the castle having held out until succoured by Edward, the Scots were forced to retire. It was retaken by Bruce in 1318. Subsequently changing masters several times, it was, in 1551, made independent of both countries. In 1648 it was taken and garrisoned by Cromwell's forces. The lands held by the burgesses, and other privileges, are by charter of King James VI. (See Tytler's *History of Scotland*, and Redpath's *Border History*.)

BERYL; *aqua-marine; émeraude limpide; beril.* This mineral, as was originally conjectured by Pliny, is a variety of the emerald, being distinguished from the latter only by its colour. The term emerald is consequently confined to that variety which presents its own peculiar colour, namely, the rich deep emerald green; while that of beryl is given to all the other varieties, as the sea-green, pale-blue, golden-yellow, and colourless.

Of the emerald we shall treat under the proper head; for although it is identically the same mineral, it sometimes leads to confusion to treat beryl and emerald under the same denomination. For instance, Haüy, speaking of emerald in the first edition of his *Traité*, says that the largest crystal he ever saw measured six inches in length and two in thickness, and that it came from Peru. In his second edition he mentions, as the largest he had ever met with, a crystal of the same dimensions which came from Santa Fé; and immediately passes on to a description of the *Siberian* emeralds. He considered them as the same mineral species. The large crystal which he mentions is in the royal collection at Madrid, and is the true emerald. This points out the propriety of confining the name of emerald to the beautiful deep green

Berzeline || Berzelius.

gem, while that of beryl may be bestowed on all the other varieties. These are by no means uncommon. They occur in veins and drusy cavities in granite, and are found in France, at Nantes, and at Limoges; in Ireland, in the mountains of Wicklow and the county of Down; in Scotland, in the district of Cairngorm; at Schlaggenwald in Bohemia; at Swezel in Bavaria; at Brodbo in Sweden; and in the Altai and Oural Mountains in Siberia, where they seem to exist in greater abundance and in larger groups and crystals than in any other quarter of the world, always excepting the varieties from Limoges. In Peru and Brazil, there are localities well known as producing beryls. In the northern states of America many of these have been indicated by the American mineralogists. Some very fine pale green-coloured beryls have been imported from the district of Ghellan, in Hindustan, 300 miles S.W. of Madras. This mineral, therefore, is not unsparingly distributed over the globe; and it affords one of the greatest embellishments to the cabinet of the mineralogist, while it yields an abundant supply to the jeweller for the exercise of his taste in producing a variety of ornaments.

Although Pliny was the first who suggested the identity of the emerald and the beryl, it was left to Romé de Lisle to put this conjecture to the proof. Pallas, who first discovered the beryl in Siberia, sent some specimens for examination to that crystallographer, who immediately observed the perfect similarity of form between some of these and certain crystals of emerald then in his possession; which circumstance, joined to the hardness and specific gravity of the two objects, soon satisfied him that they were of the same species. This was one of the first triumphs of crystallography; and it was soon after confirmed by the labours of the chemist. The analysis of this mineral is peculiarly interesting, as will be seen by the following comparative table:—

	Emerald.		Beryl.				
	Vauquelin, Peru.	Klaproth.		Vauquelin, Siberia.	Klaproth, Nertschinsk.	Berzelius, Brodbo.	Schirab, Siberia blue.
Silex.....	64·50	68·50	Silex	68	66·45	68·35	66·5
Alumina...	16·00	15·75	Alumina...	15	16·75	17·60	16·75
Glucine....	13·00	12·50	Glucine....	14	15·50	13·13	15·00
Lime.....	1·60	0·25	Lime	2	.....	.....	.....
Ox. Chrom	3·25	0·30	Chrom.	...	.....	.....	1·0
Iron	.....	1·0	Iron	1	0·6	0·72	0·75
Loss	1·15	.....					

The largest mass of precious beryl known to mineralogists is an aqua-marine belonging to the late Don Pedro: it is nearly as large as the head of a calf, and weighs 225 ounces Troy, or 18 lb. 9 oz. On one side there are slight indications of the plane of a crystal; but it is otherwise entirely water-worn. Its surface is consequently dull; but beneath it the mass is perfectly clear and transparent, and, large as it is, without a flaw. It presents a beautiful pale bottle-green colour. The largest crystals known are those from Limoges in France, and Brodbo in Sweden. At the former place they occur in a vein of quartz in granite, sometimes very perfect, and a foot in diameter; and there is a crystal from the latter place in the museum of Stockholm which weighs upwards of eighty pounds. These large crystalline masses are generally very coarse in their texture, and present an earthy aspect, somewhat like decomposed felspar.

BERZELINE, a mineral found in minute dendritic crusts on calc-spar. It is a seleniuret of copper. It occurs in Sweden and the Hartz.

BERZELITE, a honey-yellow mineral of a resinous lustre, found in Sweden. It is an anhydrous arseniate of lime and magnesia.

BERZELIUS, Baron Jan Jacob, knight commander of the Swedish order of Vasa, member of the French Legion of Honour, and of the Austrian order of Leopold, M.D., &c., &c. The honourable titles here enumerated can scarcely be said to add lustre to the name of this distinguished philosopher, but are creditable to the sovereigns and bodies who testified in this manner their appreciation of labours inseparably connected with the progress of physical science in the present century. Berzelius.

Berzelius was born August 29th 1779, at the village of Vasefunda, near Linkoping in Ostrogothland, where his father filled the humble, but in Sweden not unappreciated, office of government schoolmaster. His early acquirements and useful habits of study were formed under the care of an intelligent father. In 1796 he commenced his medical studies in the University of Upsala, where the chemical chair was then filled by Afzelius, with Ekeberg for his assistant. The account which Berzelius gave of the mode of teaching chemistry in that celebrated seminary shows how little he owed to his instructors; and contrasts very unfavourably with the practice then long established in the chemical schools of this country, when Cullen and Black had for about half a century illustrated their prelections by numerous and well-devised experiments. Berzelius stated that at Upsala the lectures were read without any experimental illustrations, and the instruction in the laboratory was of the most meagre and unsatisfactory kind.

In 1798 Berzelius quitted the university, after passing his examinations in philosophy, and became assistant to a medical practitioner at Medvi, where he soon made himself known by a masterly chemical analysis of the mineral waters of that place, which was, however, not published until he took his degree of physician, in 1804, at Upsala, where it appeared under the joint names of Berzelius and Ekeberg. Soon afterwards he gave to the world his *Physical Researches on the Effect of Galvanism on Organized Bodies;* a work which established his reputation as an experimental philosopher. He was now appointed the assistant and successor of Sparman as professor of medicine, botany, and chemical pharmacy; and succeeded to that chair in 1807. Berzelius at first followed the mode of teaching which he had seen at Upsala; but it appears that, on the suggestion of the late Dr Marcet, who at that time visited Stockholm, he adopted the method of illustrating his lectures by experiments, and speedily found that this change gave great satisfaction to his pupils, and made him a most popular teacher of chemical science.

It was in 1806 that, in conjunction with Hissurger, he commenced the *Memoirs relative to Physics, Chemistry, and Mineralogy*, his numerous contributions to these sciences exhibit that marvellous ingenuity, perseverance, and accuracy in analysis, which have placed his name among the most illustrious experimental philosophers of the age. Berzelius may also be considered as the principal founder of the highly important "Medical Society of Sweden." In 1808 he became a member of the Royal Swedish Academy, and was chosen its president in 1810.

In the intervals of his public duties he paid several visits to Paris; and in 1812 was some time in London, of which visit he always spoke with much satisfaction.

In tracing his personal career, we may briefly state that in 1815 the sovereign of Sweden enrolled his name among the knights of the *Order of Vasa;* and in 1818 he was declared perpetual secretary of the Stockholm Academy of Sciences. In the same year, on the coronation of King Charles-John, he was ennobled; and, as a special mark of distinction, was permitted, contrary to the custom of Sweden, to retain his own name; and the title of Baron Berzelius dignified the lists of Swedish nobility. In 1821 his sovereign made him "Commander of the Order of Vasa;" and foreign princes imitated the example, by nominating Berzelius a member of "the Legion of Honour" of France, and a chevalier of "the Order of Leopold" of Austria.

Berzelius.

During all that time his very important experimental researches were never intermitted; and he devoted his vigorous mind, and uninterrupted bodily health, to the cause of science with untiring ardour. When he resigned his professorship in 1832 in favour of Mosander, he continued most ardently to pursue his refined investigations.

In 1833 Berzelius took a wife; and on that event the king of Sweden wrote him a letter, in which, among other laudatory remarks, he observed, that "Sweden and the whole world were debtors to the man whose entire life had been devoted to pursuits as useful to all as they were glorious to his native country." He also about the same time received a gratifying and valuable testimony to his important services to the arts of his country from the directors of the Swedish iron works, who, in grateful acknowledgment of the light his researches had thrown on their art, conferred on him a pension for life. Among the honours conferred on him we may likewise mention, that, at a dinner given by the Academy of Sciences, of which he had been secretary for twenty-five years, the health of Berzelius was proposed by the crown prince, the chairman, who in the most complimentary terms expressed his own personal gratitude to him as the scientific instructor of his youth.

The admiration of Europe and the gratitude of his country attended him to the latest period of his life. In the midst of his fame and of his unwearied labours, Berzelius was attacked with paraplegia. He saw with calm resignation his mortal career closing, and strove to complete those investigations which he had commenced while his powers were yet equal to the task. His decay was gradual, without acute suffering; and he died on the 1st of August 1848, in the sixty-ninth year of his age.

The writer of this article considers it as one of the most fortunate events of his life that he had the pleasure of a personal acquaintance with this illustrious philosopher, and bears a willing testimony to the noble frankness and manly simplicity of his character. Berzelius was ever ready to impart, without ostentation, to others his vast stores of knowledge, —to assist the researches of those engaged in kindred pursuits, by his advice, by the unreserved communication of his beautiful methods of accurate investigation, the use of his laboratory, and by a kindness of manner that irresistibly won the attachment of all who approached him. His well-earned reputation elevated him above all jealousy of others; and, as has been well observed in the *Eloge* of Louyet in the Academy of Brussels, "Berzelius was jealous only for the cause of chemistry." Hence the occasional freedom of his strictures in his *Comptes Rendus Annuels*, which occasionally excited the displeasure of authors whose inaccuracies he detected or whose hypothetical views he opposed. But a man more willing to give due praise to the useful labours of others, or more free from a shadow of envy of contemporary genius, the author of this notice never yet had opportunity of knowing.

To attempt a detailed notice of his investigations and discoveries would be to review nearly the entire field of chemical science, for there are few parts of it which he has not illustrated; and we can here only notice his principal labours.

1. The volumes of the *Physical Memoirs*, during twelve years, containing forty-seven original papers by him of great importance.

2. His treatise on Chemistry, written with great clearness and precision, went through five large editions, and was on each occasion almost wholly rewritten. It will remain a monument of his industry and skill; for the researches there detailed are not copied from the writings of others, but are all either repeated or devised by himself. It is best known in the edition in eight volumes, translated into French, under his own inspection, by Eslangeo, and published at Bruxelles in 1835. The last volume contains an excellent dissertation on chemical apparatus, with essays on qualitative and quantitative analyses, and the use of the blow-pipe.

Besançon.

3. In 1822, at the request of the Academy of Sciences, he undertook those admirable *Annual Reports on the Progress of Physics, Chemistry, and Mineralogy*, which have proved of the utmost value to the scientific world; and the want of his free but candid and judicious criticisms is felt by all engaged in such researches.

4. His mineralogical system bears the impress of his penetrating mind. Convinced that an arrangement founded on the chemical constituents of inorganic matter was the most useful and the most interesting, he considered mineral species as depending on the atomic proportions of their principal ingredients. He arranged and designated individual minerals from this circumstance, regarding the ingredients not in atomic proportions as mechanical mixtures, that might vary in their proportions without materially changing the mineral.

5. In 1807, while the beautiful atomic theory of Dalton was scarcely well known in Britain, Berzelius began his accurate researches on "Definite Proportions;" in which, extending and systematizing the experiments of Wenzel and Richter, he applied them not only to salts, earths, and metals, but to gases and to organic compounds, and thus may be said to have been most instrumental in establishing the truth of the theory of definite proportions,—for the discoverer of which he ever expressed the profoundest respect. His determination of the atomic weights of various substances has obtained the highest praise; and, among other discoveries, we owe to him the proof of the remarkable fact, that the proportion of oxygen is constant in all the neutral salts of the same acid. It was his researches that gave the first impulse to modern organic chemistry, which of late years has made remarkable progress. We also owe to him a greater number of accurate analyses than to any other chemist of our day.

6. The last work of this celebrated man which we shall mention is his *Essay on the Use of the Blow-pipe*,—the most complete account of that instrument, of which he well knew the value. It has been translated into French by Fresnel, and from that language into English by Children in 1823. (T. S. T.)

BESANÇON, a city of France, capital of the department of Doubs, 45 miles east of Dijon, on the river Doubs, which flows round it on three sides. It is well protected by strong fortifications and a citadel on an almost impregnable rock. The town is in general well built; but the houses are old, and the streets narrow and gloomy. The principal buildings are, a Gothic cathedral, court-house, town-hall, royal college, arsenal, hospital with 500 beds, barracks, theatre, library of 50,000 volumes, museum, and several handsome fountains. It contains many Roman antiquities, including a triumphal arch, and the remains of an aqueduct and an amphitheatre. Besançon is the see of an archbishop, has tribunals of primary jurisdiction and commerce, and is the head court for the departments of Doubs, Jura, and Haute Saone. It possesses also a university-academy, a diocesan seminary, a royal academy of science and belle-lettres, a lyceum, an antiquarian museum, a society of agriculture and arts, and schools of medicine, artillery, and design, besides two deaf and dumb institutions. The chief branch of industry is the manufacture of watches and jewellery. There are also some considerable breweries, and manufactories of carpets, porcelain, hardware, Seltzer-water, &c. Besançon enjoys a central position for the commerce between France and Switzerland. Pop. (1851) 33,788. Long. 5. 56. 26. E. Lat. 47. 14. 12. N.

Besançon is a place of great antiquity. Under the name of *Vesentio*, it was held by the Romans as a fortified place in the time of Cæsar. It was destroyed by Attila, and since that period has suffered many vicissitudes. Area of the arrondissement of this name, 539 square miles; pop. 109,136.

Besant || Betchuana.

BESANT, or BEZANT, a coin of pure gold, struck at Byzantium in the time of the Christian emperors; and hence the gold offered by the king at the altar is called *besant* or *bisant*. It seems to have been current in England from the tenth century till the time of Edward III. Its value is not precisely ascertained, but it is generally estimated at 9s. 4½d. sterling.

BESOZZI, or BEZOZZI, AMBROGIO, an architectural painter of some eminence, born at Milan in 1648. He worked for a time under Dunedi, called Montalti; and afterwards studied at Rome. He died at Milan in 1706.

BESSARABIA, the most S.W. province of Russia in Europe. See RUSSIA.

BESSARION, JOHN, titular patriarch of Constantinople, archbishop of Nice, and one of those illustrious persons who contributed to the revival of letters in the fifteenth century, was born at Trebizond in 1389, or, according to Bandini, in 1395. He was very zealous to reunite the Greek with the Latin church, and induced the Emperor John Palæologus to interest himself in bringing about this great work. He passed into Italy, appeared at the council of Florence, harangued the fathers, and made himself admired as well by his modesty as by his uncommon abilities. The Greek schismatics conceived so great an aversion for him, that he was obliged to remain in Italy, where Pope Eugenius IV. honoured him with the purple in 1439. He fixed his abode at Rome, and would have been raised to the papal chair if Cardinal Alain had not represented it as injurious to the Latin church to choose a Greek, however illustrious. He was employed in several embassies; but that to France proved fatal to him. When legate at this court, he happened to visit the Duke of Burgundy before he saw Louis XI., which so displeased the capricious and tyrannical monarch, that he gave the cardinal a very ungracious reception, and even took him by his magnificent beard, saying, in his Latin patois, *Barbara Græca genus retinent quod habere solebant;* an affront which so chagrined the cardinal, as, according to Matthieu, to occasion his death at Ravenna upon his return, in 1472. Bessarion loved literary men and protected them. Argyropylus, Theodorus Gaza, Poggio, Laurentius Valla, and others, formed in his house a kind of academy, and pursued their studies in some measure under his direction. He left some works, as *Defensio Doctrinæ Platonicæ*, translations of some pieces of Aristotle, orations, epistles, &c.; and he bequeathed his valuable collection of books to the Venetian senate. He laid the foundation of the celebrated library of St Mark.

BESSEL, FRIEDRICH WILHELM, a distinguished Prussian astronomer, was born at Minden in 1784, and died March 17. 1846. For an account of his valuable contributions to science, the reader is referred to the article ASTRONOMY.

BESSI, an ancient people of Thrace, who dwelt along the southern slope of Mount Hæmus. They were a fierce and powerful race, and were probably never subdued till conquered by the Romans, after the subjection of Macedonia. Their chief town was Uscadama.

BESTAIL, or BESTIAL, in ancient statutes, all kinds of beasts or cattle.

BESTIARII (*θηριομάχοι*), those who fought with wild beasts in the Roman circus, or who were exposed to them by a sentence of the law. The bestiarii multiplied greatly under the empire, were regularly trained, and fought for pay. They are always distinguished from the gladiators, who fought with each other.

BETCHUANA, a considerable negro nation, consisting of many tribes that inhabit Southern Africa, to the north of the Gariep, or great Orange river, from about 28. to 23. S. Lat. An extensive desert is the western boundary between them and the Hottentots on the western coast; and a chain of mountains running parallel to the eastern coast, at the distance of 70 or 80 miles, divides them from Kaffirland. They have been described by Burchell, and by Campbell and other missionaries. The Betchuana are dexterous workers in copper and iron, which they fabricate into ornaments, arms, and agricultural implements, as spades and hoes. Their capital is Litâkun or Lattakoo. Each tribe is under an hereditary chief. The most civilized are the Vankeets and Mointzee tribes. The latter cultivate millet, sugar-cane, and tobacco: they build with stone, are dexterous smiths, and know how to draw copper wire, and to twist it into various neat ornaments. Of all the tribes the chief riches are cattle, and they deal in ivory to a considerable extent. Their dress consists of a covering round the loins, and cloaks of skins very neatly sewed together. (Burchell's *Travels;* Campbell's *Journeys; Geographical Journal;* Cumming's *S. Africa.*)

Betel.

BETEL, a substance compounded of different ingredients, which is chewed in the East in the same way as tobacco is used in other parts of the world, but to a much greater extent. All individuals, without exception of age or sex, begin at an early age to accustom themselves to betel, and it gradually becomes an article of such necessity, that those acquainted with the usages of the Eastern nations affirm they would more readily dispense with their ordinary quantity of food than with betel. Europeans also, who have resided long in Ceylon or India, contract the same habit, and enjoy chewing of betel equally with the natives. Betel, or *pawn* as it is denominated in Bengal, consists of part of the fruit of the *areca* palm, wrapped in the leaves of a kind of pepper plant called *betel*, smeared with a little shell lime; whence its name betel-nut is derived. The areca palm is a tree growing to forty or fifty feet in height, with a straight round stem six or eight inches in diameter, covered with a smooth ash-coloured bark, marked with parallel rings. All the leaves, which are only six or seven in number, spring from the top, and are six feet in length, declining downwards from a stalk of considerable length. The fruit or nut is covered with a green shell or skin, thin, brittle, and of the consistence of paper; it is of an oval shape, about the size of a small egg, and resembles a nutmeg despoiled of its husk. When ripe, it appears in clusters of a reddish colour, forming a beautiful contrast with the vivid green of its leaves, and then falls off to sow itself in the ground. The betel plant is a species of vine, bearing a leaf somewhat resembling ivy. It is called *piper betel* by botanists, and is of the same genus as the *piper nigrum* of Linnæus. Its culture, which is carefully attended to, is managed in the same manner. Poles are planted in the earth, around which the betel twines itself, and as it runs up, the poles require to be heightened. It is a creeping plant, seeking support from stronger vegetables, but it is said not to be destructive of them, like some other plants of a similar nature. Particular regard is paid to the cultivation of areca and betel throughout the countries of which they are natives. Several years ago it was found, on enumeration, that the number of trees, probably meaning the areca only, in Prince of Wales's Island, amounted to 342,110. The lime used with the nut is called *chunam*, and is obtained from the calcination of shells, which produces the finest kind. But the fresh nut must be avoided; it then contains a white viscous matter, insipid to the taste, and occasioning delirium, like ebriety from wine, but losing this property when dried; and it is employed either boiled or raw. The latter undergoes no change; the former is cut in slices, boiled with a small quantity of *terra japonica*, and then dried. Betel is compounded, therefore, of these three substances, with some additions or variations, according to the customs of the place where consumed; such as cardamums, and coarse pounded tobacco, by persons of more depraved taste. The union of the three ingredients is supposed to correct the effects which each would produce singly; the nut improves the bitterness of the leaf, and the lime prevents any injury to the stomach. When combined, the first consequences are, reddening the saliva, giving a bright hue

Betel.

to the lips, and, in progress of time, rendering the teeth quite black. The saliva, however, will not be tinged if the chunam be omitted; and its pernicious operation on the enamel of the teeth may be averted by rubbing them with a preparation whereby they are coated with a black substance that does not readily yield to any dentifrice, and preserves them from corrosion. Its medicinal effects are the dispelling of nausea, exciting an appetite, and strengthening the stomach. It possesses nutritious and enlivening qualities, which render it particularly acceptable to its consumers. The *terra japonica*, above alluded to, is not a universal ingredient; it is used only in certain countries, and is generally supposed to be a preparation from the areca nut itself. It consists of two varieties, the one very astringent, the other less so, and rather sweet, which is preferred by the betel-eaters. To obtain the former, the nuts are taken from the tree, and boiled some hours in an iron vessel; they are then removed, and the water remaining is inspissated by continual boiling. The nuts being dried, undergo a second boiling, and, having been taken out, the water is also inspissated, whereby the best *terra japonica* is obtained. The nuts are then dried, cut in two equal parts, and sold. Or it is obtained by inspissated decoctions of the wood of the keira tree, or *mimosa catechu*. A great quantity of this substance is made in the Mysore, and some of inferior quality in Bengal. Probably it is something of this same kind that is prepared in Sumatra, under the name of *catacamber*, and chewed along with betel to give it an additional flavour.

Betel is not only used as an article of luxury, but as a kind of ceremonial which regulates the intercourse of the more polished classes of the East. When any person of consideration waits on another, after the first salutation, betel is presented as a token of politeness: to omit it on the one part would be considered neglect, and its rejection would be judged an affront on the other. No one of inferior rank addresses a dignified individual without the previous precaution of chewing betel; two people seldom meet without exchanging it; and it is always offered on the ceremonious interviews of public missionaries. In some countries it is not uncommon for the guest who receives the betel from his host, to pass it between his thumb and fore-finger, and apply his own chunam, which never gives offence, and is thought to have orginated in guarding a stranger against the insidious conveyance of poison, formerly too frequently practised in destroying persons who were obnoxious. Philtres or amatory charms are still conveyed along with the chunam, and are conceived to consist of some powerful stimulants. Mahometans abstain from this indulgence during the fast of Ramadan, though possibly not in every country, as it would be too great a privation; and the use of it is so interwoven with the existence of the natives of the warmer climates, that females of the higher ranks are said to pass their lives in doing little else than chewing betel. When the Cingalese retire to rest at night, they fill their mouths with it, and retain it there until they awake. According to Knox, who passed many years in captivity on the island of Ceylon, most people going abroad carry a small box of gold or silver, containing the ingredients for compounding betel; and the poor keep a constant supply about them in purses of coloured straw, securely lodged in a fold of their garments. The stand or box containing it is often of elegant workmanship; it consists of silver, gold, or tortoise-shell, and forms a piece of ornamental furniture in the houses of the wealthy. It is sufficiently valuable to constitute a present between sovereigns.

Extensive gardens for cultivating betel are formed in different parts of India. The soil most favourable for the palm is a black mould on a substratum of limestone, or intermixed with calcareous nodules. Here it is planted in rows, and carefully manured and watered during several years. It begins to bear from the eighth or tenth to the fifteenth year, and remains in perfection for thirty years, soon after which it either dies or is cut down. Some, however, continue producing fruit from the fiftieth to the seventieth, or even the hundredth year; but the produce gradually declines both in quantity and quality. It appears that a very fertile tree produces at an average 857 nuts, and an ordinary one 600; but this does not hold everywhere, as there are trees affording no more than 200. The betel-leaf is either cultivated in separate gardens, where a red stony soil on the side of a rising ground is preferred, and plantains or bamboos planted along with the vines, which are arranged in trenches to support them as they grow; or when an areca plantation is formed, and the palms are fifteen years old, cuttings of the vine are planted near the roots, and trained up to the trees. In twelve or eighteen months the leaves of the vine are fit for sale, and in three years they are full-sized; but in another year they die, when all must be removed, and young plants immediately substituted for them. We do not know whether their duration is ever longer; but in the southern parts of Canara in India, the gardens require renewal every four years, and in eighteen or twenty the soil is considered to be exhausted. These gardens are always surrounded by a hedge; sometimes the cultivators are annoyed with the depredations of squirrels and elephants. The crop of areca is produced during three months; and the nuts being pulled, are cut into seven or eight pieces each, and piled up in a heap; then equal quantities of it and *terra japonica*, with a hundred leaves of betel-leaf, are beat together with water, and the juice strained into a pot. This is mixed with a decoction of the bark of the *mimosa indica* and water, and the nuts from the whole heap are successively boiled in it. They are then exposed to be dried in the sun.

Betel is a very considerable article of traffic in India and China, and, indeed, throughout Asia. In the British settlements of Bombay, Madras, and Bengal, the value of the imports amounted in a single year to L.138,836; and if the quantities consumed throughout the East are taken into view, it will appear surprising how they can be obtained. But, owing to the constant and extensive demand, the plants affording the necessary ingredients are carefully cultivated; and multitudes are employed and subsisted in the production of this Eastern luxury. (J. G. D.)

Bethabara ‖ Bethesda.

BETHABARA, or BETHBARAH, *i. e. place of the ford*, where the Israelites passed over the Jordan, mentioned in John i. 28. The best manuscripts, however have Bethany: the other reading appears to have arisen from the conjecture of Origen, who found no such place on the Jordan as Bethany, but knew a town called Bethabara, where John was said to have baptized, and therefore took the unwarrantable liberty of changing the reading. (Orig. *Opp.* ii. p. 130, ed. Huet.)

BETHANY, a village nearly two miles E.S.E. from Jerusalem, beyond the Mount of Olives. It was the residence of Lazarus and his sisters Mary and Martha, and Jesus often went out from Jerusalem to lodge there. It is now a poor village of about twenty families. The only marks of antiquity are some hewn stones from more ancient buildings, found in the walls of some of the houses. The monks, indeed, show the house of Mary and Martha, and of Simon the leper, and also the sepulchre of Lazarus; but there is no reason to believe that this is the real tomb.

BETHEL, originally called LUZ, an ancient city on the borders of the tribe of Benjamin, twelve Roman miles north of Jerusalem. It was the place of Jacob's vision, and its name was consequently changed to Bethel, which signifies the "house or place of God." It is identified with the ruins at *Beitin*.

BETHESDA, called in the Greek κολυμβηθρα προβατικη, and thence in the Vulgate *piscina, probatica*, was the Hebrew name for a pool or public bath, which had five porticos, piazzas, or covered walks, around it. This bath was called Bethesda, בית חסרה, or *Beth-Chesda*, the "House of Mercy," probably because the erection of baths

Beth-horon. || Beth-lehem.

was a kindness to the poor. Some, however, will have the word Bethesda to be בית אשרה, *Beth-asda*, the "sink-house," or "drain," because the waters which came from the temple, and the place where the victims were washed flowed thither. From the use of the word κολυμβηθρα by Josephus, to denote the baths at Jericho, Dr Macknight, in his *Harmony of the Gospels*, concludes against such an opinion; and, moreover, he considers it inconsistent with the situation of Bethesda, which was near the sheep-gate or market in the S.E. wall of the city. That which is now and has long been pointed out as the pool of Bethesda, is a great dry basin or reservoir outside the northern wall of the inclosure around the Temple Mount; but there appears much reason to suppose that this was not the pool so called. (See *Robinson's Biblical Researches*, vol. i.) With regard to the precise nature of the miracle performed here there has been much diversity of opinion. Dr M ll contends that the text of the evangelist has been interpolated, and proposes to omit a verse not to be found in the Cambridge manuscript, which originally belonged to Beza. Dr Macknight strenuously opposes this method of interpretation; and while he maintains the integrity of the text, shows that Dr Mill's expedient leaves the difficulty exactly where it was. Grotius thinks that the angel is said to have descended, not because he was ever seen to do so, but because the Jews were persuaded that God brought such things to pass by the ministration of angels. And Dr Hammond supposes that the waters became medicinal by being impregnated with a healing warmth from the blood and entrails of the beasts offered in sacrifice that were washed there; and that the ἄγγελος, "angel," or "messenger," mentioned in the text, was a common messenger or servant of the priest, who at a proper season was sent by him to trouble the pool.

BETH-HORON, two places in Scripture distinguished as the Upper and Nether Beth-horon. Dr E. D. Clarke recognised the former in the village of *Beit-Ur*, which lies twelve Roman miles N.W. of Jerusalem. The Lower Beit-Ur is separated by a narrow valley from the foot of the mountain upon which the Upper Beit-Ur stands. Both these villages are inhabited, and exhibit traces of ancient walls and foundations. They are still distinguished as the Upper and Lower Beit-Ur. (Clarke's *Travels*, vol. i. part ii. p. 628.)

BETH-LEHEM (בית לחם, *house* or *place of bread*; Sept. Βηθλεέμ), a city of Judah, six miles southward from Jerusalem, on the road to Hebron. It was generally called Bethlehem-Judah, to distinguish it from another Bethlehem in Zebulun. Bethlehem is celebrated as the birth-place of David and of our Saviour, and as the scene of the Book of Ruth.

It has always been an inhabited place, and, from its sacred associations, has been visited by an unbroken series of pilgrims and travellers. It is now a large straggling village, and is beautifully situated on the brow of a high hill, which rises in parterres of vineyards, almond-groves, and fig plantations, watered by gentle rivulets that murmur through the terraces. At the farthest extremity of the town is the Latin convent, connected with which is the Church of the Nativity, said to have been built by the Empress Helena, and alleged to be the most chaste architectural building now remaining in Palestine. It is a spacious and handsome hall, consisting of a central nave amid aisles separated from each other by rows of tall Corinthian pillars of grey marble. Two spiral staircases lead to the cave called the "Grotto of the Nativity," which is about 20 feet below the level of the church, and is lined with Italian marbles, and lighted by numerous lamps. Here a star inlaid in the marble is said to mark the exact spot where the Saviour was born, and in a kind of recess, a little below the level of the rest of the floor, is a block of white marble, hollowed out in the form of a manger, to mark the place of the one in which the infant Jesus was laid. Although tradition is in favour of this being the place of the Nativity, there are many probabilities against it. The convent was long the abode of the learned and celebrated Jerome, and most of his works were composed here. Besides the Grotto of the Nativity, and the Tomb of Rachel, Bethlehem possesses three remarkable cisterns, which are supplied with water from a pool above the town: the largest is 582 feet by 207 feet at one end, and 148 feet at the other, with a depth of 50 feet; the central one is 423 feet by 250 feet and 160 feet, and has a depth of 39 feet.

Bethlehemites || Bethylus.

The inhabitants are said to be 3000, and were all native Christians at the time of the most recent visits. Their chief trade is in beads, crosses, and other relics. The people are remarkable for their ferocity and rudeness, which is indeed the common character of the inhabitants of most of the places accounted holy in the East.

The best accounts of modern Bethlehem are those of Clarke, Wittman, Richardson, Buckingham, Hardy, Elliot, Wilde, Robinson, Paxton, Olin, Prokesch, Richter, Schubert. See also Raumer's *Palästina*, pp. 307–313.

BETHLEHEMITES, or BETHLEMITES, in *Ecclesiastical History*, a sort of monks introduced into England in the year 1257, habited like the Dominicans, except that on their breast they wore a star with five rays, in memory of the star or comet which appeared over Bethlehem at the nativity of our Saviour. They were celled at Cambridge, and had only one house in England.

BETHPHAGE, a place between Jericho and Bethany, but of which the exact site is unknown.

BETHSAIDA, a town in Galilee, on the western side of the sea of Tiberias, not far from Capernaum. It was the native place of Peter, Andrew, and Philip, and the frequent residence of Jesus: the precise site, however, is utterly unknown, and the very name has long eluded the search of travellers, though Pococke and others have attempted to identify it with different places.

On the north-eastern border of the sea of Tiberias was another Bethsaida, near which Christ fed the five thousand, and probably also the one where the blind man was restored to sight. This and not the western was the Bethsaida of Gaulonitis, which was rebuilt and enlarged by Philip the Tetrarch, and received the name of Julias, in honour of Julia the daughter of Augustus.

BETHSHAN, a town of Samaria, in the half-tribe of Manasseh, on the borders of Galilee, about two miles from Jordan, and eighteen from the southern end of lake Gennesareth. It was also called Scythopolis, and by Josephus is said to be the largest city of the Decapolis. Its site is occupied by the small village of Beisan.

BETHULIA, a place which appears to have lain near the plain of Esdraelon on the south, not far from Dothaim, and to have guarded one of the passes towards Jerusalem. Modern ecclesiastical tradition identifies Bethulia with Safed, near the lake of Gennesareth, but Dr Robinson regards the site of Bethulia as still undetermined.

BETHUNE, MAXIMILIEN DE. See SULLY.

BETHUNE, a strongly fortified town of France, department of Pas de Calais, situated on a rock above the river Brette, 16 miles N.N.W. of Arras. Its castle was fortified by Vauban. It has a tribunal of primary jurisdiction, a communal college, a Gothic church, two hospitals, and manufacturers of linen, cloth, beer, &c. The trade, chiefly in grain, cheese, linen, and oil, is facilitated by the canal which unites the Lawe with the Lys. It was taken by the allied forces in 1710, and restored to France by the treaty of Utrecht. Pop. (1851) 7150. Area of the arrondissement of this name, 360 square miles; pop. 136,078.

BETHYLUS, one of Cuvier's genera of the family of Laniadæ, or shrikes, and also a genus of hymenopterous insects.

Betlis || Betterton.

BETLIS, or BITLIS, a town of Turkish Armenia, in Kurdistan, situated on the west shore of Lake Van in a highly-cultivated valley. Here the Armenians have four churches and as many monasteries, and they enjoy more courteous treatment than usually falls to their lot in Mahommedan countries. The houses are scattered over the valley, through which runs an extremely narrow road. The castle is situated on an eminence, so steep on all sides that it is only accessible by a road winding round it. Betlis is an ancient city, founded, according to the Armenians, by Alexander the Great. It is the centre of a considerable trade. The population of the town and neighbourhood is computed at about 10,000, Kurds, Turks, Armenians, and Syrians. Long. 42. 31. E. Lat. 37. 45. N.

BETROTHMENT, a mutual promise or compact between two parties for a future marriage between the persons betrothed. Betrothment amounts to what is called by civilians and canonists *sponsalia* or espousals.

BETTERTON, THOMAS, a celebrated actor, was the son of Mr Betterton, under-cook to King Charles I., and was born in Tothill Street, Westminster, in 1635. Having received some education, his fondness for reading induced his parents to accede to his desire to be apprenticed to a bookseller; and Mr Rhodes, near Charing Cross, was fixed on for his master. Rhodes, who had formerly been wardrobe-keeper to the theatre in Blackfriars, obtained in 1659 a license to set up a company of players at the Cockpit in Drury Lane; and there Betterton made his first appearance on the stage.

Soon after the Restoration, two different theatres were established by royal authority; the one in Drury Lane, in consequence of a patent granted to Henry Killigrew, Esq., which was called the "King's Company;" and the other in Lincoln's-Inn-Fields, the company of which styled themselves the "Duke of York's Servants." The patentee of the latter was Sir William Davenant, who engaged Betterton, and all Rhodes's company, and opened the theatre in 1662 with a new play of his own, called the *Siege of Rhodes*. Betterton became so great a favourite with the king, that by his Majesty's special command he went over to Paris to examine the French stage with a view to the improvement of our own; and it was after his return, as is generally supposed, that shifting scenes were first used in the English theatre instead of tapestry.

In 1670 Betterton married Mrs Sanderson, a performer on the same stage; and his union with this accomplished and excellent woman was productive of the greatest domestic felicity. When the duke's company removed to Dorset Gardens, Betterton and his wife continued with them; as also on the coalition of the two companies in 1684.

In 1693 Betterton was enabled to erect a new playhouse within the walls of the Tennis Court in Lincoln's-Inn-Fields. It was opened in 1695 with Congreve's *Love for Love*, which was very successful. Yet, in a few years the profits arising from this theatre, opposed as it was by all the strength of Cibber's and Vanbrugh's writings at the other house, were insignificant; and Betterton, infirm through age, and labouring under violent attacks of the gout, gladly quitted the fatigues of management and the bustle of the stage.

On his retirement, the public, in order to testify their respect for this theatrical veteran, gave him a benefit-night, when the comedy of *Love for Love* was performed, in which Betterton himself, though upwards of seventy years of age, sustained the youthful part of Valentine. Some months afterwards he acted that of Hamlet, his performance of which is particularly mentioned in the Tatler. The profits of the night are said to have amounted to upwards of L.500, the prices having been raised on the occasion.

The next winter Betterton was prevailed on by Mr Owen M'Swinney, then manager of the opera-house in the Haymarket, to lend his occasional aid; and in consequence of this arrangement, in the spring of 1710, there was given out for his benefit *The Maid's Tragedy*, of Beaumont and Fletcher, in which he performed his celebrated part of Melanthus. This, however, was his last appearance on the stage: his rash attempt to reduce the swelling of his limbs by external applications, threw the gout into his head, and terminated his life on the 28th of April. On the second of May his body was interred with much ceremony in the cloister of Westminster. Betterton was the author of several dramatic works, which were popular in their day. An estimate of his character and abilities may be seen in the *Apology for my own Life*, &c., of Betterton's friend and rival Colley Cibber.

Bettinelli.

BETTINELLI, XAVIER, one of the most celebrated Italian literati of the eighteenth century, was born at Mantua on the 18th of July 1718. After studying under the Jesuits in his native city and at Bologna, he entered in 1736 upon the noviciate of this society. He then undertook a new course of study; and afterwards taught the belles-lettres, from the year 1739 to 1744, at Brescia, where the Cardinal Quirini, Count Mazzuchelli, Count Duranti, and other scholars, formed an illustrious academy. He there began to distinguish himself by some pieces of poetry, composed as scholastic exercises. Being sent to Bologna to pursue the study of divinity, he continued to cultivate his poetical talent, and wrote also, for the theatre of the college, his tragedy of *Jonathan*. The number of learned and literary persons collected in this city exceeded by far what he had met with at Brescia. The Institute, recently founded by the Count Marsigli, the Clementine Academy of Design, the school of the astronomical poet Manfredi, the growing reputation of his ingenious and learned pupils Zanotti, Algarotti, and others, at this time fixed the attention of the literary world on Bologna. It was in the midst of this society to which he was admitted, that Bettinelli completed his education, and attained the age of thirty. He went in 1748 to Venice, where he became professor of rhetoric. He left it for various missions, and returned to it often. We may see by his epistles in free verse, or *sciolti*, that he was connected on friendly terms with all that this city and state could boast as most illustrious. He was destined by the superiors of his order for the oratorical department; but the weakness of his chest compelled him to relinquish it. The superintendence of the college of nobles at Parma was intrusted to him in 1751; and he principally directed the studies of poetry and history, and the entertainments of the theatre. He remained here eight years, but not without visiting, at intervals, different cities of Italy, either on the affairs of his order, for pleasure, or for health. In 1755 he undertook a longer journey, traversed part of Germany, proceeded as far as Strasburg and Nancy, and returned by way of Germany into Italy, taking with him two young princes, sons or nephews of the prince of Hohenlohe, who had requested him to take charge of their education. He made, the year following, another journey into France, along with the eldest of these two young princes, and lodged while in Paris at the College of Louis le Grand. It was during this excursion that he wrote the famous *Letters of Virgil*, which were published at Venice with his *sciolti* verses, and those of Frugoni and Algarotti. The opinions, and we may add without much hesitation the literary heresies, maintained in these letters against the two great luminaries of Italian poetry, and particularly against Dante, created him many enemies, and, what was still more unpleasant to him, embroiled him with Algarotti. Willing to know something more of France than Paris, he made several excursions into Normandy and other provinces: he went also into Lorraine, to the court of King Stanislaus, and thence proceeded to Lyons, and afterwards to Geneva. Soon after his arrival he went to visit Voltaire. This celebrated writer sent to his

Betula || Beudant.

inn an edition of his works, upon which was inscribed this stanza, in allusion to Bettinelli's *Letters of Virgil*:—

Compatriote de Virgile,
Et son sécretaire aujourd'hui,
C'est a vous d'écrire sous lui;
Vous avez son âme et son style.

From Geneva he proceeded to Marseilles, from thence to Nismes, and returned by Genoa to Italy and Parma, where he arrived in 1759. The same year he took a journey to Venice, and afterwards to Verona, where he resided till 1767. Having resumed the occupations of preaching and teaching, he, according to the Chevalier Pindemonti, converted the youth to God in the church, and to good taste in his own house. He afterwards lived for some years at Modena, and he had just been appointed professor of rhetoric there, when, in 1773, the order of Jesuits was abolished in Italy.

He then returned into his own country, where he resumed his literary labours with new ardour, and published in succession his *Correspondence between two Ladies*, his *Letters to Lesbia on Epigrams*, his *Letters on the Fine Arts*, and his *Twenty-four Letters on Love*. The siege laid by the French to Mantua had compelled him to leave it, and he retired to Verona, where he formed the most intimate friendship with the Chevalier Hippolito Pindemonti, notwithstanding the disproportion of their age. In 1797, after Mantua had surrendered, he returned thither. Though nearly eighty years old, he resumed his labours and his customary manner of life. He began in 1799 a complete edition of his works, which was finished at Venice in 24 volumes 12mo. Arrived at the age of ninety years, he still retained the gaiety and vivacity of his mind, and died on the 13th of September 1808. The following is a list of his works:—

1. *Ragionamenti Filosofici, con Annotazioni.* 2. *Dell' Entusiasmo delle Belle Arti.* 3. *Dialoghi d'Amore.* 4. *Risorgimento negli Studj, nelle Arti e ne' Costumi dopo il Mille.* 5. *Delle Lettere e delle Arti Mantouane: Lettere ed Arti Modenesi.* 6. *Lettere dieci ei Virgilio agli Arcadi.* 7. *Italian Letters from a Lady to her Friend on the Fine Arts*, and *Letters from a Friend.* 8. *Poetry*, 3 vols. 9. *Tragedies*, 2 vols. 10. *Lettere a Lesbia Cidonia sopra gli Epigrammi.* 11. An *Essay on Eloquence*, to which are added, some letters, discourses, and other miscellanies. (See *Biographie Universelle*, tome iv.) (W. H–Z–T.)

BETULA, the genus of plants to which our birch and its congeners belong. It gives its name to the *Betulaceæ*, one division of *Amentaceæ*. See BOTANY.

BETULEIUS, SIXTUS, a grammarian, Latin poet, and philosopher, born at Memmingen, A.D. 1500. His real name was Birck. He taught the belles-lettres and philosophy with reputation, and became principal of the college of Augsburg, where he died in 1554. He published various works in prose; and several dramatic pieces. See *Betuleii Vita, per Jo. Nyseum Scripta*; and Adam's *Vitæ Eruditorum*.

BETWAH, a river of Hindustan, which rises in the native state of Bhopal in Malwa, and pursuing a course of 360 miles, for the most part in a north-easterly direction, falls into the Jumna at Humeerpoor, in Lat. 25. 57. Long. 80. 17.

BEUDANT, FRANÇOIS-SULPICE. This eminent philosopher, born at Paris in 1789, was early distinguished for his skill in mineralogy, and his valuable labours in general physics and in geology. The work by which he established a European reputation was his *Voyage Minéralogique et Géologique en Hongrie*. It appeared in 1822, in 4 vols. 4to, the last of which consisted of geological maps, designs, and sections, that attest the care with which he examined that interesting country. This great work is divided into two parts. After an introduction on the geography, population, government, natural productions of Hungary, tables of latitudes and longitudes, of barometric determinations of the heights of its mountains, &c., the first two volumes contain what he terms *Relation Historique*, giving an admirable account of his various journeys, including the best extant description of its mines, mineralogy, and geology. The general disquisitions on these, however, are reserved for the second part; which he has judiciously thus separated from the thread of his narrative, and discussed with remarkable fairness and candour. He appears to have at first adopted the Wernerian classification of rocks, but those of Hungary he divides into primitive, intermediate, secondary, tertiary, and independent,—meaning by the last the formations, or, as he styles them, the *terrains* of trachytes and basalts; which form so conspicuous a feature in the geology of Hungary, and which he has distinctly proved to have an igneous origin; but his deductions are stated with considerable impartiality and modesty, qualities not always found in geological works.

Beutelspach || Beveridge.

Beudant was advantageously known also as a mechanical philosopher, as the sixth edition of his *Traité Elémentaire de Physique* of 1838 sufficiently shows. His excellent elementary work on mineralogy went through two editions before it was enlarged in his *Cours Elémentaire de Minéralogie et de Géologie*, 18mo, in 1841. The same year exhibits him also as a philologist in his *Nouveaux Elémens de Grammaire Française*, 12mo.

Besides these works, he enriched several periodicals by his numerous communications, as *Annales de Chimie*, vols. iv., viii., xiv., xvi., xxxi., xxxviii; *Annales du Museum d'Histoire Naturelle*, vols. xv., xvi.; *Annales des Mines*, vols. iii., xii.; and *Memoires de l'Académie des Sciences*, vol. viii. Beudant died at Paris in 1852, in the sixty-fifth year of his age. (T. S. T.)

BEUTELSPACH, a town in the circle of Jaxt, kingdom of Wirtemburg. It stands on the river Beutel, and is remarkable as containing the ancient monastery and church in which is the cemetery of the ducal house of Wirtemburg. It contains 1900 inhabitants, chiefly employed in the manufacture of wine, which is of excellent quality.

BEUTHEN, two small towns in the Prussian province of Silesia. The one is capital of a circle of the same name in the government of Oppeln, and contains 6106 inhabitants, engaged in the manufacture of linen and woollen goods, and earthenware; the other is in the government of Liegnitz and circle of Freistadt, on the Oder, and has a population of 3824.

BEVEL, an instrument used by artificers for drawing angles. It consists of two limbs resembling those of a square, but which are moveable on a pivot at the joint in order to adjust it to any angle. The edge of the blade is sometimes curved, to suit the sweep of an arch or vault.

BEVEL-Angle, any angle except a right angle, whether it be acute or obtuse.

BEVELAND, NORTH and SOUTH, the name of two Zealand islands, formed by the divided branches of the Scheldt. North Beveland is about six miles in length by four in breadth. It lies to the east of the island of Walcheren, and between it and South Beveland is the island of Wolfersdyke. The inundation of 1532 completely ruined it. For many years it remained immersed in water, and was only again formed into an island by the gradual deposits of the sea. South Beveland is twenty-four miles long by from five to eight broad. It contains the town of Goes, and several forts and villages. An active trade in corn is carried on here, and the place is considered one of the most agreeable of the Zealand islands.

BEVERAGE, any liquor for drinking. In the middle ages, *beverage*, *beveragium*, or *biberagium*, was money for drink given to an artificer or other person over and above his hire or wages.

BEVERIDGE, WILLIAM, a very learned English bishop, was born at Barrow in Leicestershire, A.D. 1638, and educated at St John's College, Cambridge, where he distinguished himself very early by his extensive learning, and

Beverley ‖ Bevin.

particularly by his knowledge of the Oriental languages. Upon the deprivation of Dr Thomas Ken, bishop of Bath and Wells, for not taking the oaths to the government in 1691, he refused the offer of that see, although he was then chaplain to King William and Queen Mary. In 1704 he was consecrated to the bishopric of St Asaph, and discharged the duties of that office in an exemplary manner. He died at his apartments in the cloisters of Westminster Abbey in 1707, aged sixty-nine. His whole life was spent in acts of piety and charity, and he gave remarkable instances of both at his death, leaving the bulk of his estate for the propagation of the gospel and the promotion of Christian knowledge at home as well as abroad. His *Private Thoughts upon a Christian Life* is a very popular book. He was the author of several valuable works, particularly on the Oriental tongues.

BEVERLEY, a market and borough town in the East Riding of Yorkshire, about a mile from the river Hull, with which it communicates by means of a canal called the Beverley Beck. It is a very neat and handsome town, consisting principally of one long wide street upwards of a mile in length, and terminated by an ancient gateway. The magnificent collegiate church of St John is in size and splendour superior to many cathedrals. Having been erected at different times it exhibits various styles of Gothic architecture. The west front is said by Rickman to be the finest of its kind in England. It is 334 feet in length from east to west; the breadth of the nave and side aisles is 64 feet; the transept is 167 feet long; and the two towers at the west end are 200 feet in height. St Mary's church is also an exceedingly handsome and spacious Gothic building. The market-place, which comprises an area of nearly four acres, is ornamented with an octangular market-cross. The grammar-school is of great antiquity, and has two fellowships, six scholarships, and three exhibitions at St John's College, Cambridge. There are several national and two infant schools, Blue-coat school, mechanics' institute, newsroom, four banks, savings bank, dispensary, theatre, jail, &c. Its trade is chiefly confined to tanned leather, oatmeal, malt, corn, and coal. Market-days, Wednesday and Saturday. It is governed by a mayor, six aldermen, and eighteen councillors; and returns two members to parliament. Pop. (1851) of parliamentary borough, 10,058; of municipality, 8915.

BEVERLEY, a sea-port of Massachusetts in North America, connected with Salem by a bridge. It is sixteen miles N.E. of Boston. Pop. 4689.

BEVERLEY, *John of* (*Joannes Beverlacius*), archbishop of York in the eighth century, was descended of a noble family at Harpham in Northumberland, and was one of the most learned men of his time. He was abbot of the monastery of St Hilda, when his merit recommended him to the favour of Alfred king of Northumberland, who in 685 advanced him to the see of Hagustald or Hexham, and in 687 translated him to the archbishopric of York. This prelate was tutor to the famous Bede, and lived in the strictest friendship with Acca and other Anglo-Saxon doctors, several of whom he engaged to write comments on the Holy Scriptures. In 704 he founded a college at Beverley for secular priests; and after he had governed the see of York thirty-four years he divested himself of his episcopal character, and retired to Beverley, where he died four years after, on the 7th of May 721. Bede and other monkish writers ascribe several miracles to him. He wrote, 1. *Pro Luce exponenda;* 2. *Homiliæ in Evangelica;* 3. *Epistolæ ad Hildam Abbatissam; Epistolæ ad Herebaldum, Andenum, et Bertinum.*

BEVILE, in *Heraldry*, a thing broken, or opening like a carpenter's rule.

BEVIN, ELWAY, a musician eminently skilled in the art of composition, who flourished towards the end of Queen Elizabeth's reign. He was of Welsh extraction, and had been educated under Tallis, upon whose recommendation he was in 1589 sworn in gentleman extraordinary of the chapel; but from this situation, as well as from that of organist of Bristol cathedral, he was expelled in 1637, for his adherence to the Romish communion. He composed several services and anthems, and wrote a treatise on composition entitled the *Art of Musicke.*

Bewdley ‖ Beykaneer

BEWDLEY, a market and borough town in the parish of Ribbesford, in the county of Worcester, 129 miles from London. It is a well-built town, and is situated on an eminence near the river Severn, over which there is an elegant bridge. It has a modern town-hall, a free grammar-school, and several charities; with manufactures of combs, leather, and malt. It is governed by a mayor, four aldermen, and twelve councillors, and returns one member to parliament. Pop. in 1831, 3908; in 1851, 3124. This decrease is attributed to the decline of its transit trade by means of the river, which was formerly considerable.

BEWICK, THOMAS, a celebrated engraver on wood, born at Cherryburn, near Newcastle-on-Tyne, in 1753. He may be considered as the reviver of wood-engraving in Britain, and obtained a premium for a work in 1775 from the Society of Arts. He is well known for his illustration of *Select Fables*, which appeared in 1784; his *Quadrupeds*, published in 1790; and his *British Birds*, which appeared from 1797 to 1804. This last is his masterpiece, and exhibits him as a naturalist as well as an engraver. Our best artists on wood are Bewick's pupils. He died in 1828. A good memoir of him may be found in the *Gentleman's Magazine* for 1829. See WOOD-ENGRAVING.

BEWITS, in *Falconry*, pieces of leather to which a hawk's bells are fastened, and buttoned to his legs.

BEY, the Turkish governor of a town or district.

BEYAH, a river of Northern India, rising in the Himalayan province of Lahoul, in Lat. 32. 24. Long. 77. 11., at an elevation of 13,000 feet above the level of the sea. For the first 80 miles of its course the river takes a southerly direction to Mundi, whence turning westward it flows for the distance of 50 miles to Nadaun. From this point it makes a wide sweep of 80 miles to the N.W., and, entering the plains of the Punjaub, proceeds in a southerly direction to its confluence with the Sutlej; the whole length of its course being 290 miles. The Beyah is identical with the Hyphasis, which formed the limit of Alexander's expedition. Below its junction with the Sutlej the united streams bear the name of the Ghara. (E. T.)

BEYKANEER, or BICANERE, one of the native states of Rajpootana in the N.W. of Hindustan, bounded on the north by the British district of Butteeana; on the E. and S.E. by the native state of Shekawuttee; on the south by Joudpore; and on the west by Jessulmere and Bahawulpore. It extends from Lat. 27. 30. to 29. 55., and from Long. 72. 30. to 75. 40. and contains an area of 17,676 square miles, with a population of about half a million, consisting of Rajpoots and Jauts; the former being the rulers, the latter constituting the mass of the people.

A vast proportion of the soil of Beykaneer is a barren sandy desert, or a hard flat clay, sounding like a board under horses' feet, and entirely destitute of inhabitants, water, and vegetation. Hills and valleys of loose and heavy sand extend for many miles; the former, from twenty to a hundred feet in height, shifting their position and altering their shape according to the influence of the wind. During the heat of summer, clouds of moving sand threaten to overwhelm the traveller; and this desert sometimes exhibits the deceitful illusions of the *mirage.*

Vegetation is exceedingly scanty throughout, except in in a few patches, which are skilfully and industriously cultivated; and the whole country seems to depend on external supplies of grain. Nevertheless, in the midst of arid tracts, the water-melon, a juicy fruit, grows in profusion, attaining the remarkable size of three or four feet in circum-

Beykaneer

ference, from a stock no larger than that of the common melon. The seeds are sown by the natives, and also grow wild; but it is difficult to account for such an enlargement of size with so little moisture. There are no permanently running streams in Beykaneer. Water seems to be obtained only at an immense depth. The wells are often from 300 to 345 feet in depth, yet not above three in diameter; they are all lined with masonry; and one of the most curious objects in the city of Beykaneer is considered to be a well 300 feet deep, and fifteen or twenty in diameter, worked by four pair of oxen drawing as many buckets of water. The water is always brackish, scanty, and unwholesome; and this, combined with the nature of the soil, principally occasions the prevalent sterility of the country.

The wild ass, remarkable for its speed and its shyness, is found here, sometimes solitary, but oftener in herds. At a kind of shuffling trot peculiar to itself, it will leave the best horses behind. Antelopes are seen in some parts; also foxes, but smaller than those of Britain; and the desert rat is found in great numbers, occasioning serious inconvenience to equestrians, from the holes it makes where the ground is sufficiently solid. Of domesticated animals, horses, bullocks, and camels, are abundant; the last being kept in great herds for various purposes. The horses brought from the vicinity of the Johur jungle, an adjoining district, where they are reared on excellent pasture and with the strictest attention, are much prized.

The only towns of importance are Beykaneer the capital of the province, and Churoo on the eastern frontier. Churoo, independent of the suburbs, is above a mile and a half in circuit, and although situate among sandhills has a handsome appearance. All the houses have terraces, and are built of a pure white limestone. Beykaneer is situate in a remarkably desolate tract. It is surrounded by lofty white walls, strengthened with numerous round towers crowned by battlements, and presents the imposing picture of a great and magnificent city in the midst of a wilderness. But on entering the gates the illusion vanishes; and it is found to consist, for the most part, of huts built of mud, and painted red. Nevertheless there are some high houses, several temples, and at one corner a lofty and fine-looking fortress, a quarter of a mile square, environed by a wall thirty feet high, and a good dry ditch. The interior is a confused assemblage of towers and battlements, overtopped by houses; and it contains the royal palace, a curious old edifice.

Beykaneer is governed by a rajah, who acknowledges the supremacy of the British government. His dominions were wrested chiefly from the Batties about the middle of the fifteenth century by a younger son of the rajah of Joudpore, who founded the principality. In the following century his successors appear among the feudatories of the Mogul emperors of Delhi, in which relative position they seem to have continued until the decay of the empire, when they recovered their independence. In 1799 George Thomas, a celebrated adventurer, who raised himself to the government of a neighbouring territory, invaded Beykaneer, and compelled the rajah to purchase peace with a tribute of L.25,000. He also aided the Batties in expelling him from their country. More recently, a war having commenced between the rajahs of Joudpore and Jeypore, who were contending for the hand of an eastern princess, the interference of Soorut Sing of Beykaneer excited the wrath of some of the competitors against himself. Five different armies invaded Beykaneer in 1808, when the rajah filled up all the wells within ten miles of the walls of his capital. The contest was protracted for a considerable time, but the rajah succeeded in maintaining himself as an independent prince. His independence was finally secured to him by his being admitted, in 1818, within the line of British protection. The rajah maintains a military force of 3500 men, irrespective of the quotas furnished by his feudal chiefs, amounting to 1500 horse. His revenues are returned at L.65,000 per annum. Distance of Beykaneer N.W. from Calcutta 1175 miles. Lat. 28 N.; Long. 73. 22. E. (J. G. D.) (E. T.)

Beyra || Beyrout.

BEYRA or BEIRA, a province of Portugal, bounded on the north by the provinces of Traz-os-Montes and Minho; east by Spain; south by Alentejo and Portuguese Estremadura; and west by the Atlantic. Area about 5900 square miles. Pop. (1850) 631,416. The surface is very mountainous; its highest point, in the Sierra de Estrella, being 7524 feet. It is divided into Beira Alta and Beira Baixa; the former comprising the district between the Douro and the Sierra de Estrella, and the latter the remaining portion of the province between these mountains and the Tagus. The principal river is the Douro, which receives the waters of numerous smaller streams. The other chief rivers are the Aguada, the Mondego, the Vouga, and the Zezere. Agriculture is in a neglected state, and before the general introduction of the potato an annual importation of foreign corn was necessary for the support of the inhabitants. On the mountains and in the valleys, however, sheep are pastured in great numbers, and the olive is extensively cultivated; olive-oil and fruit forming the principal exports of the province. Good wine also is produced, and the cheese of the Sierra de Estrella district is famed. Silver and lead ores exist in some of the mountains, but the mines have not been wrought since a remote period. Iron, coal, and marble, are worked to some extent. There are few manufactures, the chief employment being the cultivation of the vine, the olive, the chestnut, the orange, &c.

The province comprehends 7 bishoprics, 22 judicial districts, 85 communes, and 860 parishes. The chief towns are Coimbra, Viseu, Aveiro, Ovar, and Lamego. The heir-apparent to the throne of Portugal has the title of Prince of Beira.

BEYRAMICH, a city of Asia Minor, the capital of the district called Troas, which belongs to the pasha of the Dardanelles. It is an extensive town, and the houses are better built and more regularly disposed than in Constantinople. Many antiquities are to be seen in this place and the vicinity; amongst which are several sarcophagi, consisting of entire blocks of granite, converted to ordinary purposes in the street. It is distant about sixty miles from the Dardanelles.

BEYROUT, BEIROUT, or BAIRUT, anciently BERYTUS (Βηρυτός), a seaport-town of Syria, in the pashalic of Saide or Acre. A tongue of land, which presents a conspicuous headland when viewed from the north, extends itself in a plain about five or six miles from the mountains towards the sea; and on the northern edge of this plain the town is situated, on a rising ground, which contributes both to its cleanliness and salubrity. To the north the projection of the land forms a fine bay, the head of which is five or six miles E.S.E. of the town; and there is thus a roadstead to the N.E., secured from the S.W. wind, which is the prevailing one. The harbour is now choked up with sand and rubbish; and all that remains of the ancient structure is a pier, to which boats can approach sufficiently for discharging goods. All along its front are ranged fine shafts of gray granite pillars, which are used for mooring small vessels. Merchant vessels and ships of war anchor at a distance in the roadstead. The town itself is an irregular square, open towards the sea, and surrounded on the three sides which face the land with a wall built by Djezzar Pasha, defended by a few round towers of little strength, and far too feeble to resist an attack of artillery. Near the sea is an old castle, on which are six pieces of artillery; and at the common landing place is a ruined tower, built on a rock in the sea. The town is in general better built, and the situation is more salubrious than any along the coast; the streets are wider, and are paved with large stones. The dwelling-houses are spacious, lofty, and well built; the bazaars are amply furnished with provisions, as well as with Oriental and European manufactures;

Beys ‖ Beza.

and the magazines near the sea-shore are large and convenient. The town contains three mosques, with their courts, fountains, and minarets; and four Christian churches. Water is abundantly supplied at all seasons from several fountains, constructed by Djezzar Pasha. The suburbs are nearly as large as the town; consisting of houses interspersed with gardens, which are planted with fruit-trees, and are extremely beautiful. "The situation," says Mr Carne, "is the most beautiful of all the Syrian towns: the environs are laid out in plantations of mulberry trees, and a quantity of silk is produced and exported." Indeed, the commerce of Beyrout is greater than that of any other port in Syria; and it is increasing. It is the maritime emporium of Damascus, and of the surrounding country. British manufactures, such as cottons, muslins, cloths, &c., with bar-iron, lead, coffee, spices, indigo, &c., are imported. The returns are made in cotton, corn, raw silk (which is the staple commodity of the country), sometimes in wine and oil, and occasionally in specie. The population, amounting to about 12,000, is composed of Druses, Maronites, Greeks, Turks, Jews, Arabs, Africans. A Greek and a Maronite bishop reside here. Beyrout still boasts some relics of the ancient magnificence of Berytus, that celebrated "nurse of tranquil life" (Βηρυτὸς βιότοιο γαληναιόο τιθήνη), as Nonus has called it (*Dionysiaca*, lib. xli. p. 708. ed. Falk. Antv. 1569). The school of jurisprudence, founded here in the third century, long maintained a high reputation. During the reign of Justinian, the two imperial cities and Berytus were the only places within the limits of the empire where law was permitted to be publicly taught; and of the three, the Syrian school (of which Theophilus and Dorotheus, the associates of Tribonian in the compilation of the *Institutions* and the *Digest* were *antecessores* or teachers) appears to have stood highest in general estimation. But the prosperity of Berytus was first interrupted, and finally subverted, by some of the great convulsions of nature. In the year 384 the town was greatly injured by an earthquake, and in 554 it was visited by another which left it a heap of ruins. After this last catastrophe the professors transferred their school to Sidon, and the surviving inhabitants made an effort to raise a new city from the ruins of the old; but another calamity awaited them, and this famous seat of jurisprudence was totally consumed by fire. After a long interval, the modern town of Beyrout was founded by the Druses near the ancient site, and was possessed by the emirs as their capital and only seaport, until they were expelled by Djezzar Pasha of Acre. Beyrout is an important possession in connection with the power of Turkey in the East. In 1840 it was bombarded by the combined fleets of England and Turkey, and wrested from the hands of the pasha of Egypt. Long. 35. 29. E. Lat. 33. 50. N. (Buckingham's *Travels among the Arab Tribes;* Volney's *Travels;* Carne's *Letters from the East;* Jowett's *Christian Researches in Syria*, &c.; Lamartine's *Travels in the East.*)

BEYS, Giles, a celebrated printer at Paris in the sixteenth century, who first made a distinction in printing between *i* and *j*, *u* and *v*.

BEZA, or Besze, Theodore, one of the principal pillars of the reformed church, was born at Vezelai in Burgundy, June 24. 1519. He was sent early to Paris to his uncle Nicholas Beza, who was counsellor to the parliament; and at nine years of age he became a student at Orleans. He afterwards went to Bourges, where, under the care of Melchior Wolmar, he made extraordinary progress in learning, and imbibed the principles of Calvinism. His uncle intended him for the bar; but the law not suiting his disposition, he spent most of his time in reading the Greek and Latin authors, and in composing verses. In 1539 he took his licentiate's degree, and went to Paris, where he yielded to the allurements of pleasure, and wrote some poems of a licentious cast. But sickness awakened him to a sense of his error, and he determined to perform a vow he had formerly made of entering into the reformed church. With this resolution he went to Geneva and made a public profession of the reformed religion. In 1549 he accepted the Greek professorship at Lausanne, where he also read lectures in French on the New Testament. Having settled at Geneva, he adhered to Calvin in the strictest manner, and became his colleague in the church and in the university. At the solicitation of some great men of the kingdom he was sent to Nerac to confer with the king of Navarre upon affairs of importance. At this time the Guises had gained authority, under the reign of Francis II., to the prejudice of the princes of the blood. The king of Navarre having testified both by letters and deputies that he desired Beza might assist at the conference of Poissy, the senate of Geneva consented. The assembly listened attentively to his harangue, till, speaking of the real presence, he said, that the body of Jesus Christ was as distant from the bread and wine, as the highest heaven is from the earth. This produced a murmur: some cried out, "Blasphemavit;" and others rose up to go away. Cardinal de Tournon, who sat in the first place, desired the king and queen either to silence Beza, or to permit him and his company to withdraw. The king did not stir, nor did any of the princes; and leave was given him to proceed. Throughout the whole conference he acquitted himself with great ability. He often preached before the queen of Navarre, the prince of Condé, and in the suburbs of Paris. After the massacre of Vassy, he was deputed to the king to complain of this violence. The civil war followed soon after, during which the prince of Condé kept Beza with him; and while the prince was imprisoned he lived with Admiral de Coligni, and did not return to Geneva till after the peace of 1563. In 1571 he was chosen moderator of the national synod of Rochelle, and assisted the year after at that of Nismes; after which he was present at the conferences of Montheliard, and at those of Berne. The infirmities of age beginning to fall heavily upon him, he seldom spoke in public, and in the beginning of 1600 ceased to do so entirely. In 1597, however, he wrote some animated verses against the Jesuits, on the occasion of a report that was circulated of his death, and of his having embraced on his deathbed the Romish faith. He died on the 13th October 1605. Beza was a man of extraordinary merit, and did great service to the Protestant cause. This, however, exposed him to innumerable calumnies; but his adversaries, both Catholic and Lutheran, found that he was well able to defend himself.

Beza wrote, 1. A Translation of the New Testament; 2. A Version of the Psalms into Latin verse; 3. A treatise on the Sacraments; 4. Some Sermons on the Passion of Jesus Christ and on Solomon's Song; 5. A version of the Canticles, in lyric verse; 6. A French tragi-comedy, entitled The Sacrifice of Abraham; and many other works.

Bezant ‖ Beziers.

BEZIERS, a city of France, in the department of Herault, and capital of an arrondissement of the same name. It is beautifully situated on a hill, on the left bank of the river Orbe, where it is joined by the canal of Languedoc, 38 miles S.W. of Montpelier. It is surrounded by old walls flanked with towers, round which is a recently planted promenade; and has a fine old Gothic cathedral, several churches, an old episcopal palace now used for the government offices, a communal college, agricultural society, theatre, and public library. It manufactures silk stockings, starch, gloves, brandy, confectionary, paper, leather, glass, &c.; and has a considerable trade. Beziers is of great antiquity, and has remains of an amphitheatre and other Roman works. The Romans established a colony here in 636; and afterwards it became the head-quarters of the seventh legion, under the title of *Biterra Septumanorum.* It was completely destroyed in 1209 by the forces of Simon de Montfort in the crusade against the Albigenses, on which occasion 60,000 persons were

Bezoar || Bheels.

barbarously massacred. Beziers was rebuilt in 1289, and again suffered severely in the civil and religious wars of the sixteenth century. Pop. (1851) 17,376.

BEZOAR. This name, which is derived from a Persian word implying an antidote to poison, was given to a concretion found in the stomach of an animal of the goat kind, and once very highly valued for this imaginary quality; and hence it has been extended to all concretions found in the intestines of animals. Of these there are several kinds; first, superphosphate of lime, which forms concretions in the intestines of many mammalia; secondly, phosphate of ammonia and magnesia, a concretion of a gray or brown colour, composed of radiations from a centre, and found in the intestines of herbivorous animals, such as the elephant, the horse, &c.; thirdly, biliary concretions, of a reddish brown colour, and frequently met with in the intestines and gall bladders of oxen. This kind is composed of inspissated bile, and is used by painters as an orange-yellow pigment. Such concretions also occur hairy, resinous, and ligniform.

BHADRINATH, a town and celebrated temple in Hindustan, in the British district of Gurwhal, situate on the right bank of the Vishungunga, a tributary of the Alcanunda river, in the middle of a valley nearly four miles in length and one in breadth. The town is small, containing only twenty or thirty huts, in which reside the Brahmins and the attendants on the temple. The building, however, which is considered a place of high sancity, by no means corresponds to its great celebrity. It is about 40 or 50 feet in height, built in the form of a cone, with a small cupola, on the top of which is a gilt ball and spire, and contains the shrine of Bhadrinath, dedicated to an incarnation of Vishnu. The principal idol is of black stone and about three feet in height. Bhadrinath is the favourite resort of pilgrims from all parts of India. In ordinary years the number varies from 7000 to 10,000; but every twelfth year, when the festival of Kumbh Mela is celebrated, the concourse of persons is said to be 50,000. In addition to the gifts of votaries, the temple enjoys a further source of revenue from the rents of villages assigned by former rajahs. Some years since the temple was shattered by an earthquake, and has only been partially restored. It is situate among mountains rising 23,000 feet above the level of the sea. Elevation of site of the temple 10,294 feet. Lat. 30. 44. Long. 79. 32. (E. T.)

BHATGAN, or BHATGONG, a town of Northern Hindustan, in the valley of Nepaul, and a celebrated place of Hindu superstition. It is the favourite residence of the Brahmins of Nepaul, and contains many more families of that order than either Catmandoo or Patu. It contains 12,000 houses, and its palace and the buildings in general are of a more striking appearance than those of the other Nepaulese towns. The town is said to contain many valuable Sanscrit libraries. Lat. 27. 37. N. Long. 85. 22. E.

BHEELS, one of the rude tribes of Hindustan, inhabiting chiefly the rocky ranges of the Vyndhia and Sautpoora mountains, and the banks of the Nerbudda and Taptee. In common with the hill tribes designated Coolies and Ghoonds, the Bheels are supposed to have been the aborigines of India, and to have been driven to their present fastnesses at the period of the Hindu invasion. They are of dark complexion and diminutive stature, but active, and capable of enduring great fatigue. Efforts have been made by the British government to reclaim the Bheels from lawless practices; and these have been rendered successful, partly by raising a local military corps into which the wild and unruly spirits were drafted, and partly by settling throughout the districts of Candeish and Ahmednuggur small agricultural communities composed of those more peaceably disposed. High commendation has been bestowed by competent military authority upon the discipline and skill displayed by the Bheel corps; while with regard to the agricultural settlements, the happy results cannot be better described than in the words of the British superintendent Mr Candeish, who says: "These districts, formerly the scene of every outrage, where neither life nor property were secure, now enjoy tranquillity; the roads, formerly hazardous for an armed party, are traversed at all hours by single passengers; the formidable list of crimes has dwindled down to the reports of a few petty thefts, and the Bheels from outcasts have become members of a society daily rising in respectability and appearance, and becoming useful and obedient servants of the state." (E. T.)

Bhurtpore.

BHURTPORE, a town of Hindustan, and the capital of a native state of the same name. It is a place of great extent, the site occupied by the town and fort measuring upwards of eight miles in circumference. It had also in former times the reputation of considerable strength; being surrounded by a mud wall of great height and thickness, with a very wide and deep ditch. The fort stands at the eastern extremity of the town; its situation is more elevated, its walls are higher, and its ditch is of greater width and depth. It is of a square figure; one of its sides originally overlooked the country, while the other three were within the town, but since the enlargement of the city, which took place after the siege of 1805, the fortress has been brought entirely within the city walls. The ditch, from the nature of the ground, may be easily filled from an adjoining lake, and being thus rendered unfordable, presents a formidable obstacle to a besieging army. The rajah of Bhurtpore and most of his people are Jauts. It was in 1700 that this tribe first attracted notice in Hindustan. They migrated from the right bank of the Indus into the province of Mooltan, and were allowed to settle in several parts of the country between the Ganges and the Jumna. They are, according to Bishop Heber, the finest people in point of bodily advantages and martial spirit that he had seen in India; and their country is one of the most fertile and best cultivated. Chooraman, their elected leader, is said to have erected the fortress of Bhurtpore at the commencement of the eighteenth century, by means of the plunder which he had carried off from Aurungzebe's army during its retreat from the Mahrattas towards Ahmednuggur. He transmitted this stronghold to his successors, by one of whom it was held at the time the British advanced into Central India. In 1803 a treaty of perpetual friendship was concluded between him and General Lake; but, notwithstanding this, he espoused the declining cause of Holkar in 1804, and admitted his routed army into the fortress. Lord Lake reached Bhurtpore on the 3d January 1805, and forthwith commenced a series of operations against the fort. A breaching battery of six eighteen-pounders, and one of four eight-inch, and four five-inch mortars, were the means of attack. The British army, from its limited numbers compared with the extent of the place, acted under every disadvantage. Their operations were confined to one point, and the besieged consequently could easily procure supplies from the surrounding country. Undismayed by these obstacles, Lord Lake made four successive attempts to storm the fortress, in all of which he was repulsed with great slaughter; his loss amounting, in killed and wounded, to about 3000. The rajah, notwithstanding his success, fearing that British courage and skill would ultimately prevail, sent his son to Lord Lake's camp with the keys of the fortress, and agreed to compel Holkar to quit Bhurtpore. A second treaty was then concluded with the rajah, and several additional precautions adopted to secure his fidelity. This signal overthrow of the British by the Jauts, the defenders of Bhurtpore, was celebrated all over India, and was by many regarded as the forerunner of their expulsion from Hindustan. But in the lapse of twenty years an opportunity occurred for a new trial of strength, which terminated in the complete triumph of the British arms. A dispute occurred in the family of the rajah respecting the succession;

Biafra ‖ Bible.

the cousin having usurped the inheritance of the son. Sir David Ochterlony prepared to expel the usurper, but was restrained by orders from the governor-general. Afterwards, however, it was determined to attack this great stronghold; and on the 10th December 1825 Lord Combermere assumed the command of the British army before Bhurtpore. As it was vain to batter in breach, on account of the extraordinary thickness of the wall, the besiegers proceeded by mining; and on the 18th January 1826, a mine of considerable dimensions having been first sprung, the signal was given for the assault. In the course of two hours every gateway and bastion, and the whole rampart surrounding the town, with the gates of the citadel, were in possession of the besiegers, and thus was effaced the transient stain which the former failure at Bhurtpore had cast on the glory of the British arms. On the 4th February the rightful rajah was reinstated in his inheritance; and some years after, on attaining his majority, was admitted to the exercise of independent authority. It was at the same time determined to dismantle the fortress; and the principal bastions, and parts of several curtains, were accordingly blown up, and left in a state of ruin. The territory of which Bhurtpore is the principal place has an area of 1978 square miles, and contains a population of 600,000. Its revenue is computed at L.170,000 per annum, and its ruler maintains a military force of 200 artillery, 1500 cavalry, and 3700 infantry. Bhurtpore is thirty-four miles N.W. from Agra. Lat. 27. 13. Long. 77. 33. (E. T.)

BIAFRA, a tract of country on the coast of Western Africa, on a bay or bight of the same name, situated at the easternmost extremity of the Gulf of Guinea. It has long been known that a number of broad estuaries open into this bight from the north; but, owing to a strange want of enterprise, or some other cause, European vessels trading on this coast have not hitherto ascended any of these beyond fifty or sixty miles from its embouchure. Lander the traveller, however, in descending the Niger, arrived by one of these channels in the Bight of Biafra; thus solving the great problem of African geography, and leaving no doubt that the system of inter-ramified river-channels, extending from Benin to Biafra, constitutes the delta of the Niger, through which, by a number of outlets, it discharges itself into the sea. For the details of this important and interesting discovery, see the article NIGER.

BIAFRA, *Bight of*, the most eastern part of the Gulf of Guinea, on the western coast of Africa, between Capes Formosa and Lopez, and containing the islands of Fernando Po, Prince, and St Thomas.

BIALYSTOCK, a fortified town of European Russia, capital of a province of the same name, which formerly formed part of the kingdom of Poland. It is situated on the Bialy, an affluent of the Narew, and is neat and well built, having a castle, four churches, a gymnasium, and a considerable trade. Pop. 9217. It is 45 miles S.W. of Grodno, in Lat. 53. 7. 35. N. Long. 23. 20. E.

Bianchi ‖ Bible.

BIANCHI, FRANCESCO, called Il Frari, an eminent painter, born at Modena in 1447; died in 1510. He had the honour of being the instructor of Coreggio.

BIANCHINI, FRANCIS, a very learned Italian astronomer and philosopher, born at Verona in 1662, of a noble and ancient family. His taste for natural philosophy and mathematics induced him to establish the academy of Alcotofili, at Verona. He went to Rome in 1684, and was made librarian to Cardinal Ottoboni, afterwards Pope Alexander VIII. He also became canon of St[a] Maria de la Rotonda, and at length of St[o] Lorenzo in Damaso. He was the author of numerous works, and died in 1729.

BIAR, a town of the province of Alicante, in Spain, containing about 3000 inhabitants, who are employed in making woollen goods. The vicinity is celebrated for its honey, which has a peculiar flavour, extracted from the rosemary, which grows wild there in great abundance.

BIARCHUS (*βίαρχος*), in the court of the emperors of Constantinople, an officer who superintended the provisions of the soldiery.

BIAS (*Βίας*), of Priene in Ionia, one of the Seven Sages of Greece, flourished about 550 years before Christ. He was accustomed to say, that it was a sickness of the mind to wish for impossible things. Being asked, when his native city was besieged, why he alone had retired from the place without carrying anything with him, he replied, that he carried his all with him; meaning, that knowledge and virtue were the only blessings peculiarly his own, since they could not be taken from him. He lived to a very advanced age, and expired immediately after pleading successfully the cause of one of his friends. Diogenes Laertius and others have recorded many of his sayings.

BIAS, the inclination or bent of the mind to a particular object. It is also applied to the weight inserted in the side of a bowl, which causes it to incline, when rolling, to that particular side.

BIBERACH, a town of Würtemberg, in the circle of the Danube, and capital of a bailiwick of the same name, 23 miles S.S.W. of Ulm. It is situated on the small river Riss, and has 5000 inhabitants, chiefly engaged in bleaching, weaving, and tanning. The bailiwick contains one city, four market-towns, 36 villages, and 26,224 inhabitants.

BIBIENA, FERDINANDO GALLI, a painter and architect, was born at Bologna in 1657, and surnamed *Bibiena* from a territory of that name in Tuscany, in which his father was born. He acquired such reputation by his skill in architecture, that he was invited to the court of the Duke of Parma, and made his first painter and architect. Bibiena afterwards went to the emperor's court, where he had the same honours conferred upon him. He wrote two books on architecture; and died at Bologna in 1745. (Lanzi, *Stor. Pitt.*)

BIBLE,

IN Greek, *βιβλος*, or *ἡ βιβλος*, *the book*,—a name applied by Christians since the fifth century to denote the collective volume of the Sacred Writings, which are designated also by various other appellations, as the Holy Scriptures, Inspired Writings, Holy Writ, &c. The names Scripture or Writing (2 Pet. i. 20), Scriptures (Matt. xxii. 29; Acts viii. 24), Holy Scriptures (2 Tim. iii. 15), are those generally employed in the New Testament to denote the writings of the Old, which was styled by the Jews *mikra*, i.e. *lesson*, *lecture*, or *reading*.

Division of the Bible.

The Bible is divided into the Old and New Testaments, so termed because they contain the history of the revelations which Jehovah has made to mankind, and of his dealings with them, under two dispensations or covenants. The former was written in Hebrew, with the exception of a small portion, which is Chaldee, and refers to Babylon, where that language was spoken, and where the Jews were held in captivity for seventy years. The Old Testament is divided into the Law, the Prophets, and Writings. This division, which is referred to in the New Testament (Luke xxiv. 44) under the terms, the Law, the Prophets, and the Psalms, is believed to be as ancient as the formation of the canon. It is mentioned in the prologue of Jesus the son of Sirach, and in Philo, and in the Talmud, as well as in the New Testament. The prophets were divided by the ancient Jews into the *early* prophets, containing Joshua, Judges, Samuel, and Kings; and the *later* prophets, which were again subdivided into the *greater*, including Isaiah, Jeremiah, Ezekiel,—and

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the *lesser*, comprehending the remaining twelve. The third division, called by the Greeks "Hagiographa," or "Holy Writings," contains all the other canonical books not included in the preceding parts. The Talmud and the modern Jews divide the sacred books into eight prophets and nine hagiographa.

Josephus enumerates twenty-two books, five of Moses, thirteen prophets, and four books of morality.[1] This number is also mentioned by Origen and Jerome, but it does not seem to have been employed by the Jews themselves. According to the oldest catalogue extant in the Christian church, the Old Testament consists of the five books of Moses, viz., Genesis, Exodus, Leviticus, Numbers, and Deuteronomy; Joshua, Judges, and Ruth; four books of Kings and two of Chronicles; the Psalms of David; the Proverbs of Solomon, Ecclesiastes, Canticles, and Job; the prophets Isaiah and Jeremiah; the twelve prophets; the books of Daniel, Ezekiel, and Ezra, under which head Nehemiah and Ezra seem to be included.[2]

Order in which the books are arranged.

With regard to the order in which the different books were arranged, the Jews not only differed from the Christians, but they were not agreed among themselves. The Talmudists arranged the prophets thus: Joshua, Judges, Samuel, Kings, Jeremiah, Ezekiel, Isaiah, and the twelve minor prophets. The hagiographa they placed in this manner: Ruth, Psalms, Job, Proverbs, Ecclesiastes, Canticles, Lamentations, Daniel, Esther, Ezra, Chronicles. The Masoretic arrangement which is adopted in our modern Hebrew Bibles is as follows: The five books of Moses, Joshua, Judges, two books of Samuel, two books of Kings, Isaiah, Jeremiah, and Ezekiel, the twelve minor prophets, Psalms, Proverbs, Job, Canticles, Ecclesiastes, Esther, Daniel, Ezra, Nehemiah, and First and Second Chronicles. Luther's arrangement, which is made entirely according to his own judgment, has been adopted by our English translators, and is generally followed by Protestants.

Division of the text.

The Hebrew text is divided into smaller and larger sections, which have descended from a very remote antiquity. The sections called "parashes," or paragraphs, of which the Pentateuch contains 669, are of earlier origin than the Talmud, and probably belong to the time when the sacred books were first read in public. These divisions are of two kinds, called by the Jews "open," and "closed." The former are so called because they commenced a new line: the latter are called "shut" or "closed," because they were separated within the line by a space or break. It is supposed that the original purpose of the open sections was to denote the introduction of a new object, while the close sections were intended to point out the most natural and prominent paragraphs in the open ones, such as the change of speakers, the members of a genealogy, &c. The larger or ecclesiastical sections are believed to be of later origin than the smaller sections. They originated in the custom of reading every Sabbath in the synagogue a portion of the law. According to Maimonides, it was the received usage among the Jews to complete in this way the reading of the law in the space of one year, beginning with the Sabbath following the Feast of Tabernacles. Hence there are fifty-four of these divisions in the Pentateuch, corresponding to the Sabbaths in a Jewish intercalary year. At a later period, certain portions of the prophets were selected for public reading in the synagogue; they were termed, "Haphtaroth," and were written on separate rolls from the Pentateuch sections. The division of the Old Testament into chapters, as they still stand in the English version, is of Christian origin, and has been ascribed by Bale, bishop of Ossory, the celebrated antiquarian, to Stephen Langton, archbishop of Canterbury, who died in A.D. 1227, and by others to Cardinal Hugo de Sancto Caro, who flourished about the middle of the same century. This arrangement was made for convenience of reference, in a concordance for the Latin Bible which was constructed at this time. But the subdivision of the chapters into verses had not yet been introduced, and for the purpose of referring more easily to a particular sentence, Hugo placed the first seven letters of the alphabet along the margin of each page. From the Christians this capitular division was borrowed by the Jews, and transferred to the Hebrew Bible. Rabbi Isaac Nathan made use of it in the preparation of a Hebrew concordance in 1438; and it was first inserted in the printed Hebrew text by Daniel Bomberg in his edition of 1525. The numbering of the verses was first employed in the Hebrew Psalter printed by Henry Stephens in 1509. In the Latin translation of the Bible made by Sanctus Pagninus of Lucca, and published at Lyons in 1528, there is a division throughout into verses, marked with Arabic numerals on the margin. The system of Pagninus was adopted by Robert Stephens in the New Testament in 1551, and in the whole Bible in 1555; after this time the practice of numbering the verses became general.

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History of the text.

The sacred books of the Old Testament have come down to our times in MSS., the oldest of which date from the twelfth century. Nothing is known of the history of the text previous to that period after the return of the Jews from their captivity, when the canon was closed, and the separate books were formed into a completed whole. It is probable that the other sacred books, as well as the law, were preserved in or by the side of the ark of the covenant, and the well-known veneration of the Jews for their holy writings would lead them to watch carefully over the integrity of the text, although it has been exposed to the ordinary causes which deteriorate writings, and various errors have crept into it through the mistakes of transcribers. The existence of the Samaritan Pentateuch, however, whatever value may be attached to its peculiar readings, proves that the copy which we now possess of the five books of Moses is substantially identical with the original manuscript of the Jewish lawgiver. Various conflicting opinions have been entertained respecting the antiquity of the Samaritan copy of the Pentateuch, and the source from which it was derived. Usher maintained that it was the production of an impostor named Dositheus, who compiled this copy from the Hebrew and the Septuagint, a hypothesis which is manifestly untenable. Le Clerc and others have conjectured that the Israelitish priest who was sent by the king of Assyria to instruct the new inhabitants in the religion of the country,[3] took with him a copy of the law, which became thenceforward the Samaritan Pentateuch. But this opinion is not supported by any historical testimony. It has been supposed by Hottinger, Prideaux, and others, that the origin of the Samaritan Pentateuch is contemporary with the erection of the Samaritan temple on Mount Gerizim, in the time of Ezra, and that Manasseh, the Jewish priest who went over to the Samaritans, took with him a copy of the law. Dr Davidson contends that the Israelites obtained a copy of the Pentateuch in the reign of Josiah, who carried his reforms not only throughout Judah, but Israel also; for we are informed that he broke down the altars and high places, and the images in Samaria, in the cities of Manasseh, Ephraim, Simeon, and Naphtali. In consequence of these vigorous measures, the Israelites, *i.e.* the Samaritans, served the Lord, and even sent money for the repair of the temple at Jerusalem.[4] And when Josiah proclaimed a solemn passover at Jerusalem, the Israelites attended as well as the people of Judah, and heard the king read in the ears of his assembled people the words of the book of the covenant.[5] This conduct, however, indicates a previous knowledge of the law on the part of

Samaritan Pentateuch.

[1] *Contra Apion*, i. 7, 8.
[2] Euseb. *Hist. Eccles.* iv. 26.
[3] 2 Kings xvii. 28.
[4] 2 Kings xxiii. 15–20; 2 Chron. xxxiv. 9.
[5] *Ibid.* v. 32; chap. xxxv. 1–18.

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the Israelites, otherwise the urgent appeal of Josiah could scarcely have produced so powerful and wide an impression. Some are therefore of opinion with Morin, Kennicot, Michaelis, Stuart, and other eminent commentators, that copies of the Pentateuch must have been in the hands of the ten tribes from the time of Rehoboam. "The prophets, who frequently inveigh against the Israelites for their idolatry and their crimes, never accuse them of being destitute of the law or ignorant of its contents. It is wholly improbable, too, that the people when carried captive into Assyria took with them all the copies of the law. Thus we are brought to the conclusion that the Samaritan as well as the Jewish copy originally flowed from the autograph of Moses. The two constitute, in fact, different recensions of the same work, and coalesce in point of antiquity."[1]

Formation of the Old Testament canon.

With regard to the formation and completion of the Old Testament canon, a very steadfast tradition of the Jews affirms that the collection of the sacred writings began with Moses, was carried on by the prophets, and was completed in the time of Ezra and Nehemiah, under the auspices of those writers and of the men of the Great Synagogue,—"a number of elders, amounting to one hundred and twenty, who, succeeding to others in a continued series from the return of the Jews again into Judæa, after the Babylonish captivity, to the time of Simon the Just, laboured in the restoring of the Jewish church and state in that country. In order thereto, the Holy Scriptures being the rule they were to go by, their chief care was to make a true collection of those Scriptures and publish them to the people."[2] The first part of this tradition is confirmed by the testimony of the Holy Scriptures themselves. We are told (Deut. xxxi. 9) that when Moses had finished the writing of the law, "he delivered it to the priests the sons of Levi,[3] and unto the elders of Israel." And the king was enjoined to "write him a copy of this law in a book, out of that which is before the priests the Levites" (xvii. 18). From Deut. xxxi. 26, we still further learn that this copy of the law was deposited in the side of the ark of the covenant. We are informed that Joshua, following the example of Moses, wrote in the book of the law of the Lord the history which bears his name (Josh. xxiv. 26); and this, as Havernick remarks, evidently refers to the passage in Deuteronomy, and hence must be understood as intimating that this document also found a place in the side of the ark of the covenant. Le Clerc conjectures with great probability that the membrane on which the words of Joshua were written was agglutinated to the volume of Moses, which had been deposited in the side of the ark. In later times also we find traces of this same custom. Thus Samuel, when he had told the people the manner (law, *jus publicum*) of the kingdom, "wrote it in *the book*, and laid it up before the Lord,"—language which plainly intimates that the documents of Samuel were appended to some particular well-known book. At a later period, in the reign of Josiah, Hilkiah the high priest is said "to have found the book of the law in the house of the Lord" (2 Kings xxii. 8), doubtless in its appointed place of deposit—the side of the ark. Isaiah, in calling attention to his own prophecies, says, "Seek ye out of the book of the Lord and read, no one of these shall fail" (xxxiv. 16); a passage on which Gesenius remarks, "the poet seems to contemplate the placing of his oracle in a collection of oracles and holy writings, from which posterity might judge of the correctness of his prediction."[4] From these statements we are warranted to conclude that the books of the Old Testament which were successively sanctioned by Moses and the prophets, were acknowledged by the Jews before the exile as of divine authority; and that an authentic copy of each book, as soon as it was concluded, was laid up in the sanctuary, and placed under the care of the priests. As Abarbanel justly remarks on Deut. xxxi. 26, "God deposited there (in the side of the ark), the book of the law, to remain there as a true and abiding witness; and that no one might have the power of falsifying or disfiguring it. None could injure writings deposited among the genealogies and with the priests." This opinion respecting the formation of the canon is corroborated by the unvarying tradition of the Jewish rabbins from the earliest period. Thus, in one of the oldest portions of the Talmud, it is said, "Moses received the law at Sinai, and transmitted it to Joshua; Joshua to the elders; the elders to the prophets; the prophets to the men of the Great Synagogue."[5] Again, in the Babylonian Gemara the rabbins enlarge at considerable length on the canon. "The wise men," they state, "have left to us the law, the prophets, and the hagiographa, combined into one whole." "Who," they go on to say, "has written these books?" To this it is replied, *Moses* wrote the Pentateuch and Job; *Joshua*, the book which bears his name, and eight verses of Deuteronomy; *Samuel*, the books of Samuel, Judges, and Ruth; *David*, the Psalms, assisted by ten men; *Jeremiah*, his book, Lamentations, and the books of Kings; *Hezekiah and his College*, Isaiah, Proverbs, Canticles, Ecclesiastes; the *men of the Great Synagogue*, Ezekiel, Daniel, and Esther; *Ezra*, his book and the genealogies in the Chronicles; and *Nehemiah* finished the Chronicles,—a passage which, as Havernick has shown, refers, not to the composition of these books, but to their insertion in the canon.

Bible.

Completion of the canon.

With regard to the time when the sacred canon was completed, Hengstenberg, Havernick, and Stuart are of opinion that this event took place under Ezra, Nehemiah, and the Great Synagogue. In support of this view, they adduce the testimony of the son of Sirach, who cites the three divisions of the canon, and refers to it as a completed whole; and of Josephus who divides the Old Testament into twenty-two books "which were justly esteemed divine," and affirms that from the time of Artaxerxes down to his own day, no one had dared either to add to, or to take from, or to alter anything in the sacred books. It was not every one, he says, who was permitted among the Jews to write therein; only the prophets were competent, in virtue of their divine inspiration. The thirteen prophets wrote their history from the death of Moses to the reign of Artaxerxes. From Artaxerxes to our day, everything also has been recorded in books, but these have not been regarded as deserving equal credit with the former, because of the failure of the exact succession of the prophets."[6] It is also contended by these writers that the time of Ezra and Nehemiah was the most suitable period for such an undertaking: that, moreover, it was the latest period at which the canon could be fixed. "As the duty to be performed was not merely that of determining the genuineness of certain books, but of pointing out those which had been divinely ordained as a rule of faith and morals to the church, it was one which none but a prophet could discharge." Now, in the days of Nehemiah and Ezra there were several prophets living, among whom we know the names of Haggai, Zechariah, and Malachi; but with that age expired the line of prophets whom God had appointed "to comfort Jacob and deliver them by assured hope." As the men of the Great Synagogue were thus the last of the prophets, if the canon was not fixed by them the time was past when it could be fixed at all. Lastly, it is urged, that we find in the time of Ezra and Nehemiah the canon treated as a whole, and regarded with the utmost veneration; that all subse-

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[1] Kitto's *Biblic. Cyclop.*, vol. ii. p. 672.
[2] Prideaux's *Connection between the Old and New Testament*, vol. ii. p. 752.
[3] Havernick has shown that it was a general custom of antiquity to intrust the sacred books to the care of the priesthood. See *Introduction to the Old Testament*, p. 18.
[4] *Ibid.* p. 20; Gesenius's *Comment.*, i. 921.
[5] Havernick's *Introduction to the Old Testament*, p. 37.
[6] Josephus, *Contra Apion*, i. 8.

quent references to the sacred writings presuppose the existence of the complete canon; and that of no one among the apocryphal books is it so much as hinted, either by the author or by any other Jewish writer, that it was worthy of a place among the sacred books, though of some of them the pretensions are in other respects sufficiently high.[1] On the other hand, Dr Davidson adduces the opinion of the later Jews, who affirm that the canon was closed by Simon the Just, who died 202 B.C. He contends that some books were received into the Jewish canon after the time of Ezra and Nehemiah; and therefore concludes that the important work begun by these eminent reformers was continued after them by the most competent authority, till the entire collection was declared complete, about 200 B.C.[2]

Canonical books of the Old Testament.

The Old Testament canon, as established in the time of Ezra, has remained unaltered to the present day. The following are the canonical books of the ancient economy, arranged in the order in which they are supposed to have been published, with the number of chapters in each:—

	Number of Chapters.		Number of Chapters.
Genesis	50	Ecclesiastes	12
Exodus	40	Song of Solomon	8
Leviticus	27	Isaiah	66
Numbers	36	Jeremiah	52
Deuteronomy	34	Lamentations	5
Joshua	24	Ezekiel	48
Judges	21	Daniel	12
Ruth	4	Hosea	14
1 Samuel	31	Joel	3
2 Samuel	24	Amos	9
1 Kings	22	Obadiah	1
2 Kings	25	Jonah	4
1 Chronicles	29	Micah	7
2 Chronicles	36	Nahum	3
Ezra	10	Habakkuk	3
Nehemiah	13	Zephaniah	3
Esther	10	Haggai	2
Job (date uncertain)	42	Zechariah	14
Psalms	150	Malachi	4
Proverbs	31		

The Old Testament contains in all, 39 books, 929 chapters, 23,214 verses, and 592,439 words.

Great care was taken by the Jews to preserve the accuracy of the sacred text, and from an early period they were in the habit of numbering the verses and words, and even letters, marking the sum-total at the end of each separate book and section,—a practice which, though in itself laborious and trifling, had a good effect on the purity of the text. The watchful care of Almighty God over the sacred books containing His revealed will, is strikingly manifested in the manner in which they have been preserved through the instrumentality of the Jews. "The reverent attention which this people gave to the Hebrew text, and the jealousy with which they guarded it from corruption, must have belonged to the wise arrangements of the Highest, who puts it into the heart of men to engage in works tending to promote his own glory." Very soon after its invention the Jews took advantage of that new and beautiful art which in the middle of the fifteenth century superseded the labours of the calligraphists; and copies of the Hebrew Scriptures were among the earliest printed books. So early as 1477 the Psalter was printed, probably at Bologna, with the commentary of Kimchi interspersed among the text. The Pentateuch was printed at the same place in 1482, with the Targum of Onkelos, and the commentary of Solomon Jarchi. Ruth, Lamentations, Ecclesiastes, and Esther, appeared the same year. A few years later appeared the *former* prophets, viz., Joshua, Judges, Samuel, and Kings, with Kimchi's commentary; and these were soon after followed by the *later* prophets, viz., Isaiah, Jeremiah, Ezekiel, and the twelve minor prophets. The Hagiographa first appeared at Naples in 1487. The entire Hebrew Bible was first printed at Soncino in 1488; another edition, which has neither date nor place, is also supposed to have appeared at Soncino. The third complete edition is that of Brescia in 1494; it was edited by Rabbi Gerson, and was the edition which Luther used in making his German version. The first edition of the Hebrew Scriptures published under the auspices of Christians was the Complutensian Polyglot, prepared at the expense of Cardinal Ximenes. It was completed in the year 1517, but did not appear till 1522, at Alcala, in Spain. Daniel Bomberg's first edition of his Rabbinical Bible, in four vols. folio, was published at Venice in 1518. His second edition, which was followed by several others, is the parent of our present Hebrew Bibles. The Antwerp Polyglot (1569), in eight vols. folio, contains the Complutensian text, collated with Bomberg's; and Hutter's edition (1587), presents a mixed text taken from the Antwerp, Paris, and Venetian editions. Other accurate editions were published by Buxtorf (1611 and 1618), by Moses Ben Simeon of Frankfort (the Amsterdam edition 1724), and by Athias (1661 and 1667), with a preface by Leusden. The second edition of Athias formed the basis of Van der Hooght's, published in 1705, and which may be regarded as the *textus receptus*. The elaborate editions of Kennicot, and De Rossi, contain an immense collection of various readings, as do also the editions of Munster, Michaelis, Houbigant, Jahn, and the polyglots.

Editions of the Hebrew Bible.

The New Testament.

The New Testament is written in what has been called Hellenistic or Hebraizing Greek, which is strongly tinged with a Hebrew colouring, derived partly from the country of the writers, partly from the original and peculiar ideas which they sought to convey to their readers. The language, idioms, and style of the sacred volume are all in accordance with the hypothesis that its authors were of Jewish extraction, and living at the commencement of the Christian era. There is abundant evidence in favour of the inspiration of the various books of the New Testament, but it is difficult to point out the precise period at which they were collected, and included in the sacred canon. The weight of authority is decidedly in favour of the opinion, that each of the original churches made a complete collection for itself of those writings which could be proved by sufficient evidence to be the production of inspired men, and that the general accordance of these various collections as to the books admitted, furnishes conclusive proof of the accuracy of the existing canon. The earliest reference to a collection of the New Testament Scriptures occurs in 2 Peter iii. 16, where the writer speaks of the epistles of Paul in such a way as to indicate that all, or the greater part of them, had been collected together at that time, and were regarded by the churches generally as entitled to equal reverence with the other Scriptures,—viz., the sacred writings of the Old and the New Testament. Mention is made of the law, the prophets, the gospel, and the apostles, in the epistle to Diognetus—one of the earliest of the uninspired Christian writings. Ignatius classes the gospels and the apostles along with the prophets. Theophilus of Antioch frequently applies to the New Testament Scriptures the appellation of "the Holy Writings," and speaks of the law, the prophets, and the gospel, as alike divinely inspired; and Clement of Alexandria distinguishes them into the "gospels and apostolic discourses." About the beginning of the third century these two collections, viz., the gospels and the apostolic epistles had been put together under one name—the New Testament. Thus, Tertullian, in his treatise against Marcion, applies this desig-

Formation of the New Testament canon.

[1] Havernick's *Introduction*, pp. 26–45; Hengstenberg, vol. i. p. 237 *seq.*; Stuart's *Critical History and Defence of the Old Testament Canon*, p. 226; *Biblic. Cyclop.*, vol. i. p. 379.

[2] Davidson's *Biblical Criticism*, vol. i. p. 106.

Bible.

nation to the whole collection, which he distinguishes from the "ancient Scriptures;" and Irenæus repeatedly calls the books of the New Testament "the Holy Scriptures," "the oracles of God," and puts them on a level with the law and the prophets. These and other similar statements warrant the conclusion that before the middle of the third century the New Testament Scriptures were formed into one collection, designated by one general title, and regarded by Christians as possessed of divine authority. This conclusion is corroborated by the testimony of Origen and Eusebius, who made careful inquiry respecting this subject, and have left an accurate record of the books which were received as canonical by the church in their day. "Of the *ten* ancient catalogues of the New Testament books still extant, *six* accord exactly with our present canon, while of the rest *three* omit only the Apocalypse, and *one* omits with this the Epistle to the Hebrews. The identity of these books with the present canonical Scriptures is proved by the copious quotations from them contained in the writings of the early fathers. It is evident from these observations that the formation of the New Testament canon was *gradual*; the collection was not made by one man, one council, at one time, or in one place. The adherents of the Christian religion in different lands came to agree in the same conclusion *progressively*, by *tacit consent*. They did so *independently* to a great extent, and in countries remote from one another. They judged by internal evidence, by tradition, by the fact of the writers being apostles or apostolic men. . . . . Slowly and surely did they arrive at the entire separation of the sacred Scriptures from the spurious imitations which were then current. And in the result of their judgment modern scholars commonly acquiesce."[1]

Canonical books of the New Testament.

The following are the canonical books of the New Testament, arranged in the order in which they are given in our authorized version, with the number of chapters in each, and the time at which they are supposed to have been written:—

	Number of chapters.	Date. A.D.
Matthew	28	38
Mark	16	65
Luke	24	63
John	21	97
Acts	28	64
Romans	16	58
1 Corinthians	16	56
2 Corinthians	13	57
Galatians	6	52
Ephesians	6	61
Philippians	4	62
Colossians	4	62
1 Thessalonians	5	52
2 Thessalonians	3	52
1 Timothy	6	64
2 Timothy	4	65
Titus	3	64
Philemon	1	62
Hebrews	13	63
James	5	61
1 Peter	5	64
2 Peter	3	65
1 John	5	69
2 John	1	69
3 John	1	69
Jude	1	70
Revelation	22	96

Editions of the Greek Testament.

The first part of the Greek Testament that was printed consisted of the hymn of Zacharias and Mary, published at Venice in 1486, and the first six chapters of St John's Gospel, which appeared in 1504. The first printed edition of the Testament was that of the Complutensian Polyglot, which was published at the expense of the celebrated Cardinal Ximenes. The printing of the New Testament in this edition was commenced in 1502, and was completed in 1514, but the work was not published till 1522. Before this edition saw the light, Erasmus published his edition at Basle in 1516; and four other editions followed successively between 1519 and 1535. Several editions were published by Robert Stephens, the third of which is called the *Regia* or royal edition, and is elegantly printed. The fourth edition is remarkable as being the first into which the division of verses was introduced. The first Elzevir edition, so called from the name of the printer, appeared at Leyden in 1624. The second, which issued from the same press in 1633, is the best of all the Elzevir editions, and has long formed the "received text." Other celebrated editions are those of Beza; the London Polyglot, edited by the learned Walton; Mill's critical edition (1707), which was the labour of thirty years; the splendid edition of John James Wetstein, which appeared in 1751; that of Griesbach, published in 1775–77, which has been said to have ushered in the "golden age" of criticism; the antagonistic edition of Professor Scholz, an eminent Roman Catholic critic, which appeared in 1830-35; and the recent editions of Tischendorf and Lachmann.

Bible.

State of the text.

The text of the New Testament has of course suffered from the mistakes of translators and from other obvious causes, but it is confessedly free from "gross and palpable errors." The researches of modern critics have conclusively shown that it has been preserved with great care, and does not materially differ from what it was 1700 years ago. The various readings which have arisen from the commutation of letters, the transposition of words, abbreviations, seeing and hearing incorrectly, and other causes, amounted in Mill's edition to 30,000, and have now increased to upwards of 100,000. This circumstance was at one time eagerly laid hold of by infidels, and excited no small alarm among religious men. But all apprehension on this point has long ago been removed, and it is now generally admitted that the greater part of these variations in the text of the Scriptures are not of the slightest importance as regards either the history or the doctrines of our religion. "Of the various readings of the New Testament," says Mr Norton, "nineteen out of twenty, at least, are to be dismissed at once from consideration, not on account of their intrinsic unimportance—that is a separate consideration—but because they are found in so few authorities, and their origin is so easily explained, that no critic would regard them as having any claim to be inserted in the text. Of those which remain, a very great majority are entirely unimportant. They consist in different modes of spelling; in different tenses of the same verb, or different cases of the same noun, not affecting the essential meaning; in the use of the singular for the plural, or the plural for the singular, where one or the other expression is equally suitable; in the insertion or omission of particles such as ἀν and δε, not affecting the sense, or of the article in cases equally unimportant; in the introduction of a proper name where, if not inserted, the personal pronoun is to be understood, or of some other word or words expressive of a sense which would be distinctly implied without them; in the addition of 'Jesus' to Christ, or 'Christ' to Jesus; in the substitution of one synonymous or equivalent term for another; in the transposition of words, leaving their signification the same; in the use of an uncompounded verb, or of the same verb compounded with a preposition—the latter differing from the former only in a shade of meaning. Such various readings, and others equally unimportant, compose far the greater part of all, concerning which there may be or has been a question whether they are to be admitted into the text or not, and it is therefore obviously of no consequence in which way the question has been or may be determined."[2]

Various readings.

The Septuagint.

The oldest version of the Old Testament in any language is the Greek translation, commonly called the SEPTUAGINT, either because it was approved and sanctioned by the Jewish sanhedrim, which consisted of seventy or seventy-two persons, or more probably from the Jewish fable that so many individuals were employed in the work. The history of this version is exceedingly obscure, and it is difficult to discriminate the genuine from the spurious traditions which are current respecting its origin. The earliest historical notice of the Septuagint is to be found in the writings of Aristobulus, a Jew, who lived about the commencement of the second century before Christ. He states that "the entire interpretation of the law was made in the time of a king

[1] Davidson's *Bibl. Crit.*, vol. ii. p. 37.

[2] Norton's *Genuineness of the Gospels*, vol. i. additional notes, pp. 38, 39.

surnamed Philadelphus, ... Demetrius Phalereus being actively employed about it." To this statement it has been objected, that Demetrius Phalereus is represented as living in the reign of Ptolemy Philadelphus, whereas he lived under his predecessor Ptolemy Lagus, and died soon after his death. This was undoubtedly the case; but it does not follow that the account of Aristobulus is therefore to be rejected as wholly undeserving of credit. Havernick contends that Aristobulus intended merely to say that Demetrius was the person who took an active part in the translation, or caused it to be undertaken, the whole being finished in the time of Philadelphus. Others are of opinion that Aristobulus made a mistake in the name of the king. Hody harmonizes the discrepancy by placing the translation of the Pentateuch in the two years during which father and son reigned conjointly, 286 and 285 B.C. An equivocal statement in the prologue of Jesus the son of Sirach has been supposed to intimate that "the law and the prophets and the rest of the books" were translated into Greek at the time he wrote; but it cannot be proved that the passage has any reference to the Septuagint. A minute account of the origin of this version has been given by Aristeas, an author who pretends to be a Gentile and a favourite at the court of Ptolemy Philadelpus, king of Egypt. In a letter addressed to his brother Philocrates, he relates that Philadelphus, when founding a public library at Alexandria at a great expense, was advised by Demetrius Phalereus to apply to the Jewish high priest Eleazar for a copy of the book containing the Jewish laws. As a preliminary step, he purchased the freedom of all the Jews in his dominions who had been taken captive by his father or himself. He then sent Aristeas and Andreas with costly presents and a letter to Eleazar, requesting him to send to Alexandria seventy-two interpreters. They were accordingly despatched with a copy of the law, "consisting of different parchments, in which the law was written in gold in the Jewish letters;" and were received and entertained by the king for several days with great respect and liberality. Demetrius then conducted them to an island, which appears to have been Pharos, where they were lodged together in a splendid house near the shore. The translation was completed in seventy-two days, having been written down piece by piece by Demetrius, as agreed upon after mutual consultation. It was then publicly read by him to a number of the principal Jews whom he had summoned together for that purpose. They approved of the translation, and imprecations were pronounced against any one who should presume to alter it. The Jews requested permission to take a copy for their own use; and the work was carefully preserved by command of the king, who sent home the interpreters loaded with presents. The substance of this narrative is repeated by Josephus; but the greater part of it is undoubtedly fabulous, and many glaring falsehoods were afterwards added to it in the days of Justin Martyr and Epiphanius, which were received by these credulous men without hesitation. The interpreters were said to have been shut up in separate cells, where, without any communication with one another, they composed seventy-two distinct versions, miraculously agreeing in every particular. Hence it was concluded that they were inspired, and their version was received as infallibly correct. This absurd story was believed both by the early Jewish rabbins and by most of the Fathers, and its credibility was not called in question till the latter half of the seventeenth century. It has now been proved to contain particulars improbable, incredible, and contrary to history. But there is good reason to believe that it is not wholly fictitious. Dr Davidson has shown that truth lies at the basis of the story contained in the narrative of Aristeas[1], and that in all probability the version was really made at the command of an Egyptian king; but that king was Ptolemy Lagus, not Philadelphus,—whether from a religious, a political, or a literary motive, it is impossible to say. When the version was made by royal authority, it is quite probable that the translators may have thought of the ecclesiastical purpose which it would serve, and that it fell in with their religious desires and wants, though they would not have undertaken it without an external impulse.

There can be no doubt that the version of the Septuagint was made by degrees, and that the Pentateuch was translated first. The precise time at which the separate portions of the version were made cannot now be ascertained; but it is probable that the interval between the translating of the law and the prophets was very short, and that the entire work was completed before the thirty-eighth year of Ptolemy Physcon. The version itself affords internal evidence that various hands were employed upon it; but nothing certain can be known respecting the number of translators. The tradition that there were seventy-two must be rejected as fabulous; but there must have been at least five or six individuals engaged on the entire work, which is consequently of unequal value. The translator of the Pentateuch was unquestionably the most skilful of all the interpreters; and that portion of the work far surpasses the others in fidelity and accuracy. Next to it in point of excellence is the version of the Proverbs. The Psalms and prophets have been but indifferently executed. The translation of Isaiah is exceedingly defective, and that of Daniel is the worst of the whole. It was probably on this account that the version of Theodotion was very early substituted for it by the Greek Church.

The well-known fact that the Septuagint harmonizes with the Samaritan Pentateuch in more than a thousand places where they differ from the Hebrew text, has given rise to various hypotheses to account for the agreement. Selden, Hottinger, Hassenchamp, and Eichorn have supposed that the version of the Pentateuch was made from the Samaritan text rather than the Hebrew; others, that the one was interpolated from the other; but the irreconcileable enmity which subsisted between the Jews and the Samaritans, both in Egypt and Palestine, renders both of these conjectures in the highest degree improbable. Dr S. Lee accounts for the agreement by supposing that the early Christians interspersed their copies with Samaritan glosses, which ignorant transcribers afterwards inserted in the text.[2] But, to say nothing of the reverence with which the early Christians regarded their sacred books, there is no evidence that they were acquainted with the Samaritan Pentateuch and its glosses. A much more plausible hypothesis has been proposed by Gesenius, viz., that the Samaritan Pentateuch and Septuagint version both flowed from a common recension of the Hebrew Scriptures, one older than either, and different in many places from the recension of the Masorites now in common use. Professor Stuart, by whom this supposition has been adopted, thinks that it will account both for the differences and for the agreements of the Septuagint and Samaritan versions; but other writers are of opinion that no satisfactory solution of the problem has yet been offered.

The Septuagint version is free rather than literal; and the translators have frequently mistaken the meaning of the original, and have indulged in many liberties with regard to the text. Its merits, however, are unquestionably great, and it has rendered important service not only in the criticism but also in the exposition of the Old Testament. It speedily acquired a high reputation among the Hellenistic Jews; and it was read publicly in the synagogues, not only of Egypt, but, sometimes at least, of Palestine itself. Josephus, though he was acquainted with Hebrew, made more

[1] *Biblical Crit.*, vol. i. pp. 169–174.

[2] See *Prolegomena* to Bagster's Polyglot.

Bible. use of the Greek version than of the original itself, and it was universally received by the early Christians. But the feelings of the Jews speedily underwent a change. In the controversies between them and the Christians, the latter were in the habit of appealing to the prophecies which this version contained respecting the Messiah, and which were fulfilled in Jesus of Nazareth. The Jews, now worsted in argument, began to deny that the Septuagint agreed with the Hebrew original; and ultimately this version became so odious to them, that, according to the Talmud, a fast was appointed on the 8th day of the month Thebet, the day on which the law was translated into Greek, to perpetuate the remembrance of this inauspicious event. It was owing to this feeling that the Jews had recourse to the version of Aquila, who is supposed to have undertaken a new translation from the Hebrew for the express purpose of supplanting the Septuagint.

Other Greek versions.

AQUILA was a Jewish proselyte, a native of Pontus, who undertook a translation of the Old Testament into Greek, probably about the middle of the second century of the Christian era. It appears from Jerome that there were two editions of this version, the second of which was more literal than the first; but it is impossible to determine whether it embraced the whole of the Old Testament or not. The version of Aquila was highly prized by the Jews, who called it the Hebrew verity, and probably this very circumstance tended to excite a prejudice against it among the Fathers, who accused him of perverting some prophecies relating to the Messiah. The translation adheres so closely to the original as to be in some cases unintelligible.

The second who composed a Greek version of the Scriptures was THEODOTION, who, according to Irenæus, was a native of Ephesus, and a Jewish proselyte. Jerome and Eusebius call him an Ebionite, or semi-Christian. He must have lived before A.D. 176. Only a few fragments of the work remain, but, according to the testimony of those who had the opportunity of examining it, the translation followed the Septuagint so closely, that it has been supposed that his intention was to make a revision of its text, rather than a new version. The numerous errors into which he has fallen, show that his knowledge of the original was not extensive or accurate.

The third Greek version was made by SYMMACHUS, who like Theodotion, appears to have been an Ebionite, and is said to have been a Samaritan by birth. The remaining fragments of the work show that the style is good, and the diction perspicuous and intelligible. The ancient writers who speak of this version remark that the author translated freely, and gave the sense of the original rather than the words. As this translation was not known to Irenæus, it is believed to be of later date than those of Aquila and Theodotion.

Three other Greek versions of the Scriptures were discovered by Origen when he travelled into Eastern countries for the purpose of collecting materials for his polyglot. They did not extend to the entire Old Testament, but only to several books, and are usually denominated the fifth, sixth, and seventh, from the position which they occupied in the columns of Origen's work entitled the *Hexapla*. Their authors were unknown to Origen himself, but they are supposed to have been Jewish Christians. These anonymous translations must have been made subsequently to those of Aquila, Theodotion, and Symmachus; and judging from the scanty fragments of them which remain, their rendering of the original must have been somewhat free and paraphrastic.

Another ancient Greek version of several books of the Old Testament, which is deposited in St Mark's library at Venice, is supposed to have been made at Byzantium for private use, not earlier than the ninth century. It has been translated directly from the original, and is more literal than any other ancient version. It cannot be certainly known whether the author was a Jew or a Christian.

Bible. There is a version of the five books of Moses in the Samaritan dialect, made from the Samaritan copy of the Pentateuch, which it follows word for word. The author and the date of this translation are alike unknown, but Dr Davidson is of opinion that it was probably made either in the second or the third century.

Samaritan version.

Old Syriac version.

One of the oldest translations of the Bible made by Christians is the version commonly called the OLD SYRIAN or PESHITO, *i.e. the simple*, because it adheres to the literal meaning, in opposition to the allegorical translations and expositions. It was undoubtedly made at a very early period, but its precise age is involved in obscurity. The traditions of the Syrians themselves claim for the Peshito a very high antiquity; some of them even allege that it was made in the time of Solomon and Hiram, but no credit can be attached to such fabulous assumptions. Jacob of Edessa adopts the tradition that this version was made in the days of Thaddeus the Apostle, and the Edessenic king Abgarus; and Havernick is inclined to regard this account as entitled to credit. Michaelis assigns it to the first century of our era, while Dr Davidson is of opinion that it probably belongs to the second. The first author who mentions it is Ephraem Syrus, who died A.D. 376. In his time it had met with a general reception among the Syrian churches, and was employed by him as the basis of his commentaries on the Bible. The Peshito originally embraced only the canonical books of the Old Testament, but the Apocrypha must also have been translated into Syriac at a very early period, since they are cited by Ephraem Syrus, who, however, did not regard them as canonical books. With regard to the author of this version, some have contended that he was a Jew, but the weight of evidence decidedly preponderates in favour of a Christian origin. It has been made directly from the Hebrew, and adheres more faithfully to the original than any other of the ancient versions. The Old Syrian version of the New Testament wants the second and third Epistles of John, the second of Peter, that of Jude, and the Apocalypse. Some have accounted for this circumstance by supposing that the translator must have made his version either before these books were written, or at least before they were acknowledged in Syria as of divine authority; while others think the fact may be explained by the non-reception of these books in the district where the version was made.

Arabic and Persian translations.

Several versions of the Scriptures were made in the ARABIC language, but all of these are supposed to be later than the Mahometan era. Three of these translations were made directly from the Hebrew, others were derived from the Peshito, while several have proceeded from the Septuagint. A version of the Old Testament in the PERSIAN language seems to have existed at an early period, and is mentioned both by Chrysostom and Theodoret. But the Persian translation of the Pentateuch, printed in the London Polyglot, and which was made by a Jew, Rabbi Jacob, the son of Joseph Tawus, is undoubtedly of later origin than the eighth century. It was first printed at Constantinople in 1546. A version of the Bible in Persian was made a few years ago by the late Rev. Dr Glen, who was sent to Persia for that purpose by the Scottish United Presbyterian Church.

Egyptian versions.

The MEMPHITIC or COPTIC translation of the Bible, written in the dialect of Lower Egypt, was taken from the Septuagint, and belongs to the third century. The THEBAIC or SAHIDIC version, in the dialect of Upper Egypt, was also made from the Greek, probably about the same period.

Æthiopic version.

Chrysostom alludes to a version of the Scriptures which was in use among the Æthiopians in his day, and appears to have been made in the fourth century, during which Christianity was diffused among that people. This translation is written in the old sacred language called the Geez, and although made by Christians is likewise used by the Æthiopian Jews. It was unquestionably derived from the Septuagint, and embraces not only the whole of the canonical books of

Bible.

Scripture, but also the Apocrypha. The entire work is extant in Europe, but only detached portions of it have been printed.

Armenian, Georgian, Slavonic, and Gothic versions.

The ARMENIAN version of the Bible was made by Miesrob, the inventor of the Armenian alphabet, assisted by two of his pupils. It was taken from the Greek, and was completed in A.D. 410. The GEORGIAN version, which belongs to the sixth century; the SLAVONIC, which was made by Cyril of Thessalonica, and his brother Methodius who invented the Slavic alphabet; and the GOTHIC, which was translated by Ulphilas in the fourth century,—were all derived from the same source.

Latin versions.

There has been a LATIN version of the Bible from the first ages of the Christian Church; but it is now impossible to discover when and by whom it was made. In opposition to Jahn, Hug, and Van Ess, Eichorn is of opinion that there was only one distinct Latin translation, and that it was made in Africa in the course of the first century; but the first certain traces of this version, called the *Vetus* or old Latin, are found at the close of the second century. Some fragments of it still exist, which show it to have adhered literally to the κοινή, or the text of the Septuagint which existed before Origen's *Hexapla*, whose defects it preserves. In the year 382, Jerome, at the request of Pope Damasus, undertook to revise and correct this version, which had become exceedingly corrupt. He first corrected the Psalms, producing what is called the *Roman Psalter*, because it is used in the church of the Vatican. Subsequently, he undertook a second version of this part of the Scriptures, which bears the name of the *Gallican Psalter*, because it was subsequently adopted in the churches of Gaul. He afterwards revised in the same way the rest of the Old Testament, but the only portions of the work which have descended to our day are the two Psalters and the book of Job.

The Vulgate.

Jerome next, at the request of his friends, and for the purpose of assisting the Christians in their controversies with the Jews, undertook a new version from the Hebrew, between the years 385 and 405. Although not free from defects, principally caused by the haste with which some parts of the work were executed, it is undoubtedly the best translation of which antiquity can boast. But in spite of its great merits, it met with a very unfavourable reception in the Latin Church. The learned and laborious translator was denounced as a heretic, and the new version was declared to be a falsification of the Word of God. Its value, however, was recognised from the first by a few discriminating scholars, and it gradually won its way to public favour till it became the only received version, and this by tacit consent, in consequence of its intrinsic merits, for it obtained no official sanction until the Council of Trent.

In the course of time Jerome's version became exceedingly corrupt, both by a mixture of the old version, and by interpolations from liturgical books. In the ninth century (A.D. 802) a version of the text was undertaken by command of Charlemagne, who intrusted the task to the celebrated Alcuin. In the eleventh century a new version was undertaken by Lanfranc, archbishop of Canterbury, and another in the following century by Cardinal Nicolaus. After the twelfth century were begun what were termed *correctoria biblica*, in which the Latin text was furnished with marginal glosses from other MSS., the fathers, and other venerated teachers of the church. The Vulgate was the first book ever printed, and it issued from the press many times without date or place. The first that had a date was published at Mentz in 1462, and other editions quickly followed. The corruption of the text now became more apparent than ever, and the necessity of an attempt to correct its errors was acknowledged by the publication of the Complutensian Polyglot, and the critical editions of Isidore Clarius, Robert Stephens, Benoist, and others.

In the year 1546, the Council of Trent passed its famous decree respecting the Vulgate, ordaining that it "shall be used in public readings, disputations, sermons, and expositions, as authentic, and that none is to presume to reject it under any pretence whatever." The text of the Vulgate having become exceedingly corrupt, various attempts were made to revise and correct it. Two editions were issued under the sanction of the papal chair, termed respectively the Sixtine and Clementine Bibles, the variations between which amounted to above two thousand: the latter is the basis of all subsequent editions of the Vulgate, from those of Plantin, which appeared in 1599 and 1650, to that of Leander Van Ess, published by authority of Leo XII. in 1826.

Bible.

After the downfall of the Roman empire and the gradual disuse of the Latin tongue, the Holy Scriptures were translated into all the languages of modern Europe.

French versions.

The oldest FRENCH Bible is the version of Peter de Vaux, the leader of the Waldenses, who lived about the year 1160. Raoul de Presle also translated the Bible into French about the year 1380; and besides these there are several old French translations of particular portions of the Holy Scriptures. The doctors of Louvain published an edition of the Bible in French at Louvain, by order of the Emperor Charles V., in 1550. The version of De Sacy, which was published in 1692, with explanations of the literal and spiritual meaning of the text, was received with great applause, and has often been reprinted. With respect to the versions of the New Testament in French, one of the best known is that which F. Amelotte of the Oratory executed by the direction of some French prelates, and printed with annotations in 1666, 1667, and 1670. The Mons New Testament, printed in the year 1665, with the permission of the Archbishop of Cambray and the license of the king of Spain, was condemned by Pope Clement IX. in 1668, and by Pope Innocent XI. in 1679, and in several bishoprics of France at different times. The New Testament published at Trevoux in 1702 by M. Simon, with literal and critical annotations upon difficult passages, was condemned by the bishops of Paris and Meaux in 1702. Another translation of the New Testament was published in 1697 by Bouhours a Jesuit, with the assistance of Michael Tellier and Peter Bernier, who were likewise Jesuits. This version, however, follows so closely the Latin text from which it is translated that it is for the most part harsh and obscure. The most approved French translations of the Scriptures are those of Descarrières and De Vence. There are also several French versions of the Bible published by Protestants. The version of Olivetan, printed at Neufchâtel in 1535, has been frequently reprinted with the corrections of Calvin and others. A somewhat paraphrastic version was published at Geneva in 1644 by John Diodati. A translation of the New Testament executed by J. Faber Stapulensis was revised and accommodated to the use of the Reformed churches in Piedmont in 1534. Lastly, a version of the New Testament in French was published at Amsterdam in 1703 by Le Clerc, with annotations taken chiefly from Grotius and Hammond; but this version was prohibited in Holland by order of the States-General, as tending to revive the errors of Sabellius and Socinus.

Italian versions.

The earliest ITALIAN Bible published by the Roman Catholics is the version of Nicolas Malermi, a Benedictine monk, printed at Venice in 1471. It was made from the Vulgate. The translation of Anthony Braccioli, published at Venice in 1532, was prohibited by the Council of Trent. Martini's translation is now commonly used in Italy. The Protestants also have their Italian Bibles. There is the version of Maximus Theophilus, published in 1551; and another of John Diodati, published in 1607 and 1641. The Jews in Italy have no entire version of the Bible in Italian; the inquisition having constantly refused to allow them the liberty to print one.

Spanish versions.

The earliest SPANISH Bible of which we have any notice is one printed at Valencia in 1478. The Gospels and Epistles were published in that language by Ambrose de

Bible. Montesin in 1512; the whole Bible by Cassiodore de Reyna, a Calvinist, in 1569; and the New Testament by Francis Enzinas or Driander in 1543. An ancient version of the Bible for the use of the Spanish Jews was printed in Gothic characters at Ferrara in 1553.

German versions. The most ancient translation of the Bible in the GERMAN language is that of Ulphilas, bishop of the Goths, about the year 360. This version did not contain the books of Kings, which the bishop omitted, lest the wars mentioned therein should encourage the martial spirit of the people. An imperfect manuscript of this translation was found in the abbey of Verden, near Cologne, written in letters of silver, for which reason it is called *Codex Argenteus*. It was published by Francis Junius in 1665. The oldest German Bible extant is that of Nuremberg (1446), which was translated from the Vulgate by an unknown author. A translation of the Bible into German by John Eckius, was published in 1537, along with the version of the New Testament by Emzer, chaplain to George, Duke of Saxony. Another version by Ulembergius of Westphalia, procured by Ferdinand, Duke of Bavaria, was printed in 1630. But by far the most important version of the Scriptures in the German language was made by the great reformer Martin Luther, who spent eleven years in completing it. The New Testament was published in 1522, the Pentateuch in 1523, the historical books and the Psalms in 1524, the books of Solomon in 1527, Isaiah in 1529, the prophets in 1531, and the other books in 1530. This celebrated translation is clear and accurate, and the language pure and idiomatic. It has exercised a powerful influence on the language and literature of Germany.

Belgian or Flemish versions. The FLEMISH Bibles of the Romanists are very numerous. For the most part they have no author's name prefixed to them, till the version of Nicolas Vinck, which was printed at Louvain in 1548. Till the year 1637 the Flemish versions used by the Protestants were taken principally from the translation of Luther. In 1618 the synod of Dort appointed a new translation to be made of the Bible into Flemish, but the work was not finished till 1637.

Danish versions. The first DANISH Bible was published in 1550 by Peter Palladius, Olaus Chrysostom, John Syningius, and John Maccabæus, who followed the first German version of Luther. Another translation was made by John Paul Resenius, bishop of Zealand, in 1605; and a version of the New Testament by John Michel, in 1524.

Swedish version. In 1534 Olaus and Laurence published a SWEDISH Bible from the version of Luther; it was revised in 1617 by order of King Gustavus Adolphus, and was afterwards almost universally adopted.

Bohemian, Polish, Russian, and Sclavonian versions. The Bible was printed in the BOHEMIAN language at Prague in 1488, and another version made by eight Bohemian doctors, who were sent to the schools of Wirtemburg and Basle to study the original languages, was printed in Moravia in the year 1539. The first POLISH version of the Bible, it is said, was that composed by Hadewich, wife of Jagellon, Duke of Lithuania, who embraced Christianity in 1390. A Polish translation of the Bible made by several Roman Catholic divines, and especially by James Wieck, a Jesuit, was published at Cracow in 1561. A translation made by the Polish Protestants from Luther's version, was published in 1596 and dedicated to Uladislaus IV., king of Poland. A version in the RUSSIAN language, made from the Greek by St Cyril, the apostle of the Sclavonians, was published in 1581; but, in consequence of its obscurity, Ernest Gluck, who had been carried prisoner to Moscow after the taking of Narva, undertook a new translation of the Bible into modern Russian, which was printed at Amsterdam in 1698.

English versions. Various portions of the Bible were rendered into SAXON between A.D. 706 and 995 by Adelm, bishop of Sherbourn, Egbert, bishop of Lindisferne, the Venerable Bede, and other translators. The first ENGLISH version of the Bible known to be extant is that mentioned by Usher as supposed to have been made in 1290. Three MS. copies of it are still in existence. The next translation of the sacred Scriptures into English was made by the celebrated reformer Wickliffe about the year 1380. A complete copy of this work has recently been published for the first time. Bible.

Tyndale's Bible. The first *printed* Bible in our language was translated by William Tyndale. His version of the New Testament was printed at Antwerp in 1526, but the edition was bought up and burned by the Romanists in 1529. Other editions were brought out by him, however, in rapid succession, and in 1536, the year in which he suffered martyrdom at Vilvorde, there were no fewer than ten or twelve editions issued from the press. He also published at different times the five books of Moses, with Jonah and Nehemiah. During the reign of Henry VIII. the possession of a copy of Tyndale's translation of the New Testament was sufficient to condemn a person to the flames, but the desire of the people to possess it was irrepressible. "It was wonderful," says an old writer, "to see with what joy the book of God was received, not only among the learned sort, and those who were noted for lovers of the Reformation, but generally all England over, among all the vulgar and common people; and with what greediness God's word was read, and what resort to places where the reading of it was; everybody that could, bought the book, or busily read it, or got others to read it to them if they could not themselves, and divers more elderly people learned on purpose, and even little boys flocked among the rest to hear portions of the Holy Scriptures read." Tyndale's translation forms the basis of all subsequent English versions of the Bible, and in spite of the unfavourable circumstances in which it was made, its high excellence has been acknowledged by the most competent judges. "The language is pure, appropriate, and perspicuous, and the work forms altogether an astonishing monument of the indomitable zeal and great learning of the author."

Coverdale's Bible. An English version of the entire Bible was made by Myles Coverdale, and was published in 1535. It owed its origin to the patronage of Lord Cromwell. As a whole, it must undoubtedly be reckoned inferior to the translation of Tyndale.

Matthews' Bible. After the death of Tyndale, a new edition of his translation was undertaken by his intimate friend John Rogers, superintendent of an English church in Germany, and the first martyr in the reign of Queen Mary. He revised the whole work, and completed the translation of the Old Testament, probably with the assistance of Coverdale's sheets. The whole was completed in 1537, and dedicated to Henry VIII. by the editor, under the assumed name of Thomas Matthews. A license was obtained for publishing the work in England, through the influence of Archbishop Cranmer. A revised edition of this translation was published in London, April 1539, under the superintendence of Richard Taverner, a learned layman.

Cranmer's Bible. The first Bible printed by authority in England was a revised edition of Matthews' or Tyndale's version, with a preface by Archbishop Cranmer, and hence it has been called Cranmer's Bible. In 1540 a copy of this Bible was required by royal proclamation to be placed in every parish church. Two years later, the Popish bishops succeeded in obtaining its suppression by authority of the king. It was restored under Edward VI., suppressed again under Queen Mary, restored again in the first year of Queen Elizabeth, and a new edition of it issued in 1562.

Geneva Bible. A revision of Tyndale's version of the New Testament, by William Whittingham, was printed at Geneva in 1557; and three years later a new translation of the entire Bible was published by Whittingham, Coverdale, Goodman, John Knox, and other exiles. This was the first English Bible printed in Roman letter and divided into verses.

Bible Societies.

Archbishop Parker's, or the Bishops' Bible, was published at London in 1568, and was so named because it was superintended by Archbishop Parker, and eight out of the fifteen translators were bishops.

The Bishops' Bible.

An English translation of the New Testament, made from the Latin Vulgate, and accompanied by annotations, was published at Rheims in 1582. In 1609–10 a translation of the Old Testament from the Vulgate was published at Douay, also with notes. This, which is commonly called the Douay Bible, is the standard version of the Roman Catholics.

Douay Bible.

King James's Bible.

The proposal to undertake a new translation of the Bible originated with Dr John Reynolds of Corpus Christi College, Oxford, in 1603, and was favourably entertained by King James VI., who appointed fifty-four learned men to perform the work. Only forty-seven, however, were actually engaged in the labour. They were divided into six companies, who met at different places, having their respective tasks assigned them. They entered upon their task in 1607, and for three years they were closely engaged in the work. "The translators in King James's time," says Selden, "took an excellent way. That part of the Bible was given to him who was most excellent in such a tongue, and then they met together and one read the translation, the rest holding in their hands some Bible, either of the learned tongues, or French, Spanish, or Italian. If they found any fault they spoke, and if not they read on." When the work was completed, the whole was revised by twelve of the translators, two having been chosen out of each of the six companies. The copy thus revised was again examined by Dr Myles Smith (who wrote the preface), and Dr Bilson, bishop of Winchester. It was first published in 1611, in a folio volume. As the translators were enjoined to follow "the ordinary Bible read in the church, commonly called the Bishops' Bible," and not to make alterations unless the meaning of the original could be more accurately conveyed, the authorized version may be regarded as a revision of the Bishops' Bible, rather than a new and independent work. It is unnecessary to pronounce any eulogium on this translation, which, it has been justly said, "far surpasses every other English version of the entire Bible, in the characteristic qualities of simplicity, energy, and purity of style, as also in uniform fidelity to the original." Selden, Lowth, Horsley, Walton, Middleton, Geddes, Doddridge, Beattie, Scott, Clarke, Stuart, and a host of other eminent divines of different communions, have borne testimony to its general accuracy and high excellence. "A revision of it, however, is now wanted, or rather a new translation from the Hebrew and Greek, based upon it. Since it was made, criticism has brought to light a great mass of materials, and elevated itself in the esteem of theologians as an important science. Hermeneutics, too, have been cultivated, so as to assume a systematic, scientific form. We require, in consequence, a new English version suited to the present state of sacred literature. It need scarcely be stated, that King James's translators have failed to apprehend the true meaning in many passages. Of the merit attaching to their version, a considerable share belongs to Tyndale. Parker's Bible was the professed basis, and *that* was a version of Cranmer's. Cranmer's Bible was chiefly a correction of Matthews', or, in other words, of Tyndale's, so far as Tyndale had translated. Thus King James's translation resolves itself at last in no small measure into Tyndale's; and when we consider the adverse circumstances continually pressing upon that noble-minded man, with the little assistance he could obtain, the work which he produced assumes a pre-eminent position amid the immortal monuments of human learning and skill." (*Biblic. Cyclop.*, vol. ii., p. 919.)

See Davidson's *Biblical Criticism*, 2 vols.; Havernick's *Introduction to the Old Testament;* Hengstenberg's contributions for the *Introduction to the Old Testament*, 3 vols.; Moses Stuart's *Critical History and Defence of the Old Testament Canon;* Bishop Marsh's *History of the Translations which have been made of the Scriptures from the earliest to the present age;* Anderson's *Annals of the English Bible*, 2 vols. (J. T—R.)

Bible Societies.

BIBLE *Societies*, associations for extending the knowledge of the Holy Scriptures. For a long period this object has been pursued to a considerable extent by several religious institutions, such as the Society for the Propagation of the Gospel in Wales, formed by the Rev. Thomas Gouge, one of the two thousand ministers ejected by the Act of Uniformity in 1662; the Society for Promoting Christian Knowledge, founded in 1698, and which has continued to the present time as the chief Bible Society of the Church of England; the Society for sending Missionaries to India, established in the year 1705 by Frederick IV., king of Denmark, and which has numbered among its agents the celebrated missionary, Christian Frederic Schwartz; the Society for Promoting Christian Knowledge in the Highlands and Islands of Scotland, formed in Edinburgh in 1709; the Moravian Missionary Society, founded in 1732; and the Book Society for Promoting Religious Knowledge among the Poor, which was formed in London in 1750, and numbered among its earliest friends Dr Doddridge and the Rev. James Hervey. But the first British association which had in view the single purpose of disseminating the Scriptures was the NAVAL AND MILITARY BIBLE SOCIETY, established in the year 1780, which has done immense service to the army and navy of Great Britain. The sphere of its operations, however, was comparatively limited, and it was not till 1804 that the BRITISH AND FOREIGN BIBLE SOCIETY, the great institution for the diffusion of the Word of God, was founded. The proposal to institute this association originated with the Rev. Mr Charles of Bala, whose labours in Wales were greatly impeded by the scarcity of the Scriptures in the principality, and it was carried out mainly by the members of the committee of the Religious Tract Society. The exclusive object of the British and Foreign Bible Society is to promote the circulation of the Scriptures, without note or comment, both at home and abroad, and its constitution admits the co-operation of all persons disposed to concur in its support. The committee of management consists of thirty-six laymen, six of them being foreigners resident in or near the metropolis, and of the remaining thirty, one-half are members of the Church of England, and the other half members of other Christian denominations. Every clergyman or dissenting minister who is a member of the society is entitled to attend and vote at all meetings of the committee. Among the early friends of the society were Lord Teignmouth, its first president, Dr Porteus, bishop of London, Admiral Gambier, Charles Grant, now Lord Glenelg, Zachary Macaulay, William Wilberforce, Granville Sharp, and Henry Thornton the first treasurer, and the Rev. Joseph Hughes and John Owen the first secretaries.

The proceedings of the British and Foreign Bible Society have given rise to several controversies, one of which related to the fundamental law of the society to circulate the Bible alone without notes or comments. On this ground it was vehemently attacked by Bishop Marsh, and other divines of the Church of England, who insisted that the Prayer-Book ought to be given along with the Bible. Another controversy, in which the late Dr Andrew Thomson of St George's church, Edinburgh, took a prominent part, related to the circulation on the Continent, by the society, of the Apocrypha along with the canonical books of Scripture. In 1826 it was resolved by the committee that the

fundamental law of the society, which limits its operation to the circulation of the Scriptures, be fully and distinctly recognised as excluding the circulation of the Apocrypha. This step, however, failed to satisfy many of the supporters of the society, particularly in Scotland; and they therefore proceeded to form themselves into independent associations. A third serious controversy by which the society has been agitated, was occasioned by the alleged inaccuracy of some of the translations executed under its authority; and a fourth referred to the admissibility of anti-Trinitarians to the privilege of membership. The refusal of the society in 1831 to alter its constitution so as to exclude such persons, led to the formation of the Trinitarian Bible Society.

The British and Foreign Bible Society soon became the parent of many other associations for the circulation of the Holy Scriptures, and at the present time (1854) there are in Great Britain 445 auxiliaries, 365 branch societies, and 2460 associations; in the colonies, 69 auxiliaries, 280 branches, and 200 associations; in Ireland there are 503; in foreign countries there are about 4000 societies with branches, making a total of 8219 Auxiliary Bible Societies. In the last report of the British and Foreign Bible Society for 1853, it is stated that the society had promoted the distribution, printing, and translation of the Scriptures in 170 languages, not less than 100 of which had never before been reduced to print, while 25 had previously no written language at all; and that it had been the means of circulating not less than 45,000,000 copies of the Bible; of which number 18,000,000 had been distributed in Great Britain and Ireland, 17,000,000 in Europe, 8,000,000 in America, and 2,000,000 among Jews, Mahometans, and heathens in other parts of the world. The total sum expended by the society since its formation has been L.3,950,953. The most active of the Continental associations are those of Berlin, Basle, Paris, Wirtemburg, Dresden, Sweden, and the Netherlands. The Central Prussian Society has issued since its commencement upwards of a million and a half copies of the Scriptures; a million copies have been circulated in Sweden during the last thirty-two years; the French and Foreign Bible Society distributed last year 28,000 copies. The Russian Society at St Petersburg, instituted in 1813, before its suspension by an imperial ukase in 1826, had 289 auxiliaries and branches, and had printed 861,105 Bibles and Testaments in various languages and dialects.

The Edinburgh Bible Society originated in the controversy respecting the circulation of the Apocrypha along with the canonical books, and is composed of Protestants professing their belief in the doctrine of the Holy Trinity, and disposed to co-operate in promoting the dissemination of the Scriptures. Its funds arise from subscriptions, collections, and the contributions of about fifty branch societies in different parts of Scotland. The average annual revenue of the society for the last three years has been about L.2900, and it distributes annually about 3500 Bibles, a large portion of which are Gaelic copies of the Scriptures circulated in the Highlands and Islands of Scotland, and in the colonies.

The Scottish Bible Society was instituted upwards of forty years ago. At the time of its establishment, the other Bible Societies in Scotland employed their funds chiefly in circulating the Scriptures in foreign countries. This association was intended exclusively for the distribution of the Bible at home, and its funds were at first derived from collections made in the parish churches within the synod of Lothian and Tweeddale, but they have since been augmented by various legacies. The annual revenue, derived chiefly from capital, is nearly L.300. This is employed in furnishing to the poor at a reduced price, and in some cases gratuitously, copies of the word of God in English and Gaelic. The distribution is almost wholly made through the Scottish parochial ministers.

The first Bible Society in America is believed to have been established by a few Baptists in New York in 1804; its object was to purchase and lend Bibles for a month at a time. The Philadelphia Bible Society, which was instituted December 12. 1808, was for some years the only association in the country for the gratuitous distribution of the Sacred Scriptures.

The American Bible Society was formed at New York May 8. 1817. It has numerous auxiliaries throughout the several states of the Union. In 1853, its income amounted to 308,744 dollars, besides large sums for its new premises —an immense Bible-house in New York. Its issues during that year were 666,015 Bibles and Testaments.

The exclusive privilege of printing the Scriptures in Scotland belonged to the queen's printers, and some years ago they instituted a law-suit against the various Scottish Bible Societies, and succeeded in obtaining an interdict preventing the importation into Scotland of Bibles printed beyond the bounds of that country. On the expiry of the monopoly however, in 1839, the House of Commons, mainly through the exertions of the Rev. Dr Adam Thomson of Coldstream, refused to renew the patent, and appointed a Bible Board for Scotland, with power to grant licenses to print the authorized version of the Scriptures. A great reduction immediately took place in the price of the sacred volume, the circulation of which has been in consequence immensely increased. The monopoly of the right to print the Bible in England is still possessed by the Universities of Oxford and Cambridge, and Her Majesty's printer for England. But after a controversy which was carried on for some time with great warmth (1840–1), intelligence and justice prevailed, and the prices of the common Bibles and Testaments were reduced, in some instances more than one-half, to their present remarkable cheapness.

See Owen's *History of the First Ten Years of the British and Foreign Bible Society; Bible Triumphs, a Jubilee Memorial for the British and Foreign Bible Society.* (J.T.)

BIBLIANDER, or more properly Theodore Buchmann, a learned Swiss Protestant divine, born at Bischoffzell in 1504. On the death of Zwingle he was appointed professor of theology at Zurich in 1532. Having adopted more liberal sentiments on the subject of predestination and free-will than were agreeable to his party, he was deprived of his professorship after having long discharged its duties with high reputation. He was a learned Oriental scholar, and published an edition of the Koran, to which he prefixed lives of Mahomet and his successors; together with an apologetical preface, which, in the words of Bayle, "raised a great outcry." Besides this, he published numerous works, chiefly on theology and ecclesiastical history. He died of the plague at Zurich in 1564.

BIBLIOGRAPHY.

That branch of knowledge to which the term Bibliography is generally applied would be more correctly designated by the word *Bibliology*. It was originally employed to denote skill in the perusing and judging of ancient manuscripts; but it is now appropriated to the knowledge of books with reference to their constituent parts, their different editions and degrees of rareness, their subjects, and classes.

Bibliography. This species of knowledge has been most successfully cultivated in France, Germany, and Italy; for though it will be seen in the sequel, that Britain has produced some valuable works in this department, it will also appear that our bibliographical labours have been greatly surpassed by the continental nations. It is to France, in particular, that we are indebted for the most popular and useful treatises in bibliography; but whilst we make this acknowledgement, in which all who have had any experience of their utility will concur, we must add, that some of her bibliographers have spoken in very extravagant terms of the nature and rank of this branch of learning. They represent it as a universal science, in whose ample range all other sciences, and all other kinds of knowledge, are comprehended. "La bibliographie étant la plus étendue de toutes les sciences, semble devoir les renfermer toutes," is the language of one;[1] "la bibliographie est la plus vaste et la plus universelle de toutes les connoissances humaines," is the language of another.[2] Nothing surely can be more preposterous than to view it in this light, merely because it is conversant about books, and because books are the vehicles of all sorts of knowledge. Yet this is the only foundation that we can discover for these extravagant representations; which tend, as in all other cases of exaggerated pretension, to bring ridicule upon a subject which, were its nature and objects simply and correctly defined, could not fail to appear both useful and important. We have already stated generally what kind of knowledge it is to which the appellation of bibliographical knowledge is applied; but, in order more fully to illustrate its nature, and to point out its limits and utility, we shall endeavour to detail somewhat more particularly the chief objects of inquiry which it embraces.

It is the business of the bibliographer, then, to trace the history of books in regard to their forms and all other constituents, and, consequently, to trace the beginnings and progress of typography. It belongs to him, in a particular manner, to mark the differences of editions, and to point out that edition of every book which is esteemed the most correct and valuable. In the case of books published anonymously, or under feigned names, it is his business to indicate the names of their real authors, in as far as the discoveries of literary history may furnish the means of doing so. All remarkable facts attaching to the history of books, such as the number of their editions, their rareness, their having been condemned to the flames, or suppressed, belong to the province of bibliographical inquiry. Further, every one who engages in any particular line of study must of course wish to know what books have been published in regard to it, or in regard to any particular point that interests his curiosity; and it is the business of the bibliographer to furnish this most useful species of information; in other words, the compilation of catalogues of those books which have appeared in the various branches of knowledge constitutes another department of bibliography. It is by means of such catalogues that "the student comes to know what has been written on every part of learning; that he avoids the hazards of encountering difficulties which have already been cleared; of discussing questions which have already been decided; and of digging in mines of literature which have already been exhausted." (Dr Johnson's Preface to the *Catalogus Bibliothecæ Harleianæ.*)

Such are the principal objects and pursuits of the bibliographer; and while it must appear abundantly evident that his science has no pretensions to those lofty epithets upon which we have animadverted, it must, we think, be allowed by every one that it comprises many curious as well as interesting subjects of inquiry; and that it is calculated to afford very useful aids to every other species of intellectual occupation. This view of it will be fully confirmed by the details which we are to offer in the course of this article; in which we propose to point out the progress and best sources of information, in all those departments of knowledge to which we have alluded. In doing so, we shall divide the subject into such heads as shall appear best suited to the purposes intended. Bibliography.

1. *Of the Constituent Parts of Books, and the Differences of Editions.*

The history of the materials employed in the formation of books, of the art of writing and printing upon these materials, and of the forms and sizes in which they have appeared, all belong to this head of inquiry.

Much curious learning has been exercised in describing the various substances used for writings previously to the important discovery of the art of making paper from linen rags. The precise era of this discovery is not known, nor are authors agreed as to the country in which it was made; but it seems to be ascertained that this kind of paper was in general use in Europe before the end of the fourteenth century. Cotton paper had been in general use more than a century before; and though of greatly inferior quality, its introduction was one of the most fortunate circumstances in the history of the arts; for parchment had become so scarce, that old writings were often erased in order to apply the parchment to modern purposes; and thus, by a metamorphosis of a singular and fatal kind, a classic was sometimes transformed into a vapid homily or monkish legend. In this way it is supposed that many valuable works of antiquity have perished; and, indeed, there can be little doubt of this when we consider the number of manuscripts that have been discovered, evidently written upon erased parchments. Parchments of this kind have been called *palimpsests*, from a Greek word signifying twice rubbed—that is, prepared for writing (*Edinburgh Review*, No. xcvi., p. 367). Dr Barret of Trinity College, Dublin, discovered a palimpsest while examining some books in the library of that college. "When thus employed he accidentally met with a very ancient Greek manuscript, on certain leaves of which he observed a twofold writing, one ancient, and the other, comparatively recent, transcribed over the former. The original writing had been greatly defaced; but on close examination he found that it consisted of the three following fragments:—The Prophet Isaiah, the Evangelist St Matthew, and certain Orations of Gregory Nazianzen. The fragment containing St Matthew's Gospel Dr Barret carefully transcribed, and it has been accurately engraved in fac-simile, and published by the order and at the expense of the University, Dublin, 1801, 4to. The original writing, or *Codex Vetus*, Dr Barret, with great probability, assigns to the sixth century; the *Codex Recens*, or later writing, he attributes to the thirteenth" (Horne's *Introduction to Bibliography*, i., p. 115). There has recently appeared "*The Codex Montfortianus*, a collation of this celebrated MS. in the library of Trinity College, Dublin, throughout the Gospels and Acts, with the Greek text of Wetstein, &c.," by O. T. Dobbin, LL.D., 1854, 8vo. But the most interesting discoveries in this line are those of the Cardinal Angelo Maio, who held the office of keeper of the Vatican library, to whom we are indebted for a considerable fragment of Cicero *de Republica*, and fragments of three of his lost orations. The reader will find a curious account of these discoveries, and of the

[1] *Cours Elémentaire de Bibliographie*, par Achard.

[2] *Dictionnaire de Bibliologie*, par Peignot.

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history of *palimpsests*, in the above-cited article of the *Edinburgh Review*.

That part of the history of books which regards the various substances upon which they have been written is compendiously but learnedly treated in the first volume of that very valuable work, the *Nouveau Traité de Diplomatique*, compiled by two Benedictines of the celebrated society of St Maur. This work was published at Paris in 1750, in six volumes quarto. M. Peignot gives a complete list of separate works on this subject in the introduction to his *Essai sur l'Histoire du Parchemin et du Vélin*, published at Paris in 1812.

The inquiry as to the origin of writing is a purely philosophical speculation; but the knowledge of the different kinds of writing peculiar to different ages is a branch of the history of books, which belongs to the province of bibliography, and upon which much information will be found in the above-mentioned work of the Benedictines of St Maur. An excellent work on this subject is Mr Astle's *Origin and Progress of Writing*, the first edition of which was published in 1784, and the second, with some additions, in 1803, each in one volume quarto. The chapters on transcribers and illuminators, and the instruments, inks, and other matters which they made use of in their operations, will be found peculiarly interesting to the bibliographer. But modern art has produced works of a similar character, unrivalled for splendour and execution, in furnishing facsimiles of ancient manuscripts. Without referring to the great work of Count Bastard, limited, from its expense, to crowned heads, we may specify Westwood's *Paleographia Sacra Pictoria*, 1845; Shaw's *Illuminated Ornaments*, 1833; Silvester's *Paléographie Universelle*, Paris, 1839–41, 4 vols. large folio; and *The Illuminated Books of the Middle Ages*, by H. N. Humphreys, and illustrated by Owen Jones, 1849, large folio.

We are now so familiar with the wonders and glorious results of printing, that it is only when we look back into the history of the darker ages that we are made fully sensible of all the various advantages which it has conferred upon mankind. The mention of the *transcribers*—that is, the class employed to copy books before the discovery of printing, naturally gives rise to reflections of this kind. Their ignorance and carelessness occasioned much trouble and mortification to living authors, and irreparable errors in the works of the dead. Petrarch, who flourished in the fourteenth century, has expressed himself in very moving terms in regard to this evil. "How shall we find out a remedy," says he, "for those mischiefs which the ignorance and inattention of the copyists inflict upon us? It is wholly owing to these causes that many men of genius keep their most valuable pieces unpublished, so that they never see the light. Were Cicero, Livy, or Pliny, to rise from the dead, they would scarcely be able to recognise their own writings. In every page they would have occasion to exclaim against the ignorance and the corruptions of those barbarous transcribers."[1] Upon the invention of printing, the class of copyists immediately took alarm, and exerted every means to extinguish an art which, whatever benefits it promised the rest of mankind, held out nothing but prospects of loss to them. They endeavoured, and their example is still steadily followed by other crafts, to set up their own petty interests in opposition to the general good, and called loudly upon the different governments to invest them with exclusive privileges, which all the great interests of society required to be abolished. Thus, when printing was introduced at Paris, the copyists complained of the innovation to the parliament, and that body forthwith caused the books belonging to the printers to be seized and confiscated; but Louis XI. had the good sense to restore their property to these ingenious artists, and to authorize them to proceed in their laudable vocation.

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The question as to the origin of printing is of a complexion wholly different from that regarding the origin of writing, as it turns entirely upon matters of fact; but it is not the less true that it is a subject upon which opinions widely opposite are still entertained; for though this art—we mean the art of printing with moveable types—was spread all over Europe within twenty years of the first discovery, it has unfortunately failed to record, in decisive terms, the name of the individual to whom the honour of the invention is due. The place where the discovery was made remains also a subject of doubt and contention. In Mallinkrot's work, *De Ortu et Progressu Artis Typographicæ*, published in 1640, he enumerates a hundred and nine testimonies in favour of Mentz as the birth-place of the art, and since that time the number has been greatly augmented; yet one of the latest of those who have engaged in this controversy declares decidedly in favour of Haerlem, which, in Mallinkrot's day, ranked only thirteen advocates; and further, assigns the wreath which the supporters of Mentz had variously placed on the brow of Gutenberg, of Fust, and of Schoiffer, to Lawrence Coster, as its rightful owner.[2] All that we can do in this place is to point out some of the works which have been published upon the origin and history of printing, and which it may be necessary for the bibliographer to examine, in order to enable him to judge of early editions; recommending those who wish to see a clear and compendious view of the various opinions which have been advanced upon this subject, to peruse M. Daunou's analysis of these opinions, published in the fourth volume of the *Memoires* of the Moral and Political Class of the French Institute.

The *Monumenta Typographica* of Wolfius, published in two octavo volumes at Hamburg in 1740, contains a collection of treatises by various authors, and also of extracts illustrative of the origin and early history of the art. Among other elaborate tables it contains one of all the authors who, up to that time, had either directly or indirectly treated of the history or of the mechanical part of printing. Meerman's *Origines Typographicæ* is one of the most instructive works as to the progress of the art. It is illustrated with various specimens of early printing, and fac-similes of the books called *Block-Books*, printed by means of wooden blocks. Meerman, who was a lawyer, and author of many elaborate treatises in the civil and canon law, was born at Leyden in 1722, and died in 1771, six years after the publication of his *Origines*; in which he supports, with great ardour and learning, the pretensions of Haerlem as the birth-place of the art, and of Lawrence Coster as its inventor. Another work of curious research on the origin and first progress of printing is that of Prosper Marchand, originally a bookseller at Paris, but whom the repeal of the edict of Nantz drove to Holland, where he employed himself till his death in 1756 in composing various works in literary history and bibliography. He makes Gutenberg the inventor of the art, and Mentz the place where he completed the invention; the first idea of it, however, having been formed whilst he resided in Strasburg. This work, entitled *Histoire de l'Origine et des premiers Progrès de l'Imprimerie*, was published in 1740. A valuable supplement, in which some errors of Marchand are corrected, was published by M. Mercier, abbé de Saint Leger, in 1773, and republished in 1775. The opinion that Gutenberg conceived the first idea of the invention at Strasburg, and afterwards completed it at Mentz, is also supported by Lambinet in his *Recherches historiques, littéraires, et critiques sur l'Origine de l'Impri-*

[1] Lambinet, *Origine de l'Imprimerie*, tome i., p. 38, 39.
[2] See Ottley's *Inquiry into the Origin and early History of Engraving*, chap. iii.

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merie, first published at Brussels in 1799, and republished in two volumes octavo at Paris in 1810, with the addition of M. D. Daunou's treatise already mentioned. Besides the main subject of inquiry, M. Lambinet's work includes various other topics,—such as the history of the substances employed for books, of inks, of engraving in relief, of block-printing, and of stereotype printing. Upon the history of printing we shall mention M. de la Serna Satander's Essay prefixed to his *Dictionnaire Bibliographique*, and the *Initia Typographica* of Professor Lichtenberger, published at Strasburg in 1811; in both of which the claims set up for Coster are treated as fabulous, Gutenberg being represented as the inventor of the art, and Mentz the place where it was perfected; and in both of which also there are ample details as to its progress in other cities and countries.

Several later works might be specified, such as Schaab's *Die Geschichte der Erfindung der Buchdruckerkunst durch Jo. Gensfleisch genannt Gutenberg zu Mainz*, 1830, 3 vols. 8vo; Wetter's *Kritische Geschichte der Erfindung der Buchdruckerkunst durch Johann Gutenberg*, 1836; Laborde's *Debut de l'Imprimerie a Strasbourg*, 1840. Nor ought we to overlook the valuable work of Dr Karl Falkenstein, *Geschichte der Buchdruckerkunst in ihrer Entstehung und Ausbildung*, 1840, 4to. On the other hand, in favour of Costar's claims, we may notice A. de Vries *Eclaircissements sur l'Histoire de l'invention de l'Imprimerie*, 1843. Without entering upon this long disputed question, we may state generally that although Lawrence Coster and other printers *may* have employed types cut in wood at a still earlier period, the true inventor of moveable types, to which the Art of Printing owes its chief importance, was John Gutenberg, in Mentz, between 1445 and 1450.

Besides the information afforded by these general histories as to the diffusion of printing throughout Europe, there are various treatises on its establishment in particular countries and places, which it will often be necessary for the bibliographer to consult. The most valuable to the English bibliographer is Ames's *Typographical Antiquities*, which contains memoirs of our early printers, and a register of the publications from 1471 to 1600. The first edition, published in 1749, consisted of one volume quarto. Another edition, enlarged by Mr Herbert to three volumes quarto, was completed in 1790; and a third, printed with great elegance, and richly embellished, was commenced in 1810, but the fourth volume, published in 1819, left the latter half of Herbert's work untouched. The plan was injudicious, and the editor, the Rev. Dr Dibden, laid no claims to that minute accuracy and research so requisite for a work of that kind, and which renders Herbert's volumes so useful. The French, Germans, and Italians, particularly the latter, are rich in typographical histories of this description; but for accounts of them we must refer our readers to Peignot's *Répertoire Bibliographique Universel*, where they are enumerated and described. There is, indeed, scarcely a town of any importance in Italy, France, Germany, and even in Sweden, which has not a separate treatise describing their earliest printed works, usually known abroad by the general name *Incunabula*. We may likewise mention a curious and interesting work, *The History of Printing in America, with a Biography of Printers*, by Isaiah Thomas, Worcester (Massachusetts), 1810, 2 vols. 8vo.

A knowledge of the different founts or kind of letters used in printing is necessary to the accurate description of books. The bibliographer must also be acquainted with the corresponding appellations used by foreign printers in regard to the different kinds of type. Thus the fount named *pica* by English printers, is called *cicero* by those of France and Germany, because Cicero's *Epistles* were printed in that type. The fount called *paragon* is the only one which retains the same name among the printers of all countries. Upon all these points, Stower's *Printer's Grammar*, 1808; Fournier's *Manuel Typographique*; Johnson's *Typographia, or the Printer's Instructor*, 1812, 2 vols. 12mo; Hansard's *Typographia; an Historical Sketch of the Origin and Progress of the Art of Printing*, 1825, royal 8vo; and Savage's *Practical Hints on Decorative Printing*, 1822, folio, may be consulted with advantage.

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The books of the ancients were generally in the form of cylinders, made by rolling the joined sheets upon a stick, to the ends of which nobs or balls were affixed, often richly ornamented. In the infancy of printing the sizes were generally folio and quarto; and some have supposed that no books were printed in the smaller forms till after 1480; but M. Peignot instances many editions in the smallest forms, of an earlier date, as may be seen in the article *Format* of the Supplement to his *Dictionnaire de Bibliologie*. An accurate knowledge of the different forms of books is necessary to the bibliographer, as without it no book can be correctly described; and however easy of acquisition this knowledge may appear, it is yet certain that errors in this respect are sometimes committed even by experienced bibliographers, and that doubts have been entertained as to the existence of editions, owing to their forms having been inaccurately described.[1] These mistakes generally proceed from this, that there are different sizes of paper comprehended under the same name. But the water-lines in the sheets afford a test, as they are uniformly perpendicular in the folio and octavo, and horizontal in the quarto and duodecimo sizes.

When books have gone through more than one edition, various minute inquiries must often be made, in order to determine the respective merits of those editions. It is a principal object of the bibliographical dictionaries, to be afterwards mentioned, to point out those editions of important works which such inquiries have ascertained to be the best. There are sometimes differences between copies of the same edition of a work;[2] and which, therefore, stand to each other in the same relation as if there had been another edition, with some variations. Walton's *Polyglot Bible* is a celebrated instance. The printing of that great work, for which Cromwell liberally allowed paper to be imported free of duty, was begun in 1653, and completed in 1657, and the preface to it, in some copies, contains a respectful acknowledgement of this piece of patronage on the part of the Protector; but in other copies the compliment is expunged, and replaced by some invectives against the republicans—Dr Walton having, on the Restoration, printed another preface to the copies which had not by that time been disposed of.[3] The copies with the original preface are much rarer, and of course more prized, than those with the loyal one, which latter seems to have helped the author to the bishopric he afterwards obtained.

II. *Of Early Printed Books.*

The productions of the press in the different countries of Europe, during the century in which printing was invented, have engaged much of the attention of bibliographers, and have been described in various works compiled for that purpose. The first of those productions to which the name of

[1] See Boulard, *Traité Elémentaire de Bibliographie*, p. 38, 39.

[2] The *Voyage to Cadiz*, in the second edition of Hakluyt's *Collection*, 1598–1600, having been suppressed in many copies, a reprint is often inserted to supply this want. This reprint may be known from the original by this mark, that it has only seven paragraphs in p. 607, vol. i., whereas the original has *eight*. The *original* ends on p. 619, the *reprint* on p. 620.

[3] See vol. i. of Dr Clarke's *Bibliographical Dictionary*, for some curious details on this point.

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Books has been applied, were printed, not with moveable types, but with solid wooden blocks, and consisted of a few leaves only, on which were impressed images of saints, and other historical pictures, with appropriate texts or descriptions. These leaves were printed only on one side, and the blank sides were generally, though not always, pasted together, so as to look like single leaves. The ink used was of a brownish hue, and glutinous quality, to prevent it from spreading. These curious specimens of the infant art are called *Image Books* or *Block Books*. They have often been largely described, every particular concerning them having been fondly canvassed by bibliographers. Their number is fixed by some at seven, by others carried to ten; but there have been numerous editions of most of them; for they maintained their popularity long after the invention of the art of printing properly so called. One of the most celebrated is the *Biblia Pauperum*, consisting of forty leaves printed on one side, so as to make twenty when pasted together; upon which certain historical passages of the Old and New Testament are represented by means of figures, with inscriptions. It was originally intended, as its name imports, for the use of those poor persons who could not afford to purchase complete copies of the Bible. There is a copious account of *Block Books* in Baron Heinecken's learned work, *Ideé générale d'une Collection complette d'Estampes*, published in 1771, octavo. Dr Dibdin's *Bibliotheca Spenceriana* contains fac-similes of the figures in several of them, as does Mr Ottley's *History of Engraving*, and Falkenstein's work, already mentioned. But a large and laborious publication, by Mr Sotheby, entitled *Principia Typographica*, in 3 vols., specially devoted to an account of wooden-block printed books, with fac-similes, may be soon expected, and will no doubt prove a most important bibliographical work, and throw much light on the early history of printing.

The first book of any considerable magnitude printed with moveable metallic types was the celebrated *editio princeps* of the Bible, printed at Mentz, between the years 1450 and 1455. It is printed in large but handsome Gothic characters, to resemble manuscript, having two columns in the page, and consisting in whole of 637 leaves: it is usually divided into two volumes. The advance from the rude *Block Books* of a few leaves to this noble monument of early typography is great indeed; and it is impossible not to regret that there should have been any uncertainty as to the person whose ingenuity furnished the means of at once raising almost to perfection an art destined ever after to exercise so vast and so beneficial an influence on the affairs of the world. The *Psalter*, printed at Mentz by Fust and Schoiffer, in 1457, is a magnificent specimen of printing, and is moreover the first book which bears the printer's name, with the date and place of printing.

In general, in the very early printed books, the name of the printer, the date,[1] and the place of printing, are either wholly omitted, or placed at the end of the book, with some quaint ejaculation or doxology. The pages have no running title, or number, or catch-word, or signature letters[2] to mark the order of the sheets. The character is uniformly Gothic till 1467, when the Roman type was first introduced. There were no capitals to begin sentences, blank spaces being left for the illuminator to supply them according to his fancy; the only points used were the colon and full stop; and in almost every sentence there were abbreviations or contractions. In regard to these and other peculiarities of early printed books, the reader may consult the following works:—*The General History of Printing*, by Palmer, (supposed, however, to have been chiefly written by the celebrated George Psalmanazar); Jungendres, *De Notis characteristicis Librorum a Typographiæ incunabulis ad an.* 1500 *impressorum*; and, *Recherches sur l'Origine des Signatures, et des Chiffres de Page*, par Marolles.

Many of the early printers had peculiar marks or vignettes, which they sometimes placed on the title-page, sometimes at the end of the books printed by them; and most of them also made use of monograms or ciphers, compounded of the initial or other letters of their names. These furnish a clue to the discovery of the printer, where they occur on books without any printer's name. An acquaintance with them, therefore, is necessary to the bibliographer, because questions occur as to early editions which can only be decided by ascertaining the printer's name. For explanations of these marks, the following works may be consulted:—Orlandi's *Origine e Progressi della Stampa*, published at Bologna in one volume 4to, in 1722; and Scholtzius's *Thesaurus Symbolorum ac Emblematum*, in one volume folio, published at Nuremberg in 1730. The monograms of the early English printers are explained in Ames's *Typographical Antiquities*.

The following works may be mentioned as among the best of those that have been devoted to the description of early printed books:—1. *Index Librorum ab inventa Typographia ad annum* 1500, *cum notis*, 2 vols. 8vo, 1791. This work, by Laire, is one of the most useful of its kind. The descriptions are clear, the notes brief and instructive; and there are four indexes, which furnish the means of ready reference to all the names, titles, places, and bibliographical notices contained in the work. 2. *Dictionnaire Bibliographique choisi du quinzième siècle*, par M. de la Serna Santander, 3 vols. 8vo, 1805. This is a very learned and exact work; and, like the preceding one, embraces only the rarest and most interesting publications of the fifteenth century. 3. *Bibliotheca Spenceriana*, or a descriptive catalogue of the books published in the fifteenth century, in the library of Earl Spencer, by the Rev. T. F. Dibdin, 4 vols. royal 8vo, 1814; to which was added the *Ædes Althorpianæ*, including a Supplement to the *Bibliotheca Spenceriana*, 1822, 2 vols.; and the additional volume of the *Cassano Library*, with the general index, in 1823. The abundance and beauty of the fac-similes and other embellishments, as well as the fineness of the paper and printing, render this one of the most splendid bibliographical works ever published in any country. It contains some curious information, enveloped, however, in a reasonable proportion of tasteless and irrelevant matter. 4. *Annales Typographici ab artis inventæ origine*, by Michael Maittaire, published in 4to, as follows:—In 1719, volume first, which embraces the period from the origin of printing to 1500; volume second, published in 1722, extends the annals to 1536; and volume third, published in 1726, brings them down, according to the title-page, to 1557; but there is an appendix which affords a partial continuation to 1664. In 1733 the first volume was republished, with corrections and large additions, and is commonly called the fourth volume. The fifth and last volume, containing indexes, was published in 1741. As four of the volumes consist each of two parts, the work is sometimes bound in five, sometimes in nine volumes. A supplement to this elaborate work by Denis, in 2 vols. 4to, was published at Vienna in 1789, and contains 6311 articles omitted by Maittaire. The latter has enriched his annals with many learned dissertations; and the work is allowed to be the most important that has yet been compiled in England, in any department of bibliography; but though written in this country,

[1] Early printed books are often found with erroneous or falsified dates (Middleton, vol. iii., p. 236). Dates are sometimes computed by *Olympiads* (*Ibid.*, p. 241).

[2] *Signatures* are letters of the alphabet placed at the bottom of the page, to show the order of the sheets and leaves. "They were used at Cologne, an. 1475; at Paris 1476; by Caxton, not before 1480" (Middleton's *Works*, vol. iii., p. 238).

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the last was the only volume published in it, the others having been given to the world in Holland. 5. *Annales Typographici ab artis inventæ origine, ad annum* 1500, *post* MAITTAIRII, DENISII, *aliorumque doctissimorum virorum curas in ordinem redacti, emendati, et aucti, opera S. W.* PANZER, 11 volumes 4to, published at Nuremberg, the first in 1793, the last in 1803. It was intended, according to the title-page of the first volume, to be limited to the fifteenth century, but, after the appearance of the fifth volume, the period was extended to the year 1536; the author reserving for a separate work books in the German language. This latter work bears the title *Annalen der Altern Deutschen Litteratur*. A more recent publication by Lud. Hain is entitled *Repertorium Bibliographicum, in quo Libri omnes ab arte Typographica inventa usque ad Annum MD. Typis expressi ordine alphabetico vel simpliciter enumerantur vel adcuratius recensentur*, 4 vols. 8vo, 1826-38, and no less than 16,299 books printed during the fifteenth century in general, are described with a minute accuracy which is so rarely to be met with. But the author did not survive to put the finishing hand to his work, after it had reached the letter *Ug*, which may account for the entire omission of *Virgilius*, &c. The addition of bibliographical notices, pointing out first editions and books of remarkable rarity and value, would have much enhanced its interest and value.

The works just described are quite indispensable to every bibliographical collection; but they have a value, we think, independent of the assistance which they afford the bibliographer in his examination of the early productions of the press; they are also calculated to interest the philosopher as curious registers of the extent and objects of intellectual industry during a period when the human mind began to be acted upon by many new impulses, and to receive the seeds of revolutions destined to change the whole aspect of the intellectual world.

III. *Of Rare Books.*

Rareness is a circumstance which must, generally speaking, confer some degree of value upon books; and it is therefore one of the objects of bibliography to indicate those books which, in a greater or less degree, come under this category. We cannot, in this department, any more than in others, indicate any but the most prominent and useful books belonging to it. The following, in this view, are particularly worthy of attention:—1. Beyeri *Memoriæ historico-criticæ Librorum rariorum*, 1734, 8vo. 2. Vogt, *Catalogus historico-criticus Librorum rariorum*, 1732, 8vo. The last and best edition was published in 1793. In this work the epithet *rare* is applied with more judgment and knowledge than in most others of the same class. 3. Gerdesii *Florilegium historico-criticum Librorum rariorum;* first published in 1740, and again in 1763, in 8vo. It was partly intended as a supplement to the above work by Vogt, and therefore notices only those books which are not included in his catalogue. 4. *Bibliothèque curieuse, ou Catalogue raisonné des Livres rares*, par D. Clement, 1750-60. This work, to which we have just alluded, is compiled upon a more extensive plan than any of the preceding; for, though consisting of 9 volumes quarto, it comes down no farther than to the letter H in the alphabetical arrangement of names; terminating here in consequence of the death of the author. Clement is generally blamed, and with justice, for a very profuse and inaccurate application of his own nomenclature; his notes, too, are crammed with citations, and tediously minute; but, on the other hand, it must be allowed that they contain many curious morsels of literary history; and it has, upon the whole, been matter of regret to bibliographers, that the work, voluminous as it must have proved, was not completed. 5. *Bibliotheca Librorum rariorum universalis.* Auctore Jo. Jac. Bauer, 7 vols. 8vo, 1770-91. Bibliography.

Books printed upon Vellum have always been objects of special interest to collectors, from the limited number of copies printed, their beauty, and extreme rarity. Panzer, in his *Essai sur l'Histoire du Parchemin et du Velin*, 1812, announced his intention of publishing a *Bibliothèque rare et précieuse, entièrement composée d'ouvrages imprimées sur Velin.* This work never appeared, but its place was well supplied by an eminent French bibliographer, M. Van Praet, in his *Catalogue des Livres imprimés sur Velin de la Bibliothèque du Roi*, 1822-28, 6 vols., and his Supplemental Catalogue of similar books in other libraries, 1824, 4 vols. royal 8vo.

Various causes contribute to give a degree of rarity and value to particular books, such, for instance, as the casual destruction of most of the copies,—as in the case of the second volume of Hevelius' *Machina Cœlestis*, 1679; the third volume of Rudbeck's *Atlantica*, 1698; and the few sheets printed of a fourth volume. At the great fire of London, in 1666, there were many works of which only a limited number of copies escaped, such for instance as some of Dugdale's works (but their value has been reduced by subsequent editions), and the first volume of Prynne's great work known as the *Records of the Tower.* Other books, again, owe their rarity to the circumstance of only a few copies having been printed for private circulation. Of this class of English books, there has appeared *A Bibliographical Catalogue of Books Privately Printed*, by John Martin, 1834, and republished, with additions, in 1854, 8vo.

IV. *Of the Classics.*

It is remarked by Mr Roscoe, "that the coincidence of the discovery of the art of printing with the spirit of the times in which it had birth was highly fortunate. Had it been made known at a much earlier period it would have been disregarded or forgotten, from the mere want of materials on which to exercise it; and had it been farther postponed it is probable that many works would have been totally lost which are now justly regarded as the noblest monuments of the human intellect." (*Lorenzo de' Medici*, chap. i.) The rapid diffusion of the art, and the speedy appearance of the *Classics* in an imperishable form, afford sufficient proofs of the bent of the age, and the opportuneness of this great discovery. Gabriel Naudé observes, that almost all the good as well as bad books then in Europe had passed through the press before the year 1474;[1] that is, within twenty years of the earliest date to which the use of moveable types can be carried. Within this period editions had been printed of nearly all the Latin classics. The whole works of some of them—of Cicero, for example—had not yet appeared in one uniform edition; but several of his treatises, the whole of Pliny the elder, of Livy, Sallust, Cæsar, Tacitus, Suetonius, Justin, Lucan, Apuleius, Terence, Ovid, Juvenal, Quintus Curtius, Virgil, and Horace, had been published before the end of 1471. Most of the early editions of the classics were published in Italy. England remained greatly behind her continental neighbours in the naturalization of these precious remains of ancient learning. Of all the classics, only Terence, Virgil, Sallust, and Cicero's *Offices*, had, in 1540, been published in this country in their original tongue. In 1591, a neat edition of the Greek text of Homer's *Iliad* was first printed at London. Caxton and others made use only of French translations in the early versions and abridgements published in England. Gawin Douglas, bishop of Dunkeld, so well known for his poetical version of Virgil, has, in his preface to that work, commemorated his indignation at the injustice done to "the divine

[1] *Addition à l'Histoire de Louis XI.*, par G. Naudé.

poet" by Caxton's second-hand translation in the following curious and emphatic lines:—

"Thoch Wylliame Caxtoun had no compatioun
Of Virgill in that buk he preyt in prois,
Clepand it Virgill in Eneados,
Quhilk that he sayis of Frensche he did translait,
It has nathing ado therwith, God wate,
Nor na mare like than the Deuil and sanct Austin.
Haue he na thank tharfore, bot lois his pyne;
So schamefully the storie did peruerte,
I reid his work with harmes at my hert,
That sic ane buk, but sentence or ingyne,
Suld be intitulit eftir the poete diuine.
His ornate goldin versis mare than gylt;
I spitte for disspite to se thame spylt
With sic ane wicht, quhilk treuly be myne entent
Knew nevir thre wordis at all quhat Virgill ment."

Almost all the Latin classics had appeared in print before the art was employed upon any Greek author. But the desire to possess printed editions of the latter became general and urgent towards the end of the fifteenth century; and Aldus had the glory of ministering to that desire, by publishing, in rapid succession, and with singular beauty and correctness, almost all the principal authors in that tongue. Beginning, in 1494, with Musæus's *Hero and Leander*, he printed before 1515, the year of his death, upwards of 60 considerable works in Grecian literature, frequently superadding the learning and cares of the editor to those of the printer. "Yet his glory," to use the words of Mr Gibbon, "must not tempt us to forget that the first Greek book, the *Grammar* of Constantine Lascaris, was printed at Milan in 1476; and that the Florence *Homer* of 1488 displays all the luxury of the typographical art" (*History*, chap. 66). Besides these works, there had been published before 1494 some Greek *Psalters*, the *Batrachomyomachia* of Homer, and the *Orations* of Isocrates; during that year the *Anthologia Græca* was published at Florence; and the works of Callimachus, of Apollonius Rhodius, and of Lucian, were published at the same place within two years after the first essays of Aldus in Greek printing. Thus, though we have no sort of wish to detract from the just fame of this learned and beautiful printer, we cannot admit the propriety of those eulogies of his biographer, M. Renouard, in which he is represented as having given an entirely new direction to the art of printing, and indeed to the literary taste of Europe.[1] It is as incorrect in point of fact as it is unphilosophical, to ascribe to Aldus the production of that taste for Grecian literature which he himself imbibed from the spirit of his age. He saw that there was a great and growing want of Greek books; and his peculiar praise lies in this, that he applied himself to supply it with much more constancy and skill, and with much more learning, than any other printer of that period. All that we have said on this point is fully corroborated by the account which he has himself given, in his preface to Aristotle's *Organon*, published in 1495, of the circumstances which induced him to undertake the publication of the Greek classics. The passage is thus translated by Mr Roscoe (*Life of Leo the Tenth*, vol. i., p. 110):—"The necessity of Greek literature is now universally acknowledged; insomuch that not only our youth endeavour to acquire it, but it is studied even by those advanced in years. We read but of one Cato among the Romans who studied Greek in his old age, but in our times we have many Catos; and the number of our youth who apply themselves to the study of Greek is almost as great as of those who study the Latin tongue; so that Greek books, of which there are but few in existence, are now eagerly sought after. But by the assistance of Jesus Christ I hope ere long to supply this deficiency, although it can only be accomplished by great labour, inconvenience, and loss of time. Those who cultivate letters must be supplied with books necessary for their purpose, and till this supply be obtained I shall not be at rest."

The *Editiones Principes* of the classics have always formed capital objects in bibliography, and are sometimes spoken of with a degree of rapture in bibliographical works, which is apt to appear inappropriate and unreasonable to those who value books solely as they are calculated to afford delight or information. The lover of first editions has, however, some plausible reasons to assign in justification of this expensive, and, as some think, factitious passion. These editions are valuable, in the first place, as curious monuments of early typography, and, in the next place, as more faithful representatives of the best ancient manuscripts than any other editions. *Earum editionum authoritatem*, says Maittaire, *aliis omnibus esse præferendam, quippe quæ sola MSS. fide nitatur*. This ground of preference, however, has some learned oppugners. Schelhorn, in his *Amœnitates Literariæ*, speaks of those to whom we are indebted for the first editions of the classics, as, in general, very ignorant men; quite incapable to collate manuscripts themselves, and seldom taking assistance from those who were. The first manuscript that could be procured, it has been said by others, and not that which, after a careful collation, appeared entitled to a preference, was hastily committed to the press, in order to take advantage of the recent discovery. Thus Grævius, in the preface to his edition of Cicero *De Officiis*, states, that the celebrated *editio princeps* of that work, by Fust, was printed from a very inaccurate manuscript.[2] On the other hand, there are many who view those editions in the same light with Maittaire. M. La Grange assures us, in the preface to his French translation of Seneca's works, that he never, in any case of difficulty, consulted the *editio princeps* of 1475, without finding there a solution of his doubts; adding generally, *que ceux qui studient les auteurs anciens, soit pour en donner des éditions correctes, soit pour les traduire dans une autre langue, doivent avoir sans cesse sous les yeux les premiers éditions de ces auteurs*. To the same purpose, M. Santander observes, that the *editio princeps* of Pliny the elder, printed at Venice by Spira in 1469, is in many places more accurate than the celebrated edition of Father Hardouin. The truth seems to be, that though many first editions have a real literary value, for such purposes as are specified by M. La Grange, there are others which have no value save what their extreme rareness gives them; that, therefore, they who scoff at, and they who laud indiscriminately, these literary rarities, are equally in the wrong; in a word, that we must apply a different rule of estimation to the first editions of an Aldus, and those of such printers as Sweynheim and Pannartz.[3]

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[1] *Annales de l'Imprimerie des* ALDE, ou Histoire des trois MANUCE, et de leurs Editions, par A. G. Renouard, seconde édition, 3 tom. 8vo, Paris, 1825; and a third edition in 1834, in one volume. Renouard afterwards published a similar work on the family of the learned printers, Robert and Henry Stephens, *Annales de l'Imprimerie des Estiennes*, Paris, 1837, 2 vols. 8vo.

[2] See a curious chapter on *First Editions* in Marchand's *Histoire de l'Imprimerie*. He mentions, as a piece of extreme folly, that one hundred guineas had been paid for a copy of the first edition of Boccaccio; but if that price deserved such a censure, what epithet shall we bestow on the purchase of a copy at the Roxburgh sale for the enormous sum of L.2260? This unprecedented sum, the largest ever given for a single volume, was a factitious price; as the identical book was resold in 1819 for L.918, 15s., which, as Brunet truly remarks, "est encore un prix fort honnête."

[3] When Dr Dibdin tells us (*Introduction to the Classics*, v. AULUS GELLIUS), "that all the first editions printed by Sweynheym and Pannartz are considered as particularly valuable by the curious in bibliography," he should have added, chiefly on account of their great rarity, not on account of their accuracy.

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The classics have often been published in sets more or less complete, and more or less estimable for beauty, correctness, commentaries, and so forth. Lists of all these sets, with remarks on their relative extent and merits, will be found in the bibliographical works to be immediately mentioned. As the origin of the *Delphin* collection forms an interesting piece of literary history, it may not be improper to notice it more particularly. This celebrated body of Latin classics was originally destined for the use of the dauphin, son of Louis XIV., and was projected by his governor the Duke of Montansier. This nobleman, who, though a courtier and soldier, was both a philosopher and a scholar, had been in the habit of carrying some of the classics along with him in all his campaigns; and had often experienced impediments to their satisfactory perusal, from the recurrence of difficulties and allusions which could not be removed or explained without books of reference too bulky for transport on such occasions. It was in these circumstances that the idea first occurred to him of the great utility of a uniform edition of the principal classics, in which the text of each should be accompanied with explanatory notes and illustrative comments; and when he became governor to the dauphin, he thought that a fit opportunity to set on foot an undertaking calculated to prove so useful to the studies of the young prince. Huet, bishop of Avranches, then one of the dauphin's preceptors, was accordingly commissioned to employ a sufficient number of learned men for this purpose, and to direct and animate the undertaking. Once every fortnight they came to him on a stated day, each with the portion of his work which he had finished in the interval, to undergo his inspection and judgment. The copious verbal indexes, which constitute so valuable a portion of these editions, were added at his suggestion; but not without considerable opposition on the part of his assistants, who were appalled by the prospect of so much irksome labour as would be necessary to do justice to this part of the plan (*Memoirs of Huet's Life*, book v.). The collection, including Danet's *Dictionary of Antiquities*, extended to sixty-four volumes quarto. "It is remarkable," says Dr Aikin, in one of the notes to his excellent translation of *Huet's Memoirs*, "that Lucan is not among the number. He was too much the poet of liberty to suit the age of Louis XIV."—This extensive series of the Latin classics, enlarged with the notes of the Variorum editions, was republished at London, 1819-1830, by A. J. Valpy, forming in all 185 vols. 8vo.

The following may be noticed as among the most useful bibliographical accounts of the classics:—1. *A View of the various Editions of the Greek and Roman Classics, with Remarks*, by Dr Harwood. This work, first published in 1775, has gone through several editions; the larger works of the same kind, to which it gave rise, not having superseded it as a convenient manual in this department of bibliography. 2. *Degli Autori Classici, sacri e profani, Greci e Latini, Biblioteca portatile*, 2 vols. 12mo, Venice, 1793. This work was compiled by the Abbé Boni and Bartholomew Gamba, and contains a translation of the preceding, with corrections and large additions, besides criticisms on the works of bibliographers, and a view of the origin and history of printing. 3. *An Introduction to the Knowledge of Rare and Valuable Editions of the Classics*, by T. F. Dibdin, D.D. The first edition was published in 12mo in 1803; but it has since been greatly enlarged in the subsequent editions, the last of which, or fourth, appeared in 2 vols. in 1827. The utility of this work is considerably enhanced by the full account which it contains of Polyglot Bibles, of the Greek and Latin editions of the Septuagint and New Testament, and of lexicons and grammars. 4. *A Manual of Classical Bibliography*, by J. W. Moss, B.A., in 2 vols. 8vo, published in 1825. This useful work contains a full account of the translations of the classics, published in the different languages of Europe, with notices of critical and illustrative comments on the various classical authors. The prices obtained for the rarer editions at public sales are also specified.

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The improved editions, by Harles and Ernesti, of the *Bibliotheca Græca* and *Bibliotheca Latina* of Fabricius, are well known to the learned as immense magazines of information in regard to the classics and classical literature; but as they extend over a much wider field of inquiry than is embraced by bibliography, it does not belong to our present subject to give a more particular account of them.

V. *Of Anonymous and Pseudonymous Books.*

The great number of books published anonymously, as well as under false or feigned names, early directed the attention of the learned to this branch of bibliographical inquiry. In 1669 Frederick Geisler, professor of public law at Leipzig, published a dissertation *De Nominum Mutatione*, which he reprinted in 1671, with a short catalogue of anonymous and pseudonymous authors. About the same period a similar but more extensive work had been undertaken by Vincent Placcius, professor of morals and eloquence at Hamburg, and which was published in 4to in 1674, with this title—*De Scriptis et Scriptoribus, anonymis atque pseudonymis, Syntagma.* Four years thereafter John Decker, a learned German lawyer, published *Conjecturæ de Scriptis adespotis, pseudepigraphis, et suppositiitis*, which was republished in 1686, with the addition of two letters upon the same subjects, one by Paul Vindingius, a professor at Copenhagen, and the other by the celebrated Peter Bayle. In 1689 John Mayer, a clergyman of Hamburg, published a letter to Placcius under this title—*Dissertatio Epistolica ad Placcium, qua anonymorum et pseudonymorum farrago exhibitur.* Placcius meanwhile had continued his inquiries; and after his death the fruits both of his first researches and additional discoveries were embodied in one work, and published in a folio volume, at Hamburg in 1708, by Matthew Dreyer, a lawyer of that city. The work was now entitled *Theatrum Anonymorum et Pseudonymorum;* and, besides an Introduction by Dreyer, and a Life of Placcius by John Albert Fabricius, it contains, in an appendix, the before-noticed treatises of Geisler and Decker, with the relative Letters of Vindingius and Bayle, as well as Mayer's *Dissertatio Epistolica* addressed to Placcius. This very elaborate work contains notices of six thousand books or authors; but it is ill arranged, often inaccurate, and three-fourths of it are made up of citations and extracts, equally useless and fatiguing.[1]

A part of this subject, that relating to books published under false or fanciful names, had been undertaken in France by Adrian Baillet, nearly about the same period that Placcius commenced his inquiries. In 1690 this author published his *Auteurs Déguisés;* but this is little more than the introduction to an intended catalogue of such authors, which Baillet never completed; being deterred, as Niceron says, by the apprehension that the exposing of concealed authors might some way or other involve him in trouble. In this piece, which was reprinted in the sixth volume of De la Monnoye's edition of Baillet's *Jugemens des Savans*, there are some curious literary anecdotes, particularly those illustrative of the rage which prevailed after the revival of letters for the assumption of classical names. In Italy these names were so generally introduced into families, that the names of the saints, hitherto the common appellatives, almost disappeared from that country.

The taste for this species of research, which the work

[1] See the copious article on Placcius, in Chaufepié's *Nouveau Dictionnaire Historique et Critique*, tom. iii.

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of Placcius had diffused in Germany, produced several supplements to it in that country. In one published at Jena in 1711, under the name of Christopher Augustus Neumann, there is, besides the list of authors, a dissertation upon the question, Whether it is lawful for an author either to withhold or disguise his name? which question he decides in the affirmative. This work is entitled *De Libris anonymis et pseudonymis Schediasma, complectens observationes generales, et Spicilegium ad* PLACCII *Theatrum.* But the most considerable of these supplements was that published by John Christopher Mylius, at Hamburg, in 1740. It contains a reprint of the *Schediasma* of Neumann, with remarks, and a list of three thousand two hundred authors, in addition to those noticed by Placcius. The notices of Mylius, however, are limited to books in the Latin, German, and French languages.

The last, and by far the best work in this department, is the *Dictionnaire des Ouvrages Anonymes et Pseudonymes*, by M. Barbier, librarian to the late Emperor of France. A second edition, greatly enlarged, was published in four vols. 8vo. in 1822–27. It comprises a vast number of articles; but the plan does not extend to any English, German, or Italian works, except those which have been translated into the French language. A similar work by Vinc. Lancetti, *Pseudonima ouvero Tavole Alfabetiche de' nomi finti*, &c., was published at Milan, 1836, 8vo. Works of this class are more particularly useful in regard to the literary productions of periods and countries which have been greatly restricted in the liberty of the press.

VI. *Of Condemned and Prohibited Books.*

Books supposed hurtful to the interests of government, religion, or morality, have sometimes been condemned to the flames, sometimes censured by particular tribunals, and sometimes suppressed. Such methods of destruction have been followed in various countries, both with respect to their own productions and those of their neighbours. In some countries, lists of the books prohibited within them have from time to time been published; and in these lists are often found the most highly-prized productions of the literature of other nations. This constitutes, indeed, a melancholy portion of the history of books; for though the facts which it collects sometimes amuse by their folly, they oftener excite indignation and pity at the oppressions of power, and the sufferings of learning.

The practice of condemning obnoxious books to the flames is of very ancient date. The works of Protagoras of Abdera, a disciple of Democritus, were prohibited at Athens, and all the copies that could be collected were ordered to be burnt by the public crier. Livy mentions that the writings of Numa, found in his grave, were condemned to the flames, as being contrary to the religion which he had himself established. Augustus caused two thousand books of an astrological cast to be burnt at one time; and he subjected to the same doom some satirical pieces of Labienus. Tacitus mentions a work which the senate under Tiberius condemned to the fire for having designated Cassius as the last of the Romans.[1] This practice was early introduced into the Christian world. "After the spreading of the Christian religion," says Professor Beckmann, "the clergy exercised against books that were either unfavourable or disagreeable to them the same severity which they had censured in the heathens as foolish and prejudicial to their own cause. Thus were the writings of Arius condemned to the flames at the council of Nice; and Constantine threatened with the punishment of death those who would conceal them. The clergy assembled at the council of Ephesus requested Theodosius II. to cause the works of Nestorius to be burnt, and this desire was complied with. The writings of Eutyches shared the like fate at the council of Chalcedon; and it would not be difficult to collect examples of the same kind from each of the following centuries."

When the Popes prevailed upon the nations of Christendom to acknowledge their infallibility in all matters appertaining to religion, they also took upon themselves the care and the right of pointing out what books should or should not be read; and hence originated those famous *Expurgatory Indexes* which furnish such ample materials for the bibliography of prohibited books. There is a copious list of these *Indexes* in the work of Peignot, to be immediately noticed. The next step in the progress of usurpation was the licensing of books. By the council of Lateran, held at Rome in 1515, it was ordered that all books should, previously to publication, be submitted to the judgment of clerical censors. "To fill up the measure of encroachment," says Milton, "their last invention was to ordain that no book should be printed, as if St Peter had bequeathed them the keys of the press also as well as of paradise, unless it were approved and licensed under the hands of two or three gluttonous friars. Till then books were ever as freely admitted into the world as any other birth; the issue of the brain was no more stifled than the issue of the womb; no envious Juno sat cross-legged over the nativity of any man's intellectual offspring" (*Liberty of Unlicensed Printing*).

The following works contain accounts of condemned and prohibited books, and of the *Indices Expurgatorii*:—1. *Dissertatio historico-literaria de Libris Combustis*, in the seventh volume of Schelhorn's *Amœnitates Literariæ.* The same subject is resumed in the eighth and ninth volumes. 2. *Index generalis Librorum prohibitorum a Pontificis auctoritate; in usum Bibliothecæ Bodleianæ*, by Tho. James, 1627. 3. *FRANCUS De Papistarum Indicibus Librorum prohibitorum*, published at Leipzig in 1684. 4. *Thesaurus Bibliographicus ex Indicibus Librorum prohibitorum congestus*, published at Dresden in 1743. 5 *Dictionnaire Critique et Bibliographique des principaux Livres condamnés au feu, supprimés ou censurés*, par G Peignot, 2 vols. 8vo, Paris, 1806. This book is amusing, and gives a copious list of *Indices Expurgatorii*, as well as of authors who have treated of the subject of condemned books in general; but it cannot be allowed that it contains anything approaching to a complete enumeration of the *principal* works which come within the scope of the title-page. There are very few English books noticed, either those condemned in this country or those prohibited in others; though in this latter class the most valuable of our philosophical and literary works would be found. One of the most preposterous sentences of prohibition incurred by an English author is that mentioned in a letter from Sir John Macpherson, while in Spain, to Mr Gibbon; namely, that Smith's *Wealth of Nations* was prohibited there, "on account of the lowness of its style and the looseness of its morals" (Gibbon's *Posthumous Works*, vol. iii.).

We should like to see an accurate account of works which have been condemned to the flames, or suppressed, in Britain. This would include such works as Halle's *Chronicle*, prohibited by Act of Parliament in 1551; portions of Holinshed's *Chronicles*, castrated by order of Queen Elizabeth; Cartwright's *Admonition to Parliament*, suppressed by the English bishops in 1572; Stubbes' *Gaping Gulf*, 1579, for which he and the printer had their right hands cut off. In short, we should find some as abominable instances of oppression in this particular as ever disgraced the worst governments of continental Europe. The proceedings against Prynne, on account of his *Histriomastix* or *Player's Scourge*, furnish a noted example. We wish

[1] See the chapter on *Book Censors* in Professor Beckmann's *History of Inventions.*

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we could add, that these proceedings have always been mentioned by our historians in the terms which their singular atrocity is calculated to call forth from every heart that has one chord in unison with the rights of humanity. Prynne, who was by profession a lawyer, is characterized by Mr Hume as being a "great hero among the puritans." He was in truth a very fanatical person; but his learning was immense, his courage unconquerable, and his honesty certainly as great as that of any of his opponents or oppressors. His *Histriomastrix*, a quarto of upwards of a thousand closely printed pages, with all its margins studded with authorities, came out in 1633, and was intended to decry all dramatic amusements and all jovial recreations, and to censure the lax discipline and the Popish ceremonies of prelacy. In the alphabetical table at the end of the volume there is a reference in these words—"*Women actors, notorious whores;*" and as the queen sometimes took a part in the dramas played at court, it was alleged that Prynne pointed at her majesty in this reference, and that the book was in fact intended as a satire upon the government. He was accordingly prosecuted in the Star-Chamber for a libel. The book (which the judges described as a huge misshapen monster, in the begetting of which the devil must have assisted) was condemned to be burned; and, after the example of foreign countries, this was ordered to be done, for the first time in England, by the hands of the hangman. It was ordered that Mr Prynne should be expelled from Oxford, he being a graduate of that university; and also from the bar. He was further sentenced to pay a fine of L.5000, and to endure perpetual imprisonment: but this was not all; he was condemned to stand in the pillory on two successive days, in Westminster and Cheapside, there, on each day, to have an ear cut off. One of the judges, who represented the queen's virtues as such that neither oratory nor poetry could do anything like justice to them, was for making the fine L.10,000; stating that he knew it was much more than Mr Prynne was worth, yet far less than he deserved to pay; and expressed a further wish, that his nose should be slit, and his forehead burned, in addition to the loss of his ears, because he might buy himself a periwig, and so hide that loss.[1] The book, which involved its author in such unprecedented calamities, had actually been licensed, according to the regulations which then obtained; but it was stated that the licenser had not read the whole of it. Well might Sir Simonds D'Ewes speak of this as a terrifying trial. "Most men," says he, "were affrighted to see that neither Mr Prynne's academical nor barrister's gown could free him from the infamous loss of his ears; and all good men conceived this would have been remitted; many asserted it was, till the sad execution of it. I went to see him a while after," continues Sir Simonds, "in the Fleet, to comfort him; and found in him the rare effects of an upright heart, by his serenity of spirit and cheerful patience."[2] Another memorable instance of persecution by the Star-Chamber, in the reign of Charles the First, was the case of Dr Alexander Leighton (father of Archbishop Leighton), for his two works—*The Looking Glasse of the Holy War*, 1624, 4to; and his *Zion's Plea against the Prelacy*, 1628, 4to. See art. LEIGHTON.

VII. *Of Bibliographical Dictionaries and Catalogues.*

The works which fall to be considered under this section, sometimes called *Dictionaries*, sometimes *Catalogues*, and sometimes *Bibliothecæ*, constitute the most generally useful and interesting class of bibliographical publications. By showing what has been written in all the various branches of human knowledge in every age and country, they act as useful guides to the inquiries of every class of the learned; while, by pointing out the differences of editions, they constitute manuals of ready information to the professed bibliographer.

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Works of this class are called *general* or *particular*, according as their object is to indicate books in all, or in one only, of the departments of science and literature. The former only aspire to point out rare or remarkable books; for no attempt has yet been made, or probably ever will be made, to compile a universal Bibliographical Dictionary. On the other hand, it is the object of *particular* dictionaries to notice all, or the greater part, of those books which have been published on the subjects which they embrace; and hence their superior utility to such as are engaged in the study of any particular science or subject.

The works of the former class which chiefly demand our notice are the following:—1, *Bibliographie Instructive, ou Traité de la Connoissance des Livres rares des singuliers*, par G. F. de Bure; in seven volumes octavo, published at Paris between 1763 and 1768. The books described in this work are arranged, in appropriate sub-divisions, under the five grand classes of *Theology*, *Jurisprudence*, *Sciences* and *Arts*, *Belles Lettres*, and *History*; and the classification which it exemplifies is that generally followed by foreign bibliographers. The names of the authors in all these classes are arranged alphabetically in the last volume; but it has no index to anonymous works, a want, however, which was afterwards supplied by another hand, in a thin octavo volume published in 1782, entitled *Bibliographie Instructive, tome dixième.* This is called the tenth volume, because De Bure had himself published a supplement of two volumes in 1769. Its title is, *Supplément à la Bibliographie Instructive, ou Catalogue des Livres de Louis Jean Gaignat.* De Bure was a bookseller at Paris, of great eminence in his profession, but still more distinguished for extensive information in all matters appertaining to bibliography and literary history; and, accordingly, his work is still the delight of bibliographers, though it has been followed by others which indicate a much greater number of books, and which also in some particulars excel it in accuracy. 2. *Dictionnaire Typographique, Historique, et Critique, des Livres rares, estimés et recherchés en tous genres*, par J. B. L. Osmont, 2 vols. 8vo, Paris, 1768. This work is more ample in notices of Italian books than that of De Bure. 3. *Dictionnaire Bibliographique*, 3 vols. 8vo, Paris, 1790. This work, generally known under the name of Cailleau's *Dictionary*, was compiled, according to M. Barbier and others, by the Abbé du Clos. It was republished in 1800, with a supplementary volume, by M. Brunet. It has been already mentioned that the third volume has a separate alphabet for anonymous books. 4. *Manuel du Libraire et de l'Amateur de Livres; contenant*, 1°, *Un nouveaux Dictionnaire Bibliographique;* 2°, *Une Table en forme de Catalogue Raisonné*, par J. C. Brunet. This comprehensive and extremely useful work was first published in three volumes 8vo, in 1810. A third edition, much enlarged, appeared in 1820, in 4 vols. 8vo. It contains a much greater proportion, both of English and of German books, than any of the preceding compilations, and its plan is such as to afford all the advantages both of a dictionary and a classed catalogue, three of the volumes being employed to indicate books under their names in alphabetical order, and the fourth to class them, divested of all bibliographical details, according to the system generally followed. The prices of the rarer editions are given from the principal sales that have taken place in France and other countries; so that, upon the whole, this work, though it has less literary interest than that of De Bure, is probably the best bibliographical dictionary extant for the purposes of the professed bibliographer. In 1836 Brunet published in three

[1] See Prynne's Trial, in the Collection of *State Trials*.

[2] See Extracts from a manuscript Journal of D'Ewes's Life, published in Nichols's *Bibliotheca Topographica Britannica*, No. XV.

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additional volumes *Nouvelles Recherches;* and a pirated edition of the two works incorporated into one alphabet, having appeared at Brussels, the author himself republished his *Manuel* in an enlarged and handsome edition at Paris, 1842, in 5 vols. large 8vo. This work is not likely to be soon superseded. F. A. Ebert's *Allgemeines Bibliographisches Lexicon*, Leipzig, 1821–30, 2 vols. 4to, is also a most useful book of reference. An English translation of it was printed at Oxford, 1837, 4 vols. 8vo.

In the class of *general* bibliographical dictionaries we must also place the following work, though its limitation to books in the learned and eastern languages renders it much less general in its plan than those we have described. It is entitled *A Bibliographical Dictionary, containing a Chronological Account, alphabetically arranged, of the most curious and useful books in all departments of Learning, published in Latin, Greek, Hebrew, Arabic, and other Eastern Languages.* It was published in 1803, by Dr Adam Clarke, in six volumes duodecimo. To the principal works noticed in this dictionary, there are added biographical notices and criticisms; but the author would have judged more wisely had he included books in the modern languages, instead of deviating so largely, and with but small pretensions to novelty, into the provinces of biography and general criticism. The supplement, which he published in two duodecimo volumes in 1806, under the title of *The Bibliographical Miscellany*, contains, among other matters, an account of English translations of the classics, and theological writers; a list of the cities and towns where printing was established in the fifteenth century; and a list of authors on literary history and bibliography. The work by Dr Robert Watt of Glasgow, so well known as the *Bibliotheca Britannica, or General Index of British and Foreign Literature*, published in 1824, 4 vols. 4to, merits great commendation as a most laborious and useful compilation. It is divided into two parts, in which authors and subjects are specified alphabetically. The plan is not very judicious, and being formed more from printed catalogues than actual examination of the books and editions, it was impossible to avoid endless mistakes; but its usefulness for reference is universally acknowledged. An American work, not yet completed, by S. Austin Allibone, promises to be one of great utility: its title, *A Critical Dictionary of English Literature, and British and American Authors to the middle of the present Century*, in one volume, royal 8vo.

The *Bibliographer's Manual of English Literature*, by W. T. Lowndes, in 4 vols. 8vo, 1834, is indispensable to a collector. For a first attempt of the kind, it displays a singular degree of accuracy and research. He had commenced another work, in which he proposed to give a minute and digested *classed Catalogue* of books connected with English literature as printed in Great Britain, as the *British Librarian or Book Collector's Guide*, 1839. He survived only to complete six numbers of the division, *Religion and its History*, which cannot but excite regret to find such a scheme to have been left unfinished. An early attempt of the kind by Andrew Maunsell, *Catalogue of English Books*, printed at London, 1595, folio, in two parts, contains the titles of many books now lost or forgotten.

The number of dictionaries and catalogues applicable to *particular* departments or provinces of learning, is much too great to permit us to do any thing more than to point out a few of them. For theology, we have Le Long's *Bibliotheca Sacra*, 1723, 2 vols. folio; and the edition by Masch, 1778, 4 vols. 4to, but never completed; Orme's *Bibliotheca Biblica*, 1824; and *Cyclopædia Bibliographica; a Library Manual of Theological and General Literature*, by James Darling, 1854, royal 8vo. This latter work is proposed to be accompanied with a separate volume of subjects, the former being a volume of authors. Lipenius, a learned German divine and professor, born in 1630, and who died in 1692, worn out, as Niceron says, by labour and chagrin, compiled a *Bibliotheca Theologica*, a *Bibliotheca Juridica*, a *Bibliotheca Philosophica*, and a *Bibliotheca Medica*, making in all six volumes folio. The *Bibliotheca Juridica* has been several times reprinted, and various supplements have been added to it by Schott and Senkenberg, published at Leipsic in 1775 and 1789; and by Madinh, at Breslau, 1816-20. An immense number of books are indicated in each of these *Bibliothecæ* of Lipenius; of all of which the plan is to arrange the books alphabetically according to their subjects; each *Bibliotheca* having also an alphabetical table of the names of the authors whose works are arranged under the alphabet of subjects. The *Bibliotheca Juridica*, owing to the corrections and additions which it has received, forms by much the most valuable part of this series. In regard to jurisprudence, we may further mention Bridgman's *Legal Bibliography;* and the valuable work of M. Camus, entitled *Lettres sur la profession d'Avocat; et Bibliothèque choisie des Livres de Droit.* Among other works of particular bibliography, a few others may be selected as worthy of special notice:—Wolfius' *Bibliotheca Hebraica*, 1715-33, 4 vols. 4to; Walchius's *Bibliotheca Theologia Selecta*, 1757, 4 vols. 8vo; and his *Bibliotheca Patristica*, new edition, 1834, with Fürst's *Bibliotheca Judaica*, Leipzig, 1851. Backer's *Bibliothèque des Ecrivains de la Compagnie de Jesus*, may be considered as an improvement upon Ziegelbauer's great work. There are some truly excellent catalogues of works in the sciences and in natural history. Such are Dr Young's *Catalogue of Works relating to Natural Philosophy and the Mechanical Arts*, annexed to his *Lectures on Natural Philosophy;* the *Bibliotheca Mathematica* of Murhard; the *Bibliographie Astronomique* of La Lande; and the *Catalogus Bibliothecæ Historiæ Naturalis Josephi Banks*, by Dr Dryander, which, though the title seems to promise only the catalogue of a private library, is allowed to furnish the most complete and best arranged view of books in natural history ever published in any country. In the great department of history there have been published various *Bibliothecæ*, some of them embracing the historical works of all ages and nations; others, those only which relate to particular countries. The *Bibliotheca Historica* of Meusel, an immense work, is of the former class. It includes voyages and travels; but of books of this class there is an excellent separate catalogue in 6 vols. 8vo, by M. Boucher de la Richarderie. *Bibliothèque Universelle des Voyages*, published at Paris in 1808. We must observe, however, that this work would have been better suited to the legitimate ends of such a compilation had the author confined himself to bibliographical notices, and wholly refrained from those long extracts by which his book has been so much enlarged. Of the class of *Bibliothecæ* applicable to the history of particular countries, the *Bibliothèque Historique de la France*, originally published in 1719, in 1 vol. folio, but in the last edition, published between 1768 and 1778, extended to five volumes, is by far the most splendid and perfect example. It contains nearly fifty thousand articles, as well manuscript as printed, methodically arranged under the different heads of French history to which they relate, and accompanied with a complete set of indexes to authors and subjects.

We must refer such of our readers as are desirous of seeing a fuller list of catalogues of books in the different branches of knowledge before 1812, to the *Répertoire Bibliographique Universel* of M. Peignot, a useful but ill arranged work

In England many useful works of particular bibliography might be specified. Such, for instance, as Gough's *British Topography*, 1780, 2 vols. 4to; Upcott's *Bibliographical Account of the principal Works relating to English Topography*, 1818, 3 vols. 8vo; the *British Librarian* of Oldys, 1740; the *Librarian* of Savage, 1808, 3 vols. 8vo; Baker and Reed's *Biographia Dramatica*, by Jones, 1812, 4 vols. 8vo; Arch-

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deacon Cotton's *Editions of the Bible and parts thereof in English*, second edition, 1852; and the Rev. Christopher Anderson's *Annals of the English Bible*, 1845, 2 vols. 8vo. Various bibliographical works relating to separate English counties might also be noticed.

Querard's *La France Littéraire, ou Dictionnaire Bibliographique*, &c., in 10 vols., and the new series, not yet completed, are works of great value. We may also mention Nisard's *Histoire des Livres Populaires, ou de la Littérature du Colportage*, 1854, 2 vols. 8vo, as a curious and amusing work. Oettinger's *Bibliographie Biographique*, contains exclusively a catalogue of biographical publications.

In foreign literature, it might be easy to enumerate various other important works. Such, for instance, as Haym's *Biblioteca Italiana*, 2 vols. 4to, or 4 vols. 8vo; Worm's *Danske, Norske og Islandske Lærde Lexicon*, 1771–84, 3 vols. 8vo; Nyerup and Kraft's *Almindeligt Litteratur Lexicon*, &c., 1820, 2 vols. 4to; Georgj's *Allgemeines Europäisches Bucher-Lexicon*, 1742–58, folio; Jöcher's *Allgemeines Gelehrten-Lexicon*, 1750, 4 vols. 4to; and Kayser's *Neues Bücher-Lexicon*, from 1750; with the continuations, by Zuchold, to 1852, still in the course of publication.

VIII. *Of the Classification of Books.*

The classing of books in a catalogue, so as to furnish a systematic view of the contents of an extensive library, is a task of much difficulty and importance. In order to this, it is necessary to refer every book to its proper place in the general system of human knowledge; and to do so with precision, it is necessary to have clear and exact ideas of the scope and objects of all the departments and branches of which that system consists. The utility of catalogues so classed is very great, and consists obviously in this, that the books upon any subject are found at once by referring to the proper head. All who duly consider the matter, therefore, must concur in Dr Middleton's brief and emphatic description of such an undertaking, as *res sane magni momenti, multique sudoris*.[1]

Whether classed catalogues were in use among the ancients is a piece of information which has not descended to us. The first who is known to have written on the subject was a German, named Florian Treffer, who, in 1560, published, at Augsburg, a method of classing books. Cardona in 1587, and Scholt in 1608, published treatises upon this subject; and, in 1627, Gabriel Naudé, a writer of no small celebrity in his day, published his *Avis pour dresser une Bibliothèque*, in which he treats of the principles of classification. A translation of this little work by John Evelyn, *Instructions concerning erecting a Library*, was dedicated to the Earl of Clarendon, Lord High Chancellor, in 1661. The catalogue which Naudé compiled of the library of the Canon de Cordes, afterwards purchased by Mazarin, was published in 1643, and is esteemed a curiosity among bibliographers. In the early part of the eighteenth century, Gabriel Martin, a learned Parisian bookseller, who seems to have been much employed in compiling catalogues, chalked out a system of arrangement, which in a great degree, superseded all others, and, in its leading divisions, is still generally followed on the Continent. Various other systems have, however, been proposed by the bibliographers of France and Germany; but, before proceeding to any particular notice, either of the system of Martin or of those which differ from it, we must observe, that all who have written upon the subject seem to have confounded two things, as we think, perfectly distinct,—the arrangement to be followed in the catalogue of a library, and that to be followed in placing its books. They all suppose the same nicety and exactness of classification to be equally necessary and equally practicable in both. Now, we must remark, that where there is a classed catalogue, the grand objects of a systematic arrangement are sufficiently provided for, independently of the location of the books; and if there should not be a classed catalogue, it seems very clear that the bulk of those who frequent a public library could derive little if any benefit from an accurate classification of books on the shelves, even supposing it practicable to effect and maintain it. The chief end of any arrangement to be effected on the shelves ought to be to aid the memories and abridge the labour of the librarians; and all that is useful in this respect may be accomplished by means of a much ruder plan than could be tolerated in any catalogue pretending to classification.

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The system generally followed, as we have already mentioned, is that of Martin, which divides books into the five great classes of *theology, jurisprudence, sciences and arts, belles lettres*, and *history*. Each of these classes has divisions and subdivisions more or less numerous, according to the number of the branches to be distinguished; and it is in the distribution of these that the chief differences are found in foreign catalogues; though the divisions and subdivisions of De Bure, as exemplified in his *Bibliographie Instructive*, are those commonly followed. Some bibliographers, however, have proposed to alter the order, others to diminish, and some to increase the number of the primitive classes. M. Ameilhon, in a paper published in the *Memoirs* of the French Institute, proposes the following leading divisions,—grammar, logic, morals, jurisprudence, metaphysics, physics, arts, belles lettres, and history.[2] In this arrangement, *theology*, to which he has great objections as a separate class, is transferred, with evident impropriety, to the class of *metaphysics*. M. Camus has also investigated the principles according to which books ought to be classed, in another paper in these *Memoirs*, already quoted; but as he has not reduced his method, which proceeds on views much too fanciful for the purpose, to specific heads, we can only refer our readers to his paper. Equally remote from the proper objects of a classed catalogue are the systems proposed by M. Peignot and by M. Thiebaut.[3] The former takes the well-known speculations of Bacon and D'Alembert, as to the genealogy of knowledge, for the basis of his system, and thus fixes upon three principal heads or classes, under the names of history, philosophy, and imagination, with the addition of bibliography as an introductory class. In the system of the latter, there are, in like manner, only three principal heads, founded upon a division of knowledge, into instrumental, essential, and suitable.

Germany also has produced a variety of bibliographical systems, some of them as absurdly refined as those just mentioned; whilst others, as, for example, that of Leibnitz, are better adapted to practical purposes. The classes proposed by this eminent philosopher are as follows,—theology, jurisprudence, medicine, intellectual philosophy, mathematics, natural philosophy, philology, history, and miscellanies.[4] Another system, not very remote from this, is that of M. Denis, formerly keeper of the Imperial Library at Vienna, in which books are divided into the classes of theology, jurisprudence, philosophy, medicine, mathematics, history, and philology. This system is developed in his *Introduction to the Knowledge of Books*, to be afterwards described.

Dr Middleton is the only British author of name who has written any separate tract on the classification of books. The classes proposed by him are these,—theology, history, jurisprudence, philosophy, mathematics, natural history, medicine, belles lettres (*literæ humaniores*), and miscellanies.

[1] See his very judicious tract, entitled *Bibliothecæ Cantabrigiensis ordinandæ Methodus*, in the fourth volume of his works.

[2] *Mémoires de l'Institut National*; Classe, Litt. et Beaux Arts, tom. ii.

[3] See *Dictionnaire de Bibliologie*, par G. Peignot, art. Système.

[4] *Idea* Leibnitiana *Bibliothecæ Publicæ secundum Classes Scientiarum ordinandæ, fusior et contractior* (Works, vol. v).

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His object in the tract referred to was to recommend the adoption of this arrangement for a catalogue of the university library of Cambridge; and, whatever may be its defects, it cannot be questioned that a printed catalogue of an extensive collection, so classed, would have proved of eminent utility.

Naudé mentions a writer who proposed to class all sorts of books under the three heads of morals, sciences, and devotion; and who assigned, as the grounds of this arrangement, these words of the psalmist, *Disciplinam, Bonitatem, et Scientiam doce me.* All such systems as those of M. Peignot and M. Thiebaut, when applied to the formation of catalogues, appear to us quite as absurd as this system deduced from the psalmist. The remark which Naudé applied to it, that it seemed intended "to crucify and torture the memory by its subtilities," is just as applicable to the former. That system, he adds, "is the best which is most facile, the least intricate, and the most practised; and which follows the faculties of theology, physic, jurisprudence, mathematics, humanity, and others."[1] M. Ameilhon also objects strongly to all over-refined bibliographical systems, and particularly to those which aspire to follow the genesis and remote affinities of the different branches of knowledge. "L'exécution," says he, "en seroit impossible; ou si elle ne l'étoit pas au moins entraineroit-elle des difficultés, qui ne pourroient être surmontées que par des hommes profondément réfléchés et exercés aux méditations métaphysiques."[2] The truth is, that when bibliographers speculate in this field with a view to catalogue-making, they entirely forget their proper province and objects. They have nothing whatever to do with genealogical trees of knowledge, or with any mode of classing books which is founded upon remote and subtile abstractions. The whole use and end of a classed catalogue is to furnish a ready index to books, arranged according to their subjects; and that arrangement is therefore to be preferred which is founded upon the most obviously marked and generally recognised divisions of those subjects. We may add, that to compile a good catalogue of an extensive library, even on this humbler plan, would require more learning and more correctness of knowledge and thinking, than are likely to be often employed in such an undertaking.

Though we are not altogether satisfied with the division and order of the classes in the system commonly followed, we have no doubt that, by means of an additional class, and a correct arrangement of the subdivisions, a catalogue might be formed perfectly adequate to every useful purpose. We allude to a class, such as is partly indicated in the schemes both of Leibnitz and Middleton, for the reception of works and collections which cannot with propriety be limited to any one division of knowledge. M. Camus thinks that works of this kind may be properly enough entered in the class in which their authors most excelled; those of Cicero, for example, among the Orators;[3] but, not to mention the evident incongruity of placing a collection so multifarious as Cicero's works under *Oratory*, there may sometimes be room for uncertainty as to the division under which, according to this rule, an author's works ought to be sought. These incongruities and inconveniences, together with those which must arise from placing Encyclopædias and general collections under any of the common divisions, can only be remedied by a *Miscellaneous Class;* and, while this class ought to indicate, in one of its divisions, the collective editions of an author's works, his separate treatises ought to be entered under the subjects to which they belong; as without this, the classed catalogue will not fully answer its purpose,—that of showing what has been written by the authors specified in it, on the different branches of knowledge. Thus, a catalogue compiled upon this plan would not only be rendered more consistent in its arrangement, but much more complete as an index to the materials of study.

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IX. *Of Bibliography in general.*

It was our object in this article to institute such a division of the subject as should enable us to point out the best sources of information in regard to all its branches; and in order to complete our view, we have still to notice some of those works which treat generally of all matters appertaining to bibliography. We do not know any book that presents a well-written, judicious, and comprehensive digest of these matters; but there are several which contain much curious and useful information in regard to them. 1. *The Introduction to the Knowledge of Books* (*Einleitung in Bucherkunde*), by M. Denis, whose supplement to Maittaire, and bibliographical system, we have already mentioned, is of this description. The last edition, published at Vienna in 1796, consists of two volumes quarto. It has never been translated from the original German; and it is to be observed, that though it treats of the substances, forms, and classification of books, it cannot be considered as a merely bibliographical work, a large portion of it being devoted to the general history of learning. The author, who was long principal librarian of the Imperial Library at Vienna, died in 1808. 2. *Manuel Bibliographique*, ou Essai sur la connoissance des livres, des formats, des éditions, de la manière de composer une Bibliothèque, etc.; par G. Peignot. Published in 1800. 3. *Dictionnaire raisonné de Bibliologie*, contenant l'explication des principaux termes relatifs à la Bibliographie; des notices sur les plus célèbres Bibliographes; et l'exposition des différens Systèmes Bibliographiques, 3 vols. 8vo, by the same author. Bibliography is certainly indebted to this industrious compiler; but his vague notions of its objects and rank have too often led him into confusion and extravagance. 4. *Cours de Bibliographie, ou la science du Bibliothécaire*, par C. F. Achard, 3 vols. 8vo, published at Marseilles in 1807. The chief value of this compilation consists in its details of the different systems which have been proposed for classifying books. We learn from the introduction, that M. François de Neufchâteau, when minister of the interior, orders the librarians of all the departments to deliver lectures on bibliography; but that the plan, which indeed savours somewhat of *bibliomania*, entirely failed, these librarians having been found quite incapable of prelecting upon their vocation. 5. *Introduction to the Study of Bibliography; to which is prefixed a Memoir on the public Libraries of the Ancients*, by Thomas Hartwell Horne, 2 vols. 8vo, published at London in 1814. This is chiefly translated and compiled from the French bibliographical works, and will be found useful to those who have not access to them. It contains full lists of writers on bibliography and literary history, and the fullest account we have seen of catalogues of libraries both British and foreign. The specimens of early typography, and of the vignettes and monograms of the early printers, are neatly executed. 6. Namur, *Manuel du Bibliothécaire*, published at Bruxelles, 1834, 8vo; also, 7, by the same author, *Bibliographie Paléographico-Diplomatico-Bibliologique Générale*, Liege, 1838, 2 vols. 8vo. 8. *The Library Companion, or the Young Man's Guide, and the Old Man's Comfort, in the Choice of a Library*, by that most enthusiastic, but not the most judicious of bibliographers, the Rev. Dr Dibdin, 1824, 8vo, may close this list; along with his well-known *Bibliomania*, 1811; his *Bibliographical Decameron*, 1817, 3 vols.; his *Bibliographical Antiquarian and Picturesque Tour in France and Germany*, 1821, 3 vols.; and his similar *Tour in the Northern Counties of*

[1] Evelyn's Translation of Naudé's *Avis pour dresser une Bibliothèque.*

[2] *Mémoires de l'Institut;* Classe, Littérat. et Beaux Arts, tom. i., p. 483.

[3] *Ibid.*, tom. i.

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England, and in Scotland, 1838, 2 vols.; the three latter works, each in royal 8vo, being printed and illustrated in a most sumptuous manner.

Bibliography certainly presents a pretty wide field of inquiry, and in which there is yet room for useful works; but it must appear evident, from the details contained in the present article, that this field has in almost every part been long cultivated; if not always with perfect taste and judgment, yet with great industry, and so as to yield very profitable returns to the commonwealth of learning.

Bichât.

BIBLIOMANCY (*βίβλος* and *μαντεια*), a kind of divination performed by means of the Bible; otherwise called *sortes biblicæ* or *sortes sanctorum*. It consisted in selecting passages of Scripture at hazard, and thence drawing indications concerning the future. It was much used at the consecration of bishops.

BIBLIOTHECA (*βιβλιοθήκη*), a library or place for books. It is also applied to a treatise giving an account of all the works on a particular subject.

BICE, or BISE, among painters, a blue colour prepared from the lapis Armenus, or calcareous salt of copper. It bears the best body of all bright blues used in common work, but is the palest in colour.

BICESTER, or BISSETER, a very neat town, in the county of Oxford, fifty-five miles from London, containing several handsome residences. The church is a large structure with a lofty tower. A small stream here runs into the Cherwell at Islip. The market is held on Friday. It has no other trade than the supply of the agricultural district which surrounds it. Pop. in 1851, 2763.

BICHAT, MARIE-FRANÇOIS-XAVIER, a celebrated French anatomist and physiologist, was born at Thoirette in the department of Ain, in 1771. His father, who was himself a physician, initiated him at an early age in those studies which were to prepare him more particularly for the profession to which he had destined him. He studied first at the college of Nantua, and afterwards at Lyons; and was early distinguished for his activity of mind and facility in acquiring knowledge. In mathematics, and the physical sciences more especially dependent on abstract reasoning, he made rapid progress. He afterwards became passionately fond of natural history, and devoted all his time to this new study; but his ardour was suddenly checked by the reflection that he was engaged in pursuits that were boundless in their object, and might lead him too far from his future profession, through which alone he aspired to celebrity. Bidding adieu, therefore, to his favourite occupations, he devoted himself to the study of anatomy and surgery, under the guidance of Petit, chief surgeon to the Hôtel Dieu at Lyons. Some time after he had fully engaged in this course of instruction, he was unable to resist his passion for mathematics, and he resumed his early studies, restricting himself however within such limits as did not interfere with his medical pursuits. Petit soon discerned the superior talents of his pupil; and, although the latter had scarcely attained the age of twenty, employed him constantly as his assistant in his professional labours. The revolutionary disturbances compelled Bichât to fly from Lyons and take refuge in Paris about the end of the year 1793. He there resumed his studies, and became a pupil of the celebrated Dessault; and after no long time his companion and his friend. The merit of Bichât was brought to the notice of Dessault by an accidental circumstance. It was the custom in the school, that the substance of the lecture of the preceding day should be recapitulated, as an exercise, before the whole class, by one of the pupils selected for this purpose: and one day when the pupil on whom this task devolved was absent, the professor asked if any one among his auditory would supply his place. Bichât volunteered his services, and acquitted himself to the admiration of all his hearers. Dessault, in particular, was strongly impressed with the superiority of his genius; and from that day Bichât became an inmate in his house, and was treated as an adopted son. Between the years 1793 and 1795 he actively participated in all the labours of Dessault. Notwithstanding these multiplied occupations, Bichât found means to prosecute his own researches in anatomy and physiology, to which he devoted every interval of leisure he could seize. The sudden and untimely death of Dessault was a severe blow to Bichât, but did not eventually relax his efforts. His first care seems to have been to acquit himself of the obligations he owed his benefactor, by contributing to the support of his widow and her son; and by conducting to a close the fourth volume of Dessault's *Journal de Chirurgie*. To this volume he subjoined a biographical memoir of its author, in which he pays a just tribute to his merit. His next object was to re-unite and digest in one body the different surgical doctrines which Dessault had advanced in fugitive papers, published in various periodical works. Of these he composed, in 1797, a work in two vols. 8vo, entitled *Œuvres Chirurgicales de Dessault, ou Tableau de sa Doctrine, et de sa Pratique dans le Traitement des Maladies Externes;* a work in which, although he professes only to explain the ideas of another, he develops them with the clearness and copiousness of one who is a perfect master of the subject. He was now at liberty to pursue the full bent of his genius, and soon arrived at those comprehensive and masterly views of physiology, by which eventually he gained so much reputation. Undisturbed by the storms which agitated the political world, he pursued with steadiness the course he had meditated, and directed his more immediate attention to surgery, which it was then his design to practise. We meet with many proofs of his industry and success at this period in the *Recueil de la Société Médicale d'Emulation*, an association of which Bichât was one of the most zealous and active members. Three memoirs which he communicated were published by the society in 1796; the first describing an improvement in the instrument for trepanning; the second a new process for the ligature of polypi; and the third, the distinction to be observed in fractures of the clavicle, between those cases requiring the assistance of art, and those in which its interference would be of no avail. In 1797 Bichât commenced a course of anatomical demonstrations. He had hired a small room for the purpose; but his merit as a teacher soon attracting a crowd of auditors, he was obliged to enlarge his theatre, and was also encouraged to extend the plan of his lectures, and to announce what had never hitherto been attempted by one so young and inexperienced, a course of operative surgery. The boldness of the enterprise was equalled only by its success. Bichât's reputation was now fully established, and he was ever after the favourite teacher with the students who resorted to the capital. In the following year, 1798, he gave, in addition to his course on anatomy and operative surgery, a separate course of physiology. A dangerous attack of hæmoptysis interrupted for a time these heavy labours; but the danger was no sooner passed than he plunged into new engagements with the same ardour as before. He had now scope in his physiological lectures for a fuller exposition of his original views in the animal economy, which immediately excited much attention in the medical schools at Paris; and he was induced to publish them in a more authentic form. Sketches of these doctrines were given by him in three papers contained in the Memoirs of the *Société Médicale d'Emulation*. The doctrines contained in these memoirs were afterwards more fully developed in his *Traite sur les Membranes*, which appeared in 1800,

Bichât.

and which immediately drew the attention of the medical world both at home and abroad. Some time previous to this he gave to the public a small work, in which he endeavoured to give, in a condensed form, the lessons of Dessault relative to the diseases of the urinary passages. In the notes to this volume we may perceive the germ of many of those views which were peculiar to Bichât.

His next publication was the *Récherches Physiologiques sur la Vie et sur la Mort*, in 1800, which consists of two distinct dissertations. In the first, he explains, at greater length than he had previously done, his classification of functions, and traces the distinction between the animal and organic functions in all its bearings. In the second, he investigates the connection between life and the actions of the three central organs, the heart, lungs, and brain. But the work on which he bestowed the most attention, and which contained the fruits of his most profound and original researches, is the *Anatomie Générale*, which was published in in four volumes octavo in 1801.

Before Bichât had attained the age of eight-and-twenty, he was appointed physician to the Hôtel Dieu, a situation which opened an immense field to his ardent spirit of inquiry. In the investigation of diseases, he pursued the same method of diligent observation and scrupulous experiment which had characterized his researches in physiology. He learned their history, not from books, but by studying them at the bedside of his patients, and by accurate dissection of their bodies after death. He engaged in a long series of examinations, with a view to ascertain the exact changes induced in the various organs by diseases, which he conceived, in every instance, primarily to affect some one of their constituent textures, while the rest did not suffer any change, unless by the supervention of some other disease. In the prosecution of these inquiries he had, in less than six months, opened above six hundred bodies. As intimately connected with the practical exercise of the healing art, he was anxious also to determine, with more precision than had hitherto been attempted, the effects of remedies on the body; and eagerly availed himself of the opportunities which his new appointment afforded him, of instituting a series of direct experiments on a very extensive scale. He began by giving singly different medicinal substances, and then watching attentively the phenomena that ensued. He then united them in various ways, first joining two together, then three, and so proceeding to more complicated combinations; and observed the particular changes in their mode of operating which resulted from their being thus combined. So wide a range of experiments, it is evident, could not have been conducted without assistance; and he selected forty of his young pupils to aid him in collecting the requisite observations. He had already, in this way, procured a vast store of valuable materials for his course of lectures on the Materia Medica, the completion of which was unfortunately prevented by his untimely death; but a great part of the facts were subsequently published in the inaugural dissertations of his pupils. Latterly, he had also occupied himself with framing a new classification of diseases.

During these arduous vocations, he never lost sight of his anatomical pursuits, and had commenced a new work on the subject, in which the organs were arranged according to his peculiar classification of their functions, under the title of *Anatomie Descriptive*. He lived only to publish the first two volumes of this work. It was, however, continued on the same plan, and completed in three volumes more, by MM. Buisson and Roux, who had been his most active assistants, and who appear to have been perfect masters of his ideas on the subject. His death was brought on by a fall from a staircase at the Hôtel Dieu; and although the accident did not at first appear to be serious, it excited so great a degree of fever, that his frame, already exhausted by excessive labour, and enfeebled by constantly respiring the tainted air of the dissecting-room, in which he had latterly passed the greater part of his time, sunk under the attack. He died on the 22d July 1802, universally regretted by his pupils, and attended to the last by the widow of his benefactor, from whom he had never been separated. Every tribute of respect was paid to his memory; his funeral was attended by above six hundred of his pupils, and by a number of the physicians in Paris. His bust, together with that of Dessault, was placed at the Hôtel Dieu by order of the first consul, in joint commemoration of the man under whose fostering protection so bright a genius was first brought before the public, and of the pupil who nobly emulated the fame of so great a master. (P. M. R.)

Bidal ‖ Biddle.

BIDAL, or BIDALE (*bid* and *ale*), in England, the invitation of friends to drink ale at some poor man's house, and there to contribute for his relief,—an ancient and still a local custom.

BIDASOA, or VIDASOA, a small river which rises in the Western Pyrenees, in the valley of Baztan, and flows to the Atlantic near Cape Higues. On its left bank is the town of Fuenterabia, where the army of Charlemagne was defeated by the Gascons. On Oct. 7. 1813, Wellington, in his victorious career, crossed the Bidasoa at Irun, and the whole British army was encamped in France by the 10th of November.

BIDDING PRAYER. It was one part of the office of the deacons in the primitive Christian church to act as monitors and directors of the people in the exercise of their public devotions in the church; to which end they made use of certain known forms of words, to give notice when each part of the service began. This was called by the Greeks κηρύσσειν, and by the Latins *prædicare*, which therefore does not ordinarily signify to "preach," as some mistake it, but to perform the office of crier (κήρυξ, or *præco*) in the assembly; and hence Synesius and others call the deacons ἱεροκηρύκες, the "holy criers" of the church, appointed to bid or exhort the congregation to pray and join in the several parts of the service of the church. Analogous to this practice is the form "Let us pray," repeated before several of the prayers in the English liturgy, and used as a sort of proem in the simpler invocations of the Presbyterian church.

BIDDLE, JOHN, one of the most eminent English writers among the Socinians, was born in 1615, at Wotton-under-Edge, in Gloucestershire, and educated in the free school of that place. Before he had completed his twentieth year, he published a translation of Virgil's Bucolics, and the first two satires of Juvenal. In 1634 he was entered at Magdalen Hall, Oxford, where he took his degree of M.A. In 1641 the magistrates of Gloucester elected him master of the free school of that city; in which office he acquitted himself to their entire satisfaction. But having expressed some peculiar opinions concerning the Trinity, he suffered various persecutions and imprisonments in the time of the Commonwealth. During one of these confinements, which lasted for several years, being reduced to great indigence, he was employed by Roger Daniel of London to correct the impression of the Septuagint Bible, which that printer was about to publish, and wished to render as accurate as possible. The general act of oblivion passed in 1651 restored him to liberty; but he was afterwards imprisoned on account of his tenets; and, at last, in October 1655, the protector banished him for life to the castle at St Mary's, one of the Scilly isles. In 1658 he was again set at liberty. But after the restoration of Charles II. he was fined in L.100, each of his hearers being amerced in L.20, and he was condemned to lie in prison till the fine was paid. Here the severity of his confinement brought on a disease, of which he died on the 22d of September 1662, in the forty-seventh year of his age. The Life of Biddle was published in Latin in 1682, by Mr Farrington of the Inner Temple, who represents him as possessed of extraordinary piety, charity, and humility. He had so happy a memory, that he retained word for word the

Bid-doomahs || Bidloo.

whole New Testament, not only in English, but in Greek, as far as the fourth chapter of the Revelation of St John. (See also Toulmin's *Life of Biddle*.)

BIDDOOMAHS, a fierce and piratical tribe who inhabit a cluster of large rugged islands in the eastern part of the great African lake called the Tsad. They neither sow, plant, nor rear cattle, but maintain themselves by plunder. They own nearly a thousand barks, with which they have made themselves complete masters of this water, and extend their ravages round the whole circuit of its shores. Some of these men, whom Major Denham saw at Bornou, appeared to him the wildest and rudest human beings he had ever beheld. This tribe was lately visited by Dr Overweg, as mentioned in the article AFRICA. He was well received by them; but describes them as being constantly at war with their neighbours of Bornou and Wadai, and as using boats more than 40 feet in length, without sails, but propelled by long poles.

BIDEFORD, a borough, market-town, and seaport, in the county of Devon, 29 miles N.W. of Exeter. It is pleasantly situated on the slopes of two hills which rise on either side of the river Torridge, near its confluence with the Taw, and about four miles from the sea. The two portions of the town are connected by a bridge of fourteen arches, said to have been built early in the fourteenth century. This bridge is endowed for its repair with lands which produce an annual rent of from L.300 to L.400. It forms a favourite promenade. Many of the houses are constructed after the ancient fashion, with bricks and wooden framework, and the streets are well paved and lighted. It contains an ancient church with a tower and six bells, several dissenting places of worship, a free grammar-school, and several other schools, a literary and scientific institution, a reading-room, a town-hall, a hospital for aged poor, and a dispensary.

Bideford was once a place of some commercial importance, and has still considerable shipping trade. It imports timber from Canada and the Baltic, with fruits, wines, and brandies from the south of Europe; and exports oak-bark, sails and cordage, earthenware, and corn, to Ireland, Wales, Scotland, the Channel Islands, &c. Vessels of 500 tons come up at high tide to the quay. Manufactures—earthenware, ropes, sails, and leather. There is also some ship-building. Corporation—a mayor, three aldermen, twelve councillors. Pop. (1851) 5775.

BIDENS, a botannical genus of the natural order of Compositæ. See BOTANY.

BIDENTAL, in *Roman Antiquity*, a place blasted with lightning, and where if a person were killed he was usually buried. The spot was immediately consecrated with the sacrifice of a *bidens*, *i. e.* a two-year old sheep, was surrounded with a ditch, wall, or other fence, and ever afterwards accounted sacred. The officiating priests were called *Bidentales*.

BIDET, a nag or little horse formerly allowed to each trooper and dragoon for carrying his baggage.

BIDIÆI (βιδιαῖοι, βίδεοι, βίδυοι), magistrates at Sparta who inspected the gymnastic exercises. They were either five or six in number, and, as Böckh has shown, were distinct from the *Nomophylaces*, who appear to have exercised a higher authority in the state.

BIDPAI, or PILPAY, the Hindu author of the celebrated fables called in India *Pancha Tantra*, or "the five sections," which has been translated into Tamul, French, Latin, Spanish, and part into English, by Sir Charles Williams and by Sir William Jones. A good account of this work is given in vol. i. of the *Royal Asiatic Society's Transactions*, by H. H. Wilson, from which it appears that scarcely any book but the Bible has been translated into so many languages.

BIDLOO, GOTTFRIED, a celebrated Dutch surgeon and anatomist, born at Amsterdam, March 12. 1649. In 1688 he was chosen professor of anatomy at the Hague, and in 1694 at Leyden, when he was appointed physician to William III. of England, who permitted him to retain his professorship. He published in Latin, 1. The Anatomy of the Human Body, demonstrated in 105 cuts, explained by the discoveries of the ancient and modern writers. (Cowper, the English anatomist, bought up 300 copies of the plates of this work, and published them at Oxford in 1698 as his own.) 2. An Oration upon the Antiquity of Anatomy; 3. A Letter to Anthony Leeuwenhoeck on the animalcules sometimes found in the liver of sheep and other animals; 4. Two Decades of Dissertations in Anatomy and Chirurgery; and other pieces. He died at Leyden in April 1713.

Bidschow || Bigamy.

BIDSCHOW, NEW, capital of a circle of the same name in the Austrian kingdom of Bohemia, is situated on the river Cydlina, 50 miles E.N.E. of Prague. It has some trade in cattle, with manufactures of linen and cotton goods and leather. Pop. 4000, of whom about 500 are Jews, who have a synagogue here.

BIEDENCOPF, a city of Hesse-Darmstadt, province of Upper Hessen, on the river Lahn. It is a town of much industry, containing 3580 inhabitants, employed in making cloth, baize, blankets, and various other kinds of goods.

BIELEFELD, a walled town in the Prussian province of Westphalia, government of Minden, and capital of a circle of the same name. It is pleasantly situated at the foot of a hill on the river Lutter, on the line of the Minden and Cologne railway, 26 miles S.W. of Minden. It was formerly the capital of the county of Ravensberg, and is now the centre of the Westphalian linen trade, with extensive bleaching-fields, &c. It has a gymnasium, several schools, and 10,308 inhabitants. The circle in 1849 contained one city, six market-towns, thirty-one villages, and 47,739 inhabitants.

BIELITZ, a town of Austrian Silesia, in the circle of Teschen, 16 miles N.E. of the town of that name, on the left bank of the Biala. It has considerable manufactures of fine cloths and cassimeres. The ducal palace and park adjoining are very magnificent. Pop. 6000.

BIELLA, an Italian province of the kingdom of Sardinia. It is a mountainous district, bounded on the N. by Sesia, on the E. and S.E. by Vercelli, on the S.W. and W. by Ivrea, and on the N.W. by Aosta. Area 264 square miles; pop. in 1848, 130,691. The capital, from which the province derives its name, is on the banks of the rivers Cervo and Aurena, 38 miles N.E. of Turin. Pop. between 8000 and 9000, employed chiefly in the manufacture of silk and linen goods, and in the cultivation of vines. Long. 7. 50. E. Lat. 45. 55. N.

BIER, a wooden carriage or frame for carrying the bodies of the dead to the place of interment.

BIFRONS, double-fronted, an epithet of the god Janus, who was represented with two faces.

BIGA, or BIGÆ, in *Antiquity*, a chariot with two horses abreast. Races of chariots with two horses were introduced into the Olympic games in the 93d Olympiad; but the invention was much more ancient, as we learn that the heroes of the *Iliad* fought in chariots of that kind. The moon, the night, and the morning, are by mythologists supposed to be carried in *bigæ*, but the sun in *quadrigæ*. Statues in *bigæ* were at first only allowed to the gods, but were afterwards conceded to conquerors in the Grecian games. See CHARIOT.

BIGAMY (compounded of the Latin *bis*, twice, and the Greek γαμέω, I marry) literally signifies being twice married; but with us the term is used as nearly synonymous with polygamy Wherever Christianity prevails, the union with more than one spouse is condemned by religion, public opinion, and law; although in the polemical contests of the Reformation there was some risk of the principle being relaxed, in the zeal with which the spirit of celibacy attri-

Bigamy.

buted to the Church of Rome was controverted. Most nations of modern Europe have taken their law of bigamy in some measure from the canon law; but England, with her usual jealousy of the influence of that system, has dealt with bigamy penally through the statute law. A second marriage while the former husband or wife is still living, is simply null by ecclesiastical law. By the Act of 9th Geo. IV. cap. 31. § 22, amending first of James I., cap. 10, the offence is declared felony, and all concerned in it as principals or accessories are liable to transportation for seven, or imprisonment with hard labour for two years. By the act of 1853 this, with other offences incurring transportation, may be punished with penal servitude. The statute law makes an exception of cases where the second marriage is a question of foreign law, or where it has been contracted in innocent unconsciousness; as for instance where the spouse of the first marriage has been for seven years absent, and is believed to be dead.

The offence is not incurred under the act where at the time of the second marriage the party is "divorced from the bond of the first," or where it has been declared "void by the sentence of any court of competent jurisdiction." But here the rigid character of the English law comes in conflict with those systems which, founded on the common principles of canonical jurisprudence, are easily adjusted to each other. The English courts, for instance, counting an English marriage as indissoluble by law, have refused to admit a Scottish divorce as having any effect on the condition of the married persons; and in the celebrated case of Lolley, who had been divorced for adultery in Scotland and married again in England, on the understanding that he was safe from penal consequences, sentence was passed on the verdict of a jury after solemn argument before the twelve judges. (*Russell and Ryan's*, cc. 237.) In the subsequent case of Conway *v.* Beazeley (1831, Haggart's *Ecclesiastical Cases*, iii. 639), the sweeping character of this decision seemed to create some uneasy doubts; but it was unnecessary in Beazeley's case to decide the ultimate question whether the bond of the English marriage can ever in any circumstances be legally dissolved, and it was held that a Scottish marriage following a Scottish divorce was ineffective against a previous English marriage, the parties having their domicile in England. The question how the law would have stood had they been domiciled in Scotland was left open.

In Scotland, at the date of the only statute respecting bigamy, that of 1551, cap. 19, the offence seems to have been chiefly considered in a religious point of view, as a sort of perjury, or violation of the solemn vow or oath which was then used in contracting marriage; and, accordingly, it was ordained to be punished with the proper pains of perjury. But this injunction has not in every instance been complied with; and, from considerations of policy or expediency, the court has long been in use to inflict an arbitrary punishment, suited, as nearly as may be, to the degree and measure of guilt brought home to the prisoner. The most important point concerning the description of bigamy which is the contracting of a second marriage during the subsistence of the first, relates to the quality of the two marriages, and involves the nice and delicate inquiry whether both must be marriages by formal celebration, or whether the charge will lie although both or one of them be contracted in that loose and unceremonious fashion which is sustained, in single cases, by the law and custom of Scotland. And here it may be observed, in the first place, that from the general strain and language of the statute above referred to, which passed at a time when there was no marriage without formal celebration, the presumption appears to be in favour of the more lenient opinion; and this is further confirmed by the circumstance that the application of the pains of perjury to this offence seems plainly to presuppose the contempt of a solemn oath or vow, and a gross abuse of the service of the church. The most favourable case for the offender, therefore, is that where both connections are of this loose and ambiguous character, as by promise and *copula*, courtship and acknowledgments, or the like: for here it may be urged that there has been no solemn entry into the holy state of matrimony, and no prostitution of religious ceremonies or ecclesiastical ministrations; and that circumstances which may be held relevant in a civil question of *status*, if consisting merely of probabilities and presumptions of law, cannot afford that full and decisive proof of *dole*, or of a settled purpose to marry and betray, without which there ought to be no conviction of the crime of bigamy. Secondly, although this argument does not fully apply to the case of one who, after having duly solemnized a marriage, betakes himself to some clandestine and irregular connection; yet it may still be argued, that, as he knew himself to be already married, and consequently for the time incapable of contracting a second marriage, so it ought to be presumed in his favour as long as it reasonably can, and until he take the decisive step of again undergoing the ceremony, that he had no abusive or deceitful purpose in view, but merely intended an intercourse of a different sort, highly immoral in itself, but by no means tantamount to the celebration of a second marriage. Thirdly, a more unfavourable case than either of the former is that of a regular marriage subsequently to some clandestine connection; yet even here it is doubtful whether we have got the proper materials of the crime of bigamy. For, in those anomalous situations where the female has not been in possession of the repute and status of a married woman, but is merely a claimant or pretender to that character, it may be exceedingly doubtful whether, after all, the man intended to marry, notwithstanding what the civil court may have found; and, while such a doubt exists, it may deserve consideration whether the party can be reasonably and consistently held to have committed the particular crime contemplated by the law. But this will scarcely apply to the case where, instead of a secret and ambiguous intercourse, the woman has been supposed and held to have been in the full and continued enjoyment, not only of that degree of repute which a civil court might possibly sustain as sufficient to entitle her to the legal character and privileges of a wife, but of that public and invariable character which prevents any doubt being raised as to the understood relation of the parties. So much for the form of the two marriages. The other qualities which must unite in the first marriage to bring it under the safeguard of the law are, 1. That it must be a lawful marriage, such as has not been contracted in contempt of any injunctions of law relative to proximity of kindred or previous conviction of adultery; and, 2. That it be not only a lawful, but a subsisting marriage, the parties living together lawfully married and undivorced. In every case the second marriage is null from being contracted during the subsistence of a previous one; and if it be also an incestuous, adulterous, or otherwise forbidden marriage, this additional aggravation cannot alter the character or shelter from the pains of the crime of bigamy. Further, it is obvious that, according to the circumstances of the case, the guilt of this offence may either be chargeable exclusively against one of the parties, in whose person there is a double marriage; or it may be the common guilt of both the parties to the second marriage, although to one of them it may be a first marriage. (Hume's *Commentaries*, vol. i. p. 459 *et seq.*)

Bigbone Lick || Biggar.

BIGBONE LICK, a district in Kentucky, so called from the number of bones of the *mastodon* and *elephas primigenus* there discovered in the gravel resting on the clay of a swampy soil.

BIGGAR, a town and parish of Scotland, in the county of Lanark. The town is small, but the main street, though

Biggleswade || Bijanagur.

irregular, is broad and spacious. The only building worthy of notice is the church, which was collegiate, and founded in 1545, by Malcolm Lord Fleming, who liberally endowed it. The parish contains vestiges of three Roman camps and a large tumulus. The remains of Biggar Castle are situated in a bog about a quarter of a mile south of the town. Biggar is distant from Edinburgh twenty-seven miles S.W. Pop. of town (1851) 1530.

BIGGLESWADE, a market-town in the county of Bedford, forty-five miles from London. It is agreeably situated on the river Ivel, by which the town and neighbourhood are supplied with abundance of coal, timber, and merchandise. The land near it is remarkably prolific; and being cultivated chiefly as gardens, it yields abundant crops of culinary vegetables, and a large supply of seeds for the London seedsmen. Market-day Wednesday. Pop. (1851) 3976.

BIGHORN RIVER, in North America, is said to rise in the Rocky mountains, near the Yellow Stone river and the sources of the Platte, and then to find its way through the eastern range of the Rocky mountains. Taking a northerly direction, it falls into the Yellow Stone river in about the 47th degree of north latitude. In its long course it receives two considerable rivers, one from the west and the other from the south; and being unobstructed by falls, it is navigable for canoes to a great distance, through a fine, rich, open country, well supplied with timber.

BIGHT (Dutch *bogt*, participle of *boogen*, to bend), a bend in the sea-coast, forming an open bay; also a round of a rope or cable when coiled.

BIGNON, JEROME, a French writer, was born at Paris in 1590. Under the care of his father he early acquired uncommon knowledge in philosophy, mathematics, history, civil law, and divinity; and had almost completed his studies at an age when it is usual to send children to school. At ten years of age he gave the public a specimen of his learning in a *Description of the Holy Land;* and two years after he published a *Discourse concerning the principal Antiquities and Curiosities of Rome*, and a *Summary Treatise concerning the Election of Popes*. Henry IV. desired to see him, and appointed him page to the dauphin, who was afterwards Louis XIII. At this time he wrote a treatise on the precedency of the kings of France, which he dedicated to Henry IV., by whom he was ordered to continue his researches on the subject; but the death of that prince interrupted his design. In 1613 he published the *Formulæ of Marculphus*. In 1620 he was made advocate-general in the grand council, and discharged that post with such reputation that the king nominated him some time afterwards counsellor of state, and at last advocate-general in the parliament. He resigned his offices in 1641, and the year following was appointed principal keeper of the king's library; but he was obliged to resume his office of advocate-general, which he continued to hold till his death in 1656.

BIGNONIA, a genus of magnificent shrubs. See BOTANY.

BIGOT, a person obstinately and perversely wedded to some opinion or practice, particularly of a religious nature. Camden has probably hit upon the true origin of the word. He relates, that when Rollo, Duke of Normandy received Gisla, the daughter of Charles the Simple, in marriage, together with the investiture of that dukedom, he would not submit to kiss Charles's foot; and when his friends urged him by all means to comply with that ceremony, he made answer in his peculiar dialect, "NE SE, BY GOTT;" upon which the king and his courtiers, deriding him, and corruptly repeating his answer, called him *bigot:* hence the Normans were called *bigods*, or *bigots*.

BIJANAGUR, an ancient city in the south of India, in the Balaghaut ceded territories, once the capital of a great Hindu empire, though now in ruins. It is situated on the south bank of the Toombuddra river, directly opposite to Annagoondy. The city has been inclosed with strong stone walls on the east side, and is bounded by the river on the west, the circumference of the whole appearing to be about eight miles. The streets of this city, from thirty to forty yards wide, can be traced between the immense piles of rocks crowned with pagodas; and one street yet remains perfect. The building of this metropolis was begun in 1336. Between the sovereigns of the principality of which it was the capital, and the Mahommedan sovereigns of the Deccan, constant hostility was maintained; and in 1564, Ram Rajah, the sovereign of Bijanagur, was totally overthrown on the plains of Tellicotta, by a combination of four Mahommedan sovereigns of the Deccan, who immediately marched to the metropolis, which they abandoned to pillage; and since this period it has lain in ruins. Travelling distance from Calcutta, 1120 miles. Lat. 15. 19. Long. 76. 32.

Bilbao

BILBAO (*i. e.* "the beautiful bay"), a city of Spain, capital of the province of Viscaya (Biscay), is situated in a small and fertile plain bounded on three sides by mountains, on the banks of the river Nervion (or, as it is called in the Basque language, Ibaizabal), six miles from its mouth. This river, which divides the old town from the new, is crossed by an ancient stone bridge of two arches, and also by a modern suspension bridge. The houses in the principal streets are built of hewn stone, several stories in height, with projecting eaves, which throw a deep shadow. The streets have an air of cleanliness and quiet, no waggons or carts being permitted to enter the town. The transport of goods is carried on by means of trucks. The principal public buildings are the churches and monasteries, a spacious hospital with 600 beds, town-hall, custom-house, charity-house, theatre, a new college, and a fine *abattoir* of Tuscan architecture. Of the educational institutions, the principal are, the *Colegio General de Vizcaya;* the schools supported by the board of trade for affording gratuitous instruction in design, architecture, languages, and mathematics; a nautical academy; besides several other public schools, and twenty-four private academies. Pop. about 15,000, chiefly engaged in agriculture, trade, and the iron manufacture. It may be mentioned that the women of the humbler class are much employed in masculine occupations, such as carrying burdens, &c., for which they are well fitted by their robust and vigorous frames. The climate of Bilbao, though humid, is on the whole healthy, though pulmonary diseases are somewhat frequent. The *Arenal*, which is a favourite promenade, extending along the right bank of the Nervion, is ornamented with rows of fine trees, and diversified with houses, gardens, warehouses, &c. The other favourite walks are the *Campo Volantin*, to the north of the Arenal; and the *Paseo de los Caños*, so called from its forming the roof of the great aqueduct for conveying the water of the river to the town.

Bilbao is the principal seat of foreign commerce in the north of Spain. The tide ascends as high as the town, but the river is only navigable for small vessels above the port of Portugalete, at its mouth. The average value of the exports, consisting chiefly of wool, iron, hardwares, fire-arms, wheat, wine, oil, fruit, chestnuts, madder, &c., is estimated by Madoz at about L.500,000, of which sum about one-fourth is of native and colonial produce. The average value of the imports—including cotton and woollen stuffs, hemp, sheet-iron, steel, coffee, sugar, &c.—is, according to the same authority, about L.156,000, of which about the half is foreign. Principal manufactures, hardware, woollens, paper, hats, leather, copper goods, &c. The iron-mines in the vicinity are very productive; and Bilbao sword-blades have long been celebrated. Lat. 43. 15. N. Long. 2. 56. W.

Bilbao was founded A.D. 1300, by Don Diego Lopez de Haro. At the end of the fifteenth century it was considered of sufficient importance to supersede Burgos as the seat of the *Consulado*, or supreme tribunal of commerce. During the Peninsular war Bilbao was sacked by the French, and

in the recent Carlist wars it twice sustained severe sieges. See SPAIN. (Madoz, *Dicionario de España;* Ford, *Handbook of Spain.*)

BILBOES, a punishment at sea, answering to that of the stocks on land.

BILDERDYK, WILLEM, a Dutch poet and historian, born at Amsterdam in 1756. His best known productions are his poem on *The Love of Fatherland*, his translation of the *Œdipus Tyrannus* of Sophocles, his *Buiten Lieven*, or *Rural Life*, and *The Destruction of the First World.* He was pensioned by Louis, King of Holland; but neglected by the succeeding government. His *History of Holland* was edited by M. Tydemann after his death, which occurred at Haarlem in 1831.

BILDULGERID. See BLED-EL-JEREED.

BILFINGER, GEORG BERNHARD, was born on the 23d of January 1693, at Canstadt in Wirtemburg. His father was a Lutheran minister. By a singularity of constitution, hereditary in his family, Bilfinger came into the world with twelve fingers and twelve toes. An amputation happily corrected this deformity. Bilfinger, from his earliest years, discovered the greatest inclination to learning. He studied in the schools of Blaubeuern and Bobenhausen, and afterwards entered into the theological seminary of Tübingen. The works of Wolf, which he studied in order to learn mathematics, soon inspired him with a taste for the Wolfian philosophy and that of Leibnitz; a passion which made him neglect for some time his other studies. Returning to theology, he wished at least to try to connect it with his favourite science of philosophy; and in this spirit he composed a tract entitled *De Deo, Anima, et Mundo.* This work, filled with new ideas, met with great success, and contributed to the advancement of the author, who was appointed soon after to the office of preacher at the castle of Tübingen, and of reader in the school of theology; but Tübingen was now become too small a theatre for him. He obtained from his friends in 1719 a supply of money, which enabled him to spend some time at Halle, in order to attend the lectures of Wolf; and, after two years of study, he returned to Tübingen, where the Wolfian philosophy was not yet in favour. He found his protectors there cooled, saw his lectures deserted, and perceived himself shunned, from the dislike of his new doctrines: his ecclesiastical views also suffered from the same cause. By the intervention of Wolf, he received an invitation to Petersburg, where Peter I. wished to appoint him professor of logic and metaphysics, and member of his new academy. He was received in that city, where he arrived in 1725, with the consideration due to his abilities. The Academy of Sciences of Paris having proposed about this time the famous problem on the cause of gravity, Bilfinger gained the prize, which was a thousand crowns. The reputation of this success was spread among the learned of Europe; and the Duke Charles Edward of Wirtemburg, finding that the author of this admired memoir was one of his subjects, hastened to recal him into his dominions. The court of Russia, after having made some useless attempts to detain him, granted him a pension of four hundred florins, and a present of two thousand, in reward of an invention relative to the art of fortification. He quitted Petersburg in 1731. Returned to Tübingen, Bilfinger soon excited considerable attention in that quarter, both by his own lectures, and by the changes which he introduced into the school of theology. After his return to Tübingen, the Duke Charles Alexander appointed him privy counsellor in 1735. This nomination was not a simple honorary title. Bilfinger saw himself raised at once to a power almost unlimited. He resisted some time a promotion for which he did not think himself qualified. In accepting office his first care was to acquire the knowledge necessary to the discharge of its duties. He employed almost two years in assiduous labour to instruct himself thoroughly in the statistics of the country, its political situation, its constitution, and its interests; and became, at the end of all this study, one of the most enlightened ministers that his country had yet produced. Bilfinger was placed in a situation too elevated not to excite jealousy and hatred. He felt it, and wished to quit the ministry; but the court refused to receive his resignation, soon after the tender of which the duke died. Bilfinger received from his successor all the consideration and all the friendship which he had experienced in the beginning of his career. Enjoying a confidence without bounds, he had the power to realize, without obstacle, those plans of administration with which the most enlightened patriotism had inspired him; and Wirtemburg still feels the happy influence of his ministry. Commerce, public instruction, and agriculture, flourished under his care. The culture of the vine, of so much importance in that country, was one of the principal objects of his attention. We ought not to forget that he was the original author of that strict union which has long united Wirtemburg and Prussia, and of the importance to which the hereditary prince of Wirtemburg was raised at the court of Berlin. He has been reproached with being irascible; but, in spite of some slight blemishes, the memory of Bilfinger will be always dear to his countrymen, and honoured by all Germans. Wirtemburg reckons him among the greatest men which she has produced, and proposes him as a model to her statesmen and her men of letters. He was never married, and left no issue. He died at Stuttgardt on the 18th of February 1750. His works, besides various papers separately published in the Memoirs of the St Petersburg and Paris Academies of Science, are numerous and valuable. (See *Biographie Universelle*, tom. iv.) (W. H–Z–T.)

BILGE of a ship, the bottom of her floor, or the breadth of the part she rests on when a-ground. *Bilge-water* is that which lodges on her floor below the level of the well of the pump; and *bilge-pumps*, or burr-pumps, are those that carry off the bilge-water. A ship is said to be *bilged* when her bilge is broken in and she springs a leak.

BILGE, the greatest circumference of a cask.

BILL, an instrument of iron, with an incurvated edge, and fitted with a handle. It is used by plumbers, basket-makers, and gardeners. Its form varies according to its particular use. When short it is called a *hand-bill*, and when long a *hedge-bill.*

BILL, in *Nautical Language*, the point of the fluke of an anchor.

BILL, in *English Law*, a declaration in writing, expressing either some wrong the complainant has suffered from the defendant, or a fault committed by the person complained of against some law or statute. In Scottish law, every summary application, by way of petition to the Court of Session, is called a *bill.*

BILL, in commerce, has been usually defined a writing in which one man is bound to another to pay a sum of money, on a day that is future, or presently on demand, according to the agreement of the parties at the time when it is drawn; and on which, in the event of failure, execution may be summarily done to enforce payment.

BILL of Exchange. See EXCHANGE; and BOOK-KEEPING.

BILL of Lading, a document by which the master of a ship acknowledges to have received on board in good order and condition certain specified goods laden by some particular shipper, and binds himself to deliver them in like good order and condition (the dangers and accidents of the seas, fire, enemies, &c., excepted) to the assignees of the shipper at the port of destination, on payment of a stipulated freight. Bills of lading are usually drawn out in sets of two, three, or four copies, "one of which bills being accomplished the others stand void." Each of these copies must be written on a sixpenny stamp.

A bill of lading is a negotiable document, and may, like a bill of exchange, be transferred by indorsation, either blank,

Bill of Mortality || Billiards.

or in favour of any particular assignee. The shipmaster is bound to deliver the goods to the holder of the bill of lading, who on his part becomes responsible for the freight stipulated as payable on delivery. If the goods be lost or damaged by any causes not falling within the exception of the "dangers and accident of the seas, &c.," as for instance by improper stowage, the holder of the bill of lading may recover the damages from the master or owners of the ship.

Bills of lading should never be granted till the goods are actually on board, otherwise the shipmaster will be personally liable for their value, failing delivery, to any individual who may have acquired the bill of lading for an onerous consideration. In a recent case of this nature it was decided that the *owners* of the ship could not be held liable for the value of the goods, on the ground that the shipmaster, in granting bills of lading for goods not on board, was acting beyond the scope of his authority as their agent. (J. W—K.)

Bill of Mortality, a periodical register of the numbers of births and burials within a certain district. See MORTALITY, HUMAN.

Bill in Parliament, a draft of a proposed act or statute, public or private, containing the substance of a measure submitted to parliament, and subject before passing to modifications in the way and manner to be afterwards described, or to rejection. For the parliamentary procedure in bringing in bills, discussing them, and passing them into laws, see PARLIAMENT; STATUTES; LEGISLATION.

BILLERICAY, a market-town, parish of Burstead, hundred of Barstable, and county of Essex, 24 miles from London. It is situated on an elevated plain, commanding a fine view of the rich vale of the Thames. Pop. (1851) 1533.

BILLET, in *Heraldry*, a bearing of an oblong form.

BILLETING, the quartering or lodging of soldiers in private houses, by billets or tickets.

BILLETON, an island of the East Indies, belonging to the Dutch, situate between Sumatra and Borneo, in Lat. 3. S. Long. 108. E. It is of a circular form, about 50 miles in length by 45 in breadth; and is rich in wood, iron ore, and tin. It has a population of about 6000, and is much infested by pirates.

BILLIARDS, a well-known game, played on a rectangular table with ivory balls, which are driven into hazards or holes, according to certain rules. This game was invented by the French, and was originally played in a manner different from that which is at present practised, by having a pass or iron fixed on the table, through which the balls at particular periods of the game used to be played; but this method is now quite disused.

The table on which the game is played is generally about twelve feet long and six feet wide, in the exact form of an oblong: it is covered with fine green cloth, and surrounded with cushions to prevent the balls running off, and to cause them to rebound. There are six holes, nets, or pockets, fixed at the four corners, and in the middle, opposite to each other, to receive the balls, which when driven into them are called hazards. The making of a hazard, that is, putting the adversary's ball in, at the usual game reckons for two in favour of the player. The game is played either with maces or with cues. The first is a long straight stick, with a head at the end; the second is a thick stick, diminishing gradually to a point of about half an inch diameter or less; and this instrument is played over the left hand, and supported by the fore-finger and thumb.

The rules generally observed at the common game are these:—1. For the lead, the balls must be put at one end, and the players must strike them against the farthermost cushion, in order to see which will be nearest the cushion that is next to them. 2. The nearest to the cushion is to lead and choose the ball if he pleases. 3. The leader is to place his ball at the nail, and not to pass the middle pocket; and if he holes himself in leading he loses the lead. 4. He who follows the leader must stand within the corner of the table, and not place his ball beyond the nail. 5. He who plays upon the running ball loses one. 6. He who touches the ball twice and moves it loses one. But these two rules are seldom or never enforced, especially in England. 7. He who does not hit his adversary's ball loses one. 8. He who touches both balls at the same time makes a foul stroke, in which case, if he should hole his adversary, nothing is gained by the stroke; but if he put himself in he loses two. 9. He who holes both balls loses two. 10. He who strikes upon his adversary's ball and holes himself loses two. 11. He who plays at the ball without striking it, and holes himself, loses three. 12. He who strikes both balls over the table loses two. 13. He who strikes his ball over the table, and does not hit his adversary's ball, loses three. 14. He who retains the end of his adversary's stick when playing, or endeavours to baulk his stroke, loses one. 15. He who plays another's ball or stroke, without leave, loses one. 16. He who takes up his own ball, or his adversary's, without leave, loses one. 17. He who stops either ball, when running, loses one; and if it be near the hole, loses two. 18. He who blows upon the ball when running, loses one; and if near the hole, loses two. 19. He who shakes the table when the ball is running loses one. 20. He who strikes the table with the stick, or plays before his turn, loses one. 21. He who strikes his stick upon the table, and hits the ball, loses one. 22. If the ball stand upon the edge of the hole, and, after being challenged, fall in, it is nothing, but must be put up where it was before. 23. If any person, not being one of the players, stop a ball, the ball must stand in the place where it was stopped. 24. He who plays without a foot upon the floor, and holes his adversary's ball, gets nothing for it, but loses the lead. 25. He who leaves the game before it is ended loses it. 26. Any person may change his stick in play. 27. If any difference arise between players, he who marks the game, or the majority of the company, must decide it. 28. Those who do not play must stand from the table, and make room for the players. 29. If any person lay any wager, and does not play, he shall not give advice to the players upon the game.

Billiards.

Besides the common winning-game, which is twelve up, there are several other kinds of games, viz., the losing-game, the winning and losing, choice of balls, bricole, carambole, Russian carambole, the bar-hole, the one-hole, the four-game, and hazards.

The *losing-game* is the common game nearly reversed; that is to say, except hitting the balls, which is absolutely necessary, the player gains by losing. By putting himself in he wins two; by putting his adversary in he loses two; but if he pockets both balls he gets four. The *winning and losing game* is a combination of both games; that is to say, all balls that are put in by striking first the adversary's ball reckon towards game; and holing both balls reckons four. *Choice of the balls* is choosing each time which ball the player pleases. *Bricole* is being obliged to hit the cushion, and cause the ball to rebound, or return to hit the adversary's ball, otherwise the player loses a point. *Carambole* is a game introduced from France. It is played with three balls, one red, which is neutral, and is placed on a spot in a line with the stringing nail, or that part of the table from which the player strikes his ball at setting off, and which is marked on the edge of the table with two brass nails. Each antagonist, at the first stroke of a hazard, plays from a mark which is upon a line with it at the other end of the table. The chief object at this game is, for the player to hit with his own ball the two other balls, which is called a carambole, and by which the player wins two. If he puts in the red ball he gets three; and when he holes his adversary's ball he gets two; so that seven may be made at one stroke, by caramboling and putting in both balls. *Russian carambole* is played in the following manner: The red ball is placed as

Billon ‖ Bilson.

usual on the spot for that purpose; but the player, when he begins, or after having been holed, never places his ball on any particular place or spot, being at liberty to put it where he pleases. When he begins to play, instead of striking at the red ball, he leads his own gently behind it, and his antagonist is to play at which he thinks proper. If he plays at the red ball and holes it, he scores three as usual towards the game, which is twenty-four instead of sixteen points; and the red ball is put upon the spot again, at which he may strike a second time, or take his choice which of the two balls to push at, always following his stroke till both balls are off the table. He is entitled to two points each time that he caramboles, the same as at the other game; but if he caramboles, and puts his own ball into any hole, he loses as many as he might have got had he not holed himself. In other respects it is played like the common carambole game. The *bar-hole* is so called from the hole being barred which the ball should be played for, and the player striking for another hole. The player at the *one-hole*, though it seems to those who are not judges of the game to be a great disadvantage, has in fact the best of it; for as all balls that go into the one hole reckon, the player endeavours to lay his ball constantly before the hole, and his antagonist frequently finds it very difficult to keep one or other ball out, particularly on the leads, when the one-hole player lays his ball on the brink of the hole. The *four-game* consists of two partners on each side, at the common winning game, who play by succession after each hazard, or two points lost. *Hazards* are so called because they depend entirely upon the making of hazards, there being no account kept of any game. The only general rule here is not to lay any ball at hazard for the next player.

BILLON, in *Numismatics*, a composition of precious and base metal, in which the latter predominates.

BILMA, a town situated in the heart of the African desert, and the capital of the wandering tribe called the Tibboos. The place is mean and poor, surrounded with a mud wall. In its vicinity are a number of lakes, the waters of which, on evaporation by the heat of the sun, yield a quantity of very pure and fine salt. The largest of these lakes is at Agram, situated about four miles to the westward. This salt is the object of a very extensive and important trade, which consists in conveying the commodity to the countries in Central Africa. The Tibboos, however, an unwarlike race, are unable to secure to themselves the enjoyment of these natural treasures, but have the chagrin of seeing the Tuaricks, their neighbours, come and load their camels with this valuable article, which they then convey to the countries in the south. Near Bilma is a small circular spot, in which several springs bubble up, and maintain a brilliant verdure; but immediately to the south begins the most dreary part of the African desert, over which the caravans travel for fifteen days without discovering the slightest trace of vegetable life.

BILSAH, a town of Hindustan, in the territory of Gwalior or the possessions of Scindia, situated on the Betwah river. It is inclosed with a stone wall, defended by square towers and a ditch. The suburbs without the walls are not very extensive; but the streets are spacious, and contain some good houses. The town and the surrounding country are celebrated all over India for the excellent quality of the tobacco, which is bought up with great eagerness and exported. Pop. about 3000. Distance south from Gwalior 190 miles. Lat. 23. 30. Long. 77. 50.

BILSON, Thomas, bishop of Winchester, was born in that city in 1536. He was successively fellow of New College, Oxford, master of Winchester School, prebendary of the cathedral, and warden of Winchester College. In 1596 he was consecrated bishop of Worcester; and next year translated to the see of Winchester, and sworn of Queen Elizabeth's privy council. He was one of the principal managers of the Hampton Court conference in 1604; and he was the colleague of Dr Miles Smith, bishop of Gloucester, in the revision of the new edition of the Bible. He died in 1616, and was buried in Westminster Abbey. Bishop Bilson bore the character of a learned divine, an able civilian, and an upright man.

Bilston ‖ Binary Arithmetic.

His principal works are entitled, *The true difference between Christian Subjection and Unchristian Rebellion*, Oxf. 1585, 4to, Lond. 1586, 8vo; *The Perpetual Government of Christ's Church*, Lond. 1593, 4to, black letter; *The effect of certain Sermons touching the full redemption of mankind by the death and blood of Christ, &c.*, Lond. 1599, 4to; *The survey of Christ's suffering for man's redemption, and of his descent to Hades or Hell*, Lond. 1604, fol.

BILSTON, a market-town of England, in the parish of Wolverhampton, hundred of Leisdon, and county of Stafford; $2\frac{1}{2}$ miles S.E. of Wolverhampton. Bilston is chiefly indebted for its importance to the iron trade, for which it possesses many advantages. In the vicinity are very productive mines of coal and ironstone, as well as sand of the finest quality for casting. Its productions also find a ready exit by means of canals to London, Liverpool, Bristol, &c.; and the Willenhall station of the London and Birmingham railway is within $1\frac{1}{2}$ miles of the town. It has numerous furnaces, forges, rolling and slitting mills, for the preparation of iron. The town itself is very irregularly built; but has some handsome buildings, as St Leonard's and St Mary's chapels, and the Roman Catholic chapel. Bilston suffered severely from the cholera in 1832 and 1849. Pop. (1851) 23,527.

BIN (Saxon *binn* or *binne*), a chest for holding bread, corn, or other provisions. The open subdivisions for bottles in a wine-cellar are also called bins.

BINACLE, or Binnacle (formerly *Bittacle*, from the French *habitacle*), a wooden case or box in which the compasses are kept on board a ship, with lights to show the compass at night.

BINARY ARITHMETIC, that kind of notation in which unity or 1 and 0 only are used. This was the invention of Leibnitz, who shows it to be very expeditious in discovering the properties of numbers and in constructing tables; and M. Dangecourt, in the History of the Royal Academy of Sciences, gives a specimen of it concerning arithmetical progressionals, where he shows, that because in binary arithmetic only two characters are used, therefore the laws of progression may be more easily discovered by it than by common arithmetic. All the characters used in binary arithmetic are 0 and 1; and the cipher multiplies every thing by two, as in the common arithmetic by 10. Thus 1 is one; 10, two; 11, three; 100, four; 101, five; 110, six; 111, seven; 1000, eight; 1001, nine; 1010, ten; which is founded on the same principles with common arithmetic. Hence appears the reason of the celebrated property of the duplicate geometrical proportion in whole numbers, namely, that one number of each degree being taken, we may thence compose all the other whole numbers above the double of the highest degree. For example, 111 being the sum of 4, 2, and 1, or, analytically, of $100 = 4$, $10 = 2$, and $1 = 1$, or 7 in all, this property may serve assayers to weigh all kinds of masses with a little weight; and may be used in coins, to give several values with small pieces. The binary method of expressing numbers once established, all the operations will be easy; in multiplication, particularly, there will be no need for a table, or getting anything by heart. But the inventor does not recommend it for common use, because of the great number of figures required to express a number; adding, that if the common progression were from 12 to 12, or from 16 to 16, it would be still more expeditious; and that its use consists chiefly in discovering the properties of numbers, in constructing tables, and the like. What makes the binary arithmetic the more remark-

Binary Measure || Biography.

able is, that it appears to have been the same with that used four thousand years ago among the Chinese, and left as an enigma by Fohi, the founder of their empire as well as of their sciences.

Binary Measure, in *Music*, is a measure which is beaten equally, or where the time of rising is equal to that of falling. This is usually called *common time*.

Binary Number is that which is composed of two units.

BINGEN, a town in the grand duchy of Hesse-Darmstadt, province of Rhenish Hesse, and fifteen miles west of Mentz. It is pleasantly situated on the left bank of the Rhine, where that river receives the Nahe. It has a considerable trade in wine, grain, and cattle, and manufactures leather and tobacco. Pop. 4500.

BINGHAM, Joseph, a learned scholar and divine, born at Wakefield in Yorkshire, in September 1668; educated at University College, Oxford; and afterwards, by John Radcliffe, M.D., presented to the rectory of Headbournworthy, near Winchester. In this country retirement he began his laborious and valuable work entitled *Origines Ecclesiasticæ*, or Antiquities of the Christian Church, the first volume of which appeared in 1708. It was completed by the publication of the tenth volume in 1722. Notwithstanding his learning and merit, Bingham received no higher preferment than that of Headbournworthy till the year 1712, when he was collated to the rectory of Havant, near Portsmouth, by Sir Jonathan Trelawney, bishop of Winchester. He died August 17. 1723, in his fifty-fifth year.

Bingham, a market-town in the hundred of that name, in the county of Nottingham, 123 miles from London, and 8½ from Nottingham. It is situated in the fertile vale of Belvoir, and consists of two parallel well-paved streets, with a fine Gothic church, and a good market-place, in which a market is held on Thursday. Pop. of parish in 1851, 2054.

BINGLEY, a market-town in the west riding of Yorkshire, on the river Aire, 31 miles W.S.W. of York. The inhabitants in 1851 amounted to 5019, principally engaged in manufactures of worsted, cotton, and paper, which have been much improved during the last ten years. The town is well built and flourishing, and has a neat church, grammar-school, and several charities.

BINK, Jacob, a German engraver, who also designed well; born about 1500. Bartsch describes 98 prints by him. He seems to have died about 1550.

BINOMIAL, in *Algebra*, a root consisting of two factors connected by the sign *plus* or *minus*. Thus $a + b$ and $8-3$ are binomials, consisting of the sums and differences of these quantities. See Algebra.

BINTANG, one of the Dutch East India islands, S.E. of Singapore, in Lat. 1. 5. N. Long. 104. 30. E. It is about 24 miles in length by 12 in breadth, and is surrounded by numerous rocky islets, which render the navigation dangerous. Its principal exports are pepper, rice, and particularly *gambier*, from its chief town Rhio on the S.W. coast. Pop. 15,000.

BIOGRAPHY (*βίος*, life, and *γραφή*, a writing), the history of a life. Of this species of literary composition examples are preserved in the earliest records of antiquity. In Sacred Scripture we have the history of the lives of Abraham, Joseph, David, &c. In the first rank in Grecian literature stand the *Parallel Lives* of Plutarch, which comprise the biographies of forty-six of the most celebrated Greeks and Romans who flourished prior to his own time. The *Lives of the Philosophers* by Diogenes Laertius, the *Lives of Philosophers and Sophists* by Eunapius, and the *Lives of the Sophists* by Philostratus, are the other principal works of this class in the Greek language. Among Roman writers of biography the principal are Cornelius Nepos and Suetonius. Besides these there are other writers whose works, though in a certain degree biographical, more strictly belong to the province of history; as, for example, Sallust's account of the conspiracy of Catiline, the *Commentaries* of Julius Cæsar, and Quintus Curtius's account of the expedition of Alexander. Biography.

In all civilized countries biography has always formed a favourite subject of study. France has been especially prolific in biographical publications, and our own country can show a goodly array of volumes in this department of literature; and, indeed, the same may be said of Italy, Germany, and Spain. To enumerate even the principal works of this class, whether single lives or biographical collections and dictionaries, in any of these languages, would far exceed our limits. We shall therefore content ourselves with a few general reflections on the uses and peculiarities of biographical composition.

It is pleasant no less than instructive to be, as it were, introduced to the companionship of men who have been distinguished in the sphere which they occupied. If they be great and good men, we love to be made acquainted with the motives of their actions, to follow them in their wanderings, to mark the difficulties and the opposition they had to encounter in their honourable struggles through life, the energy and skill by which these were overcome, and the courage that animated them to persevere in their career of usefulness and honour.

If the author honestly exhibit the failings as well as the excellences of his subject, the reader will be warned of the quicksands and dangers that beset the path of life; and should he succeed in portraying aright the attractive lineaments of a virtuous character, he will insensibly arouse in the mind of the reader aspirations after the excellences which he is led to admire. The mind has a tendency to assimilate to the character of those with whom we associate; and to peruse the memoirs of wise and good men is living for the time in their company.

Every man, whatever be his sphere in life, has an influence for good or for evil on the society around him; and he who gives to the world the history of an exemplary life, reproduces in a certain degree the influence which had been extinguished by the hand of death. The biographer not only revives the lost influence, but by the circulation of his narrative he becomes the medium of more extended usefulness, and in some degree a benefactor of mankind.

Where personal character and habits form the principal subject of interest, a stranger stands at too great a distance to give to his portrait a faithful outline or correct colouring: a true picture can only be drawn by one whose friendly intercourse gave opportunity of marking the peculiar characteristics of his subject.

Autobiography, or memoirs of one's self, is preferable to biography only when the writer has something to communicate, by way of confession or explanation, of which no other person is cognisant. But it is almost impossible, nor is it perhaps desirable, that an autobiographer should disclose with unflinching impartiality the whole particulars of his life, and unveil the real motives of his actions.

"Thus conscience does make cowards of us all."

Nevertheless, in autobiography concealment itself is a species of disclosure. The moment a man begins to speak of himself, however cautious his mode of expression, the discerning reader will have little difficulty in appreciating his real character and the quality of his actions. What reader is blind to the bad temper, meanness, and impracticableness of Rousseau, notwithstanding his cunning attempts to disguise them? The autobiographer always betrays himself when he least suspects it: he exhibits his greatest weakness when he flatters himself that he is putting forth his strength. The task of the autobiographer is not only delicate but difficult. How frequently does the consciousness of sitting for one's portrait to another alter at once the

whole demeanour; but still more marked is the change when a man becomes the limner of his own mental likeness. In short, the obstacles to a successful execution of this experiment are almost insuperable.

Of autobiographies which interest principally as histories of the mind, the examples are rare; but those which are intended to amuse or instruct, as delineations of the times in which the writer lived, are innumerable. Of biography of all kinds the same may be said. The unparalleled increase of this department of literature in our own time may be regarded as one of the most characteristic features of the age; and, as must therefore be the case, the number of obscure or unimportant lives thus chronicled forms an enormous proportion to the histories that are truly deserving of record.

BIOLOGY (*βίος* and *λόγος*), a term introduced by Treviranus of Bremen, in place of physiology, to signify *the science of life.*

BION *of Smyrna*, a bucolic poet, who flourished about the year B.C. 280. He was an admirable poet, according to the accounts of his disciple Moschus; and the few pieces of his which are extant tend to confirm that opinion. The latter years of his life were spent in Sicily, where he died by poison. The best editions of the poems of Bion, including those of Moschus, are by Fr. Jacobs, Gotha, 1795; Gilbert Wakefield, London, 1795; and that of J. F. Manso, Leipzig, 1807, which contains an elaborate dissertation on his life and poetry, and a German translation.

BION, surnamed *Borysthenites*, a Scythian philosopher, born at Borysthenes. He flourished about B.C. 250, and resided for some time at the court of Antigonus Gonatas, king of Macedonia. He was the son of a freedman, and while young was sold as a slave to a rhetorician, who adopted him as his heir (Diog. Laert. iv.) Athenæus (xiii. c. 293) states that his mother was a Lacedæmonian courtezan named Olympia. He studied at Athens, where he became first an academic and a disciple of Crates, and then a Cynic; and after embracing the tenets of Theodorus the atheist, he finally became a pupil of Theophrastus the peripatetic. Bion was possessed of much natural acuteness; but his habits of life were grossly profligate. The keenness of his satire is alluded to by Horace, *Epist.* ii. 2. 60.

BIPES, a genus of reptiles, in which the hind feet alone are visible. See REPTILES.

BIQUADRATE, or BIQUADRATIC, is the next power above the cube, or the square multiplied by itself.

BIQUADRATIC EQUATION, an equation raised to the fourth power, or where the unknown quantity of one of the terms has four dimensions. Thus $x^4 + ax^3 + bx^2 + cx + d = 0$ is a biquadratic equation. See ALGEBRA.

BIQUADRATIC Parabola, in *Geometry*, a curve line of the third order, having two infinite legs tending the same way.

BIQUADRATIC Power of any number is the fourth power, or squared square of that number. Thus 16 is the biquadratic power of 2; for $2 \times 2 = 4$ and $4 \times 4 = 16$.

BIQUADRATIC Root of any number is the square root of the square root of that number. Thus the biquadratic root of 81 is 3; for the square root of 81 is 9, and the square root of 9 is 3.

BIR, or BEER, a town of Asiatic Turkey, in the government of Orfa. It occupies an elevated situation on the left bank of the Euphrates, which is here about 130 yards broad, deep and rapid, and is crossed by a bridge of boats. The town consists of about 2000 houses, mostly in a decaying state, and is protected by a citadel, which stands on a precipitous eminence, and by a wall in a dilapidated condition. Bir is a considerable thoroughfare from Aleppo to Orfa, Diarbekr, and Persia, and a considerable trade was formerly carried on to Baghdad by vessels descending the river. It is 144 miles N.E. of Aleppo, and 115 S.W. of Diarbekr. Long. 38. 6. E. Lat. 36. 48. N.

BIRBHOOM, a British district of Hindustan, in the province of Bengal, situated between Lat. 23. 32. and 24. 40. Long. 86. 25. and 88. 30., and containing an area of 4730 square miles, with a population of 1,040,876. Along the courses of the rivers Damooda and Hadjee, which traverse the southern and western parts of the district, coal and iron ore are found in large quantities. The district was acquired by the East India Company in 1765, by virtue of the grant of the emperor of Delhi. (E. T.)

BIRCH, THOMAS, D.D., a laborious and voluminous historical and biographical writer, born in London in 1705. His parents were Quakers; and his father was by trade a coffee-mill maker. By his unremitting diligence in his studies, though he had not the advantage of a university education, he soon became qualified to take holy orders in the Church of England. In 1728 he married the daughter of the Rev. Mr Cox, to whom he was curate; but in less than a year this lady died in childbed. In 1732 he was recommended to the friendship and favour of the Lord Chancellor Hardwicke, then attorney-general, to whom, and to the succeeding Earl of Hardwicke, he was indebted for all his preferments. In 1732 he obtained the living of Ulting in Essex; and in 1734 was appointed one of the domestic chaplains to the unfortunate Earl of Kilmarnock, who was beheaded in 1746. He became a member of the Royal Society in February 1734–35, and of the Society of Antiquaries in December 1735; and was afterwards director of the latter, which office he held till his death. Previously, the Marischal College of Aberdeen had conferred on him the degree of master of arts. In 1743, through the interest of Lord Hardwicke, he was presented by the crown to the sinecure rectory of Landewy Welfrey, in Pembrokeshire; and in 1743–44 he was preferred to the rectory of Sidington in St Peter's, in the diocese of Gloucester; but he appears to have quitted this charge almost immediately. On the 24th of February 1743–44, he was appointed to the united rectories of St Michael Woodstreet and St Mary Staining; and in 1745–46 to the united rectories of St Margaret Patens and St Gabriel, Fenchurch Street. In January 1752 he was elected one of the secretaries of the Royal Society. In 1753 the Marischal College of Aberdeen created him doctor of divinity; and in that year the same degree was conferred on him by Archbishop Herring. He was one of the trustees of the British Museum, for which honour he was probably indebted to the Earl of Hardwicke, as he also was for his last preferment, the rectory of Depden in Essex, to which he was inducted in February 1761. In the latter part of his life he was chaplain to the Princess Amelia. In 1765 he resigned his office of secretary to the Royal Society. His death was caused by a fall from his horse, or perhaps by a fit of apoplexy, on the road between London and Hampstead, in the sixty-first year of his age. Dr Birch bequeathed his library of books and manuscripts, and all his pictures and prints not otherwise disposed of by his will, to the British Museum. He likewise left about L.500, to be laid out in government securities, for the purpose of applying the interest to increase the salaries of the three assistant librarians.

His principal publications were, 1. The General Dictionary, Historical and Critical, including a new translation of Bayle, and interspersed with several thousand new lives, in ten volumes folio. 2. Dr Cudworth's Intellectual System, improved from the Latin edition of Mosheim; his Discourse on the true Notion of the Lord's Supper; and two Sermons, with an account of his Life and Writings, 2 vols. 4to, 1743. 3. The Life of the Honourable Robert Boyle, 1744, prefixed to an edition of that philosopher's works. 4. The Lives of Illustrious Persons of Great Britain, annexed to the engravings of Houbraken and Vertue, 1747–1752. 5. An Inquiry into the share which King Charles I. had in the Transactions of the Earl of Glamorgan, 1747, 8vo. 6. An edition of Spenser's Faery Queen, 1751, 3 vols. 4to, with prints from designs by

Birch ‖ Bird's-Nests.

Kent. 7. The Miscellaneous Works of Sir Walter Raleigh, with his Life, 1751, 2 vols. 8vo. 8. The Theological, Moral, Dramatic, and Poetical Works of Mrs Catherine Cockburn, with a Life, 1751, 2 vols. 8vo. 9. The Life of Dr Tillotson, Archbishop of Canterbury, compiled chiefly from his original Papers and Letters; 1762, 8vo. 10. Milton's Prose Works, 1753, 2 vols. 4to, with a Life. 11. Memoirs of the Reign of Queen Elizabeth, from the year 1581 till her death; from the original papers of his intimate friend Anthony Bacon, Esq., and other MSS.; 1754, 2 vols. 4to. 12. The History of the Royal Society of London, from its first rise; 1756 and 1757, 4 vols. 4to. 13. The Life of Henry Prince of Wales, eldest son of James I., compiled chiefly from his own papers and other MSS., 1760, 8vo. His numerous communications to the Royal Society may be seen in the *Philosophical Transactions*.

BIRCH. See PLANTING and *Index*.

BIRD, WILLIAM, an eminent English composer, and one of the best organists of his time, was born about 1546, and died at London, 4th July 1623. He was organist of Lincoln cathedral in 1563; and in 1575 he and his master Tallis were gentlemen of the chapel royal, and organists to Queen Elizabeth. Bird was the earliest English composer of madrigals; and among his numerous sacred compositions, some are still much esteemed. His vocal canon *Non nobis Domine* is well known, and often sung. In his compositions there is a freedom and elegance rarely found in the music of that period. (G. F. G.)

BIRD. See ORNITHOLOGY.

BIRD'S-EYE VIEW, a perspective representation of objects as they appear when viewed from above.

BIRD-*Lime*, a viscid substance used for snaring birds. It is usually prepared by boiling holly bark ten or twelve hours; and when the green coat is separated from the other, it is covered up for a fortnight in a moist place; then pounded into a tough paste, and washed in a running stream till no motes appear. It is next put up to ferment for four or five days, and repeatedly skimmed. To prepare it for use, a third part of nut-oil, or thin grease, must be incorporated with it over the fire.

BIRDS, in *Heraldry*, according to their several kinds, represent either the contemplative or active life. They are the emblems of liberty, expedition, readiness, swiftness, and the like, and are therefore more honourable bearings than fishes. Birds must be borne in coat-armour, as is best fitting the propriety of their natural actions. Such as are either whole-footed, or have their feet divided, and yet have no talons, are said to be *membered;* but the cock, and all birds of prey with sharp and hooked beaks and talons for encounter or defence, are said to be *armed*. In the blazoning of birds, if their wings be not displayed, they are said to be borne close.

Bird's-Nests, Edible, the nests of a small Indian swallow, which are eaten as a delicacy. These birds abound on the sea-coasts of China and in Java at certain seasons of the year. They build in the rocks, and fashion their nests out of a gelatinous matter which they find on the shore. According to Kempfer, this substance is molluscæ or sea-worms; M. le Poivre supposes it to be fish-spawn; and according to Linnæus, it is a kind of medusa or jelly-fish. The nests are hemispherical, of the size of a goose's egg, and in substance much resemble ichthyocolla or isinglass. They are sent to all parts of the world, and are highly prized as a luxury. They abound in Sumatra, particularly about Croe, near the south end of the island. Four miles up the river of that name is a large cave, where the birds build in vast numbers. The nests are distinguished into white and black; but of these the former are more scarce and valuable, being found in the proportion of only one to twenty-five. According to Marsden's account, the white nests sell in China at the rate of 1000 to 1500 Spanish dollars the pecul; the black are disposed of at Batavia for about twenty dollars the same weight, and manufactured into glue. The difference of colour is said to be owing to the admixture of feathers. By steeping for a short time in hot water, the black nests are said to become in a great degree white. The natives enter the caves with torches, and by means of a ladder made of a single bamboo notched, they take the nests, which adhere in masses from the side and top of the rock. The more frequently and regularly the cave is stripped, the greater proportion of white nests is found; for which reason they destroy the old nests, in order that they may find their place supplied by white nests the next season. (See also Crawfurd's *Eastern Archipelago*, vol. iii. p. 432; and Count Hogendorp's *Coup d'Œil sur l'Ile de Java*, p. 291.)

Biren ‖ Birken-head.

BIREN. See ANNA IVANOVNA, and RUSSIA.

BIRGUS, a species of land crab, or crustaceous animal, that can live either on land or under water, having respiratory organs fitted for both modes of existence. The most remarkable is *B. latro*, that climbs cocoa trees to prey on the fruit, a native of Amboyna. This species is described by Cumming as inhabiting the islands in the Pacific, and we know that *B. laticauda* is found in Mauritius.

BIRKBECK, GEORGE, an English physician and philanthropist, born in Yorkshire in 1776. He early evinced a strong predilection for scientific pursuits; and shortly after graduating as doctor of medicine, he was appointed to the chair of natural philosophy at the Andersonian Institution of Glasgow. In 1804, with a view to the improvement of the working-classes of that town, he delivered for their behoof a gratuitous course of scientific lectures. From Glasgow he removed to London, where he endeavoured to prosecute his philanthropic schemes, at first without obtaining much encouragement, but ultimately with marked success. In 1827 he contributed to found the Mechanics' Institute. His coadjutors in this undertaking were Bentham, Wilkie, Cobbett, and other distinguished men. He was appointed director of the Institute, which he had originally endowed with the sum of L.3700. This office he held till his death, which took place on the 1st December 1841.

BIRKENHEAD, SIR JOHN, a political writer, born about 1615. He suffered imprisonment several times during the Commonwealth, for writing in favour of the exiled king. He was one of the earliest English journalists, having conducted a kind of weekly gazette, entitled *Mercurius Aulicus*, in one or more quarto leaves, from 1st January 1642 until the end of 1645. At the Restoration he received various preferments for his loyalty, and was elected member of parliament for Wilton. He died in 1679.

BIRKENHEAD, a seaport, market-town, and township in the union and lower division of the hundred of Wirrall, south division of Cheshire. It is situated on the river Mersey, opposite to and about $\frac{3}{4}$ of a mile west from Liverpool by ferry, 16 miles from Chester, and 202 from London. It comprises the ancient extra-parochial district or chapelry of Birkenhead, the former township of Claughton in Bidstone, and part of Oxton in Woodchurch. Birkenhead is of considerable antiquity. In 1150 a priory was founded in honour of St Mary and St James, by Harris de Massey, third baron of Durham-Massey, which had considerable endowments. The priors sat in the parliaments of the Earls of Chester, and enjoyed all the dignities and privileges of palatinate barons. The revenues of the priory were valued at the Reformation at L.90, 13s. according to Dugdale, but Speed makes it L.102, 16s. 10d. Of the priory building nothing now remains but a portion of the ivy-covered gable and Gothic window of the refectory. The priory-house—which was garrisoned by the royalists and captured by the parliamentary troops in 1644—was pulled down in 1843.

From an obscure fishing village, Birkenhead has become a large and important town with a rapidity truly marvellous. In 1818 the village consisted of the priory, the priory-house, three other houses, and a few cottages, and its population was not more than 50. In 1821 the population was 200,

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in 1831 it was 2569, in 1841 it was 8227, and in 1851 it had risen to 24,175, with 3228 houses, and 503 buildings in course of erection. In 1823 the annual value of the assessable property was L.3101, and in 1847 it amounted to L.114,301.

The town of Birkenhead is built on a regular plan, the principal streets running nearly east and west (one of them, Conway Street, being upwards of two miles long), and crossed at right angles by shorter streets. The summit of the ground next the Mersey is occupied by Hamilton Square, which contains 6½ acres of ground. The houses are four stories high, with stone fronts, and the centres and ends of each side ornamented with Doric columns. The sides of the square coincide with the directions of the streets. Birkenhead in some respects may be considered a model town, its projectors at the outset providing for its future wants by sewering the streets at the time they were laid out. In 1833 an act was obtained for paving and improving the town, for regulating its police, and establishing a market. This was amended by another act in 1838; and in 1841 an act was obtained for lighting it with gas and supplying it with water. The level of the pumping-station is 104 feet above the sea, and the wells are sunk 294 feet deep in the red sandstone. A supply of excellent water is thus obtained, pumped to such a height that it will rise above the tops of the houses in Hamilton Square.

The market is in the form of a parallelogram, 430 feet long, and 131 feet wide, and is well supplied with all sorts of produce. It was opened July 12. 1845, at a total cost of nearly L.35,000. About 400 yards from the market, in Jackson Street, are situated the slaughter-houses, a massive structure of freestone, standing in a sufficient extent of ground to admit of extension to meet the exigencies of the town.

For about 1150 yards Conway Street is bounded on the south by Clifton park, a piece of ground of 180 acres beautifully laid out by Mr Panton with plantations, flowerbeds, lakes, and drives, for public recreation and enjoyment. The park was opened April 5. 1847. Near St James's Church, which forms a beautiful termination to Conway Street, it is proposed to form a public cemetery on the site of an old quarry on Bidston Hill.

Besides St James's Church, which is not completed, there are five other Episcopal churches, one in connection with the Established Church of Scotland, a Free Presbyterian church, a Roman Catholic, a Wesleyan, and an Independent chapel. Of Welsh churches and chapels, there are an Established church, an Independent, a Wesleyan Methodist, and a Calvinistic Methodist chapel. St Aidan's Theological College was established in 1846. Its patron is the Archbishop of Canterbury. The students are connected with the Liverpool Parochial Assistant Association, the object of which is to provide additional aid to meet the pastoral wants of Liverpool, Wallon, Birkenhead, and the neighbourhood. The Birkenhead Mechanics' Institution was established in 1840. There are numerous free schools in connection with the different churches and chapels. There is also a lying-in hospital, an infirmary, and a dispensary.

The late Mr William Laird, whose name is so well known in connection with iron ship-building, first conceived the idea of turning to advantage the capabilities of Wallasey pool for the formation of a dock. After a lapse of many years, the commissioners of Birkenhead, alive to the advantages which the project of Mr Laird would confer upon the town, employed Mr Rendel as their engineer, and applied to parliament for powers to construct works embracing a sea wall from Woodside to Seacombe, docks at Bridge-end, and a tidal basin of 37 acres, accessible at all times of the tide, by vessels of 12 feet draught; a basin of 16 acres for coasters, and a dam to pen up the waters of Wallasey pool into a float, like that at Bristol. The bill passed on the 15th July 1844, and the foundation-stone of the new docks was laid by Sir Philip de Malpas Grey Egerton, on Oct. 23. 1844. On the 5th of April 1847 the first dock was opened by Lord Morpeth, and called the Morpeth Dock. Subsequently the dock powers of the commissioners were transferred by act of parliament to a corporate body of trustees (thirteen); six of whom are elected by the bondholders, four by the commissioners of Birkenhead from their own body, and three by the commissioners of Wallasey from their own body. The docks are intended to bound the town on the north and north-east, and partly on the east, extending from the pier at Woodside-ferry to the Wallasey bridge. The Wallasey pool will form a great float of 150 acres. It separates Birkenhead from Bolton-cum-Seacombe in the parish of Wallasey, and will communicate on the east with a low-water basin of 37 acres, and on the S.E. with the Egerton dock of 3 acres. On the north the Egerton dock will be connected with the low-water basin, and on the S.E. with the Morpeth Dock. The Morpeth Dock communicates on the S.E. with a tidal basin of 16 acres for coasters. The total accommodation will be above 200 acres. The great sea-wall next the Mersey will be broken only by the entrance to the low-water basin of 27 acres. At its southern extremity is the basin of 16 acres, bounded on the south by the Woodside-ferry pier.

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The company, established under an act of parliament, and called the Birkenhead Dock Warehouse Company, purchased a large extent of land fronting Wallasey pool, and laid it out to accommodate the rising traffic of the port. In April 1847 their first warehouses, capable of stowing 80,000 tons of goods, were opened. Each block of warehouses is detached and provided with water, and the whole premises are surrounded by a wall 12 feet high. A railway branching from the Chester and Birkenhead line is carried round the property. The company also built houses for their workmen, but although ingeniously constructed, the error of too great an economy of space has, despite very perfect internal arrangements, rendered this part of their speculation unremunerative.

The custom-house department of Birkenhead is under that of Liverpool, and the entries passed at the latter place answer for Birkenhead.

Many manufactories have sprung up on the margin of the pool, such as iron-foundries, gun-works, boiler-yards, potteries, varnish works, breweries, &c. No place could be better suited for the establishment of ship-building yards and manufactories, which require, on sanitary and economical grounds, to be situated at a distance from the inhabited portion of a large town.

In regard to traffic accommodation Birkenhead is well provided. It has three ferries with a hotel at each. The ferries of Woodside and Monks ferry belong by purchase to the commissioners of Birkenhead. The slips at Woodside are excellent, and the boats are admirably managed. The Monks ferry is in connection with the Chester and Birkenhead railway. The Birkenhead ferry and hotel are the property of the corporation of Liverpool.

The Chester and Birkenhead railway, 16 miles in length, connects Birkenhead with the midland counties, with the metropolis, and with Ireland. By a tunnel of about 500 yards long, the line is extended to the water's edge at Monks ferry. The station there is extensive, being 250 feet long, and 120 feet wide. Another extension line is carried from Grange Lane to the docks. It has two stations, one at Canning Street for passengers, and the other at the docks for goods.

The affairs of the township of Birkenhead are managed by 21 commissioners chosen by the rate-payers; seven of these retire annually, but are eligible for re-election. The commissioners of the town were constituted originally under an act passed June 10. 1833. The mayors and bailiffs of Liverpool, with the 4 junior aldermen, together with 60 other persons named in the act, were constituted the commissioners. A subsequent act of the 1st Vict. decreed, that

Birket-el-Keroun || Birmingham.

there were to be 24 commissioners, 3 of whom were to be appointed by the town-council of Liverpool, and the remainder elected by the rate-payers. In 1846 an act was passed for the exclusion of the Liverpool members. (J. N.)

BIRKET-EL-KEROUN, *i.e.*, the *Horn* or *Bow Lake*, the ancient Mœris, is in the province of Fayoum, in Central Egypt, in Lat. 29. 30. N. Long. 30. 31. E. This lake has undergone a remarkable diminution since the days of Herodotus. It was then from 400 to 500 miles in circumference, while its present length is about 30 miles, its greatest breadth about 6, and it is gradually contracting. Its waters are brackish, but it still abounds in fish. It communicates by two channels with the Nile. See EGYPT.

BIRKET-EL-MARIOUTH, or EL KREIT, known to the ancients as the Palus Marea or Mareotis, a lake in Lower Egypt, in Lat. 31. 4. N. Long. 30. 4. E., separated from the sea by the narrow peninsula on which Alexandria stands. After the fall of that city the waters of the lake were gradually dried up. In 1801 a French garrison took possession of Alexandria, and the British army sent to expel them cut a canal across the isthmus, and let in the waters of the sea. The old bed of the lake was covered to the extent of 30 miles in length, and 15 in breadth, while the depth of the water varies from 4 to 14 feet. See ALEXANDRIA, and EGYPT.

BIRMAH. See BURMAH.

BIRMINGHAM, or BERMINGHAM, a large commercial and manufacturing town, situated in a projecting angle of the north-western portion of the county of Warwick, near the confines of Staffordshire and Worcestershire. It is in 52. 59. N. Lat. and 1. 18. W. Long.: 102 miles in a straight line N.W. of London, and by the North-Western railway 112 miles. The parish of Birmingham is bounded on the E. and N.E. by the parish of Aston, and on the south by that of Edgbaston, both in the county of Warwick; and on the W. and N.W. by those of Harborne and Handsworth, in the county of Stafford. The parishes of Birmingham and Edgbaston, with about a third part of Aston, form the parliamentary and municipal borough; the total area in statute acres being 7831; of which Birmingham contains 2660, Edgbaston 2545, and Aston 2626.

The parish from which the town derives its name, is, with the exception of a small portion of land at its western and northern extremities, almost entirely covered with buildings. Edgbaston, from the circumstance of the fee-simple of almost the entire parish being vested in one proprietor, who exercises a stringent control as to the nature of the buildings erected, is the most pleasant and fashionable part of the borough.

Birmingham is situated nearly in the centre of England, built on the crest and sides of a gentle hill, and when viewed from the S.E. presents the appearance of a vast semicircle, the gradual elevation of the surface adding to the picturesqueness of the view. This circumstance, too, is favourable to its salubrity; and the general health of the inhabitants will bear comparison with that of any other large manufacturing district. Water is obtained in abundance at a medium depth of about 20 yards; and the town is further supplied by a company, whose distribution of this first necessary of life amounts to upwards of a million gallons per day, and occasionally even to upwards of two million gallons. One shallow river, the Rea, flows through the lower part of the town, and affords a convenient outlet for drainage.

The general appearance of the town, which in the earlier part of the present century was not of an inviting character, is rapidly improving. In addition to the public buildings, now becoming numerous, many judicious alterations have been effected by the widening of streets, the removal of unsightly buildings, and the cultivation of a more refined taste in street architecture generally. The great value of land, however, in the principal thoroughfares, forms the main obstacle to the carrying forward of improvements greatly needed in almost every direction. Many of the streets in the suburbs, and in the centre of the town, are occupied with the residences of the working classes, who, too frequently, seek to reside in as close proximity as possible to the manufactories in which they are employed. Each family, however, has a residence of its own, and the practice of living in cellars is here entirely unknown.

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Anterior to the Norman conquest Birmingham was a market-town, and probably to some limited extent its inhabitants were engaged in manufactures. Its proximity to the iron and coal districts of Staffordshire would afford great facilities to the workers in metals; but the arguments that have been made use of to show that it was a place of manufacturing celebrity in the times of the ancient Britons are so extravagant as to carry with them their own refutation. Notwithstanding its local advantages, the progress of the town must for a long period have been slow, as in the levy of men ordered to be made for the French war in 1346 Birmingham contributed but four, while Coventry supplied forty. Leland is the first writer who has left any description of the town on record. In the *Itinerary* (temp. Henry VIII.) he thus speaks:—"The beauty of Birmingham, a good market towne in the extreame parts of Warwickshire, is one street going up alonge almost from the left ripe of the brooke [the Rea], up a meane hill by the length of a quarter of a mile. I saw but one paroch church in the towne. There be many smithes in the towne, that use to make knives, and all manner of cutting tooles, and many lorimers that make bittes, and a great many naylors; so that a great part of the towne is maintained by smithes, whoe have their iron and sea-cole out of Staffordshire." Camden, who wrote half a century later, describes it as "swarming with inhabitants, and echoing with the noise of anvils (for here are great numbers of smithes)." The parochial registers, which commence in 1554, show that the population must at that period have been very limited, as the entries of deaths in the first six months amount to only 16, the marriages to 6, and the births to about 24. At the commencement of the following century, however, an increase was apparent; the burials in 1608 being 37, and in 1611, 64; the marriages in 1621 were 10, and in 1625, 17; and in 1627 the baptisms were 102.

In the unhappy contest between Charles I. and his parliament, the inhabitants warmly espoused the cause of the latter; and in 1642, when the king was on his march from Shrewsbury to relieve Banbury, they disarmed a guard who were conveying the royal plate and furniture to the camp, and sent their prize to Warwick Castle, one of the strongholds of their party. So devoted also were they to the cause they had espoused, that their workshops supplied 15,000 swordblades to Cromwell's soldiers, while no temptations could induce them to furnish a single weapon to the royalist forces. In 1643 they opposed Prince Rupert's entrance into the town, but were defeated with considerable loss; and the victors not only levied heavy contributions, but set the town on fire, eighty houses being consumed. In this fray the Earl of Denbigh lost his life. A more serious calamity, however,—the plague,—desolated the town in 1665, and the inhabitants were compelled to bury their dead in a lonely spot called Ladywood, at the outskirts of the town. No records remain to show the number of victims, the entries of burials in the parochial registers not exhibiting any increase over their ordinary numbers.

The revolution of 1688 was signalized by the total demolition of a Roman Catholic church and convent. These buildings had only been erected a few months; James II. having been a contributor of 125 tons of timber from the royal forest of Needwood. But the close of the eighteenth century was marked by an outbreak of so disgraceful a character as to have left an indelible stigma on the party at whose instigation it was excited. The strenuous efforts of the dissenters

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throughout the kingdom to obtain redress of the grievances under which they laboured, had been in no instance more zealously supported than by the Unitarians of Birmingham; and Dr Priestley, the minister of one of the meeting houses belonging to that body, by his arguments and satire, had excited against himself the hatred of the more violent members of the church party. The orthodox dissenters, while warmly sympathizing with the doctor's views relative to the connection of ecclesiastical establishments with the state, held aloof from him on account of his religious writings and opinions, and hence were not viewed with the same degree of dislike. On the 14th of July 1791, a dinner in commemoration of the French revolution was held at the Hotel, but as the public mind had been excited by an inflammatory handbill that had been extensively circulated, the company separated at an early hour. A mob assembled, however, and for three days held the town completely under their control, burning and pillaging the places of worship and private houses of the Unitarian body. The damage, at a moderate computation, was L.60,000; but of all the property destroyed no loss was so much to be deplored as that of Dr Priestley's laboratory and library, where the results of the doctor's scientific researches during a whole life were collected. The reputation of the town suffered for many years from the remembrance of this outbreak; but religious animosities by degrees subsided, as Dr Priestley, against whom the chief feeling was raised, never again resided in Birmingham.

When the great movement in favour of parliamentary reform was commenced in 1830, Birmingham took the lead, but notwithstanding the intensity of the political excitement, no breach of the peace occurred: and the working classes have on many occasions borne the reverses of trade, which have sometimes been severe, with exemplary patience. In 1839 when the people, at the instigation of trading political agitators, had abandoned those leaders in whose counsels they had previously reposed confidence an aimless outbreak occurred, and several houses in the market-place were destroyed.

The family of De Bermingham is supposed to have held the manor before the Norman conquest, and retained it after that epoch in dependence on the Norman lord of Dudley Castle. One of them engaged in the Barons' war against Henry III., and fell at the battle of Evesham in 1265; but under the Dictum de Kenilworth the estate was restored to his son. The last male representative was deprived of the family possessions through a conspiracy of John Dudley Duke of Northumberland, in 1527, who being desirous of obtaining the estate, contrived a pretended robbery by his creatures, in the presence of De Bermingham, when riding in the vicinity of the town; and who being tried and convicted as an accessary, was persuaded to surrender his estates to the crown, on promise of a pardon, and a small annuity. The act of parliament confirming the pardon still remains on the statute book. On the attainder of Northumberland, the manor lapsed to the crown, and was granted in 1555 to Thomas Marrow, of Berkswell, in the county of Warwick. The present owner is Christopher Musgrave, Esq. The value, however, is little more than nominal, as the market-tolls were purchased by the commissioners under the Street Act, whose powers were vested in the town-council by the Improvement Act of 1851. They now produce L.6400 per annum. The manorial residence, which stood near the parish church, and was surrounded by a moat, fell into decay after the ruin of the family; but the moat remained till 1816, when with other land it was appropriated to the purposes of a cattle-market.

From the earliest known period Birmingham was governed by two bailiffs, chosen at the court leet of the lord of the manor; but these officers, for several centuries, could have been but mere deputies of the lord, having no separate or independent powers. They were recognized authorities, however, as instances occur of writs of the crown having been directed to them as early as the time of Edward III. The duty of the high bailiff (who was generally a Churchman) was to convene public meetings, inspect the markets, and proclaim the fairs, two in number. The low bailiff (usually a dissenter) summoned the leet jury, on whom devolved the choice of the other officers. By the provisions of the Reform Bill, the elective franchise, with the privilege of returning two members to parliament, was conferred upon the town, the bailiffs being appointed returning officers. In 1839, a charter of incorporation was granted by the crown, but its validity was disputed, though ultimately confirmed by the legislature. In consequence of the various boards of commissioners retaining their authority undiminished, the powers of the corporation were of very limited extent; and it was not till 1851 that the conflicting views of the different bodies could be sufficiently harmonized to allow of a successful application to parliament for a bill consolidating the whole of the governing powers within the borough. By virtue of this act, all the rights and privileges formerly belonging to the different boards are now vested in the town-council; and the offices of high and low bailiffs are but a name. The revenue of the corporation is derived entirely from rates levied on the inhabitants.

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With the exception of the parish church of St Martin, Birmingham possesses no buildings of antiquity. A few half-timbered houses, with projecting eaves and pointed gables, of the time of James I., still remain in that portion of the town which Leland denominated "a pretty street"—Deritend; and part of a brick mansion of considerable size (also belonging to the Jacobean era) stands at the back of a retail shop in the High Street. The remembrance of the hospital or priory of St Thomas the Apostle is still preserved in several streets, bearing the names of Upper and Lower Priory, Minories, and Thomas Street, though the building itself was destroyed before the close of the sixteenth century; and the possessions of another establishment, of a semi-religious character, the Guild of the Holy Cross, were granted by Edward VI. for the purpose of endowing the grammar school now called after that pious monarch.

Until the year 1711, Birmingham proper possessed but one parish church, that of St Martin's, erected about the middle or towards the close of the thirteenth century. The interior has undergone considerable changes, many incongruous alterations having been made, while the exterior was cased with brick so far back as 1692, and presents, in consequence, a mean and uninviting appearance. The spire escaped this renovation, but having been constructed of a friable stone, was in so dilapidated a condition as to require to be taken down in 1853 preparatory to the erection of a new one. This elegant specimen of architectural skill was erected about the middle of the fourteenth century. The church contains some ancient monuments of the lords of Bermingham, and a curious one of an ecclesiastic, which were carefully restored in 1846. St Philip's church, consecrated in 1715, is in the Italian style, and the general effect is striking and beautiful. The churches of the establishment in the entire borough are twenty-five in number, eighteen having been erected within the last thirty years. Two new ones are also in course of erection (1854). The dissenting chapels are numerous, and some of them display evidence of superior taste. The members of the Roman Catholic body possess a cathedral and episcopal residence, a chapel, an oratory of St Philip Neri, a convent for Sisters of Mercy, adjacent to which is an asylum for destitute female servants, and a cemetery. There are also two public cemeteries of considerable extent, the grounds of which are laid out with great taste.

Until a recent period Birmingham was entirely destitute of public buildings having the smallest pretension to architectural beauty. But the deficiencies of former days are now being rapidly supplied. Chief among the ornaments of the borough is the town-hall, a splendid edifice in the Corinthian style. The most remarkable feature of this building is a series of fluted columns forty feet in height, which rest on a rustic basement, and support a bold entablature. The front elevation is

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terminated by a noble enriched pediment, and the general effect is exceedingly striking. The principal room in the interior is 145 feet long, 65 wide, and of the same height. It will accommodate about 4000 persons when seated, but double that number in a standing position. The decorations of the walls and roof are very rich. The building was commenced in 1832, and was opened for the first time in October 1834, on the occasion of the triennial musical festival for the benefit of the general hospital. The organ at the northern extremity of the hall is one of the finest in Europe, and was erected by public subscription. The cost of the hall, including land, was about L.40,000. The design was not entirely completed till 1850, the additional expense being L.12,000. The material employed is Anglesea granite. The market-hall commenced about 1830, is of Grecian design, having two large Doric, besides smaller entrances. It is 360 feet in length by 108 in width, and 60 in height, and is lighted by twenty-six windows on each side, with six at the north, and two at the south entrances, as well as by skylights. The roof is supported by seventeen series of beams, which rest on as many pairs of iron pillars 28 feet in height and 20 feet apart. In addition to stallage for more than 500 persons, there is sufficient space for 4000 persons to perambulate. The expense of the erection was L.30,000, but the site cost more than double that sum. Near the market-hall is placed the sole statue of which Birmingham can at present boast, erected in 1809 to the memory of Lord Nelson. The public office—the only building belonging to the town in which public meetings could be held before the erection of the town-hall—is in the Ionic style: having been considerably enlarged in 1830, it now contains numerous apartments in which much of the public business is transacted. The town prison is situated at the back of this building. The borough jail, which was built by the corporation, is very capacious, inclosing within its boundaries seven acres of land, and containing accommodation for more than 300 prisoners. The separate system of prison-discipline is here carried out. Adjacent to the jail is the lunatic asylum, in which 350 patients can be accommodated. This building was also erected by the corporation, who have likewise established a set of baths. A new workhouse, under the supervision of the guardians of the poor, was opened in 1852, and the total expense incurred in the erection of these four edifices has been upwards of L.150,000. A plan of sewerage is also being carried out, which will involve an expenditure equal to that just named. Bingley Exhibition Hall, in the Roman-Doric style, erected in 1850 by share subscription at a cost of L.7000, for the accommodation of the great cattle and poultry shows held annually in the town, is about 224 feet long by 212 wide, and covers 1¾ acre of land. These exhibitions, which were commenced in 1849, are held in the month of December, and have already attained so great a degree of celebrity as to rival those of the London Smithfield Club held about the same period, and have given a stimulus to the establishment of similar societies throughout the kingdom. The number of visitors is generally from 40,000 to 50,000. A corn-exchange has also been recently erected by private enterprise for the use of agriculturists and others attending the markets. There are also, in addition, a school of design, post-office, theatre, news-room, subscription libraries, and other minor public edifices. With the exception of the polytechnic institution, which is a mechanics' institute, there is no institution for the promotion of science, but the corporation having granted a site of land for the purpose. Buildings for a Midland Literary and Scientific Institute on an extended scale are about to be erected. A statue of the late Sir Robert Peel by a native artist—Mr Peter Hollins—will also be placed in some public thoroughfare of the borough in the course of the present year (1854). A flourishing society of artists, holding an annual exhibition of pictures, has been in existence in the town for eleven years. Street architecture has considerably advanced of late, many of the retail shops and offices being erected in a style of magnificence worthy the important community amongst which they are situated. There is also a botanic garden with extensive conservatories at Edgbaston.

The educational establishments of Birmingham are varied and flourishing. The free grammar school, founded by Edward VI. in 1552, is a noble institution, affording gratuitous instruction in its chief and branch schools for nearly 2000 young persons. The revenues are derived from lands formerly the property of a semi-religious fraternity dissolved at the Reformation, and called the "Guild of the Holy Cross." These possessions, originally of the value of L.21 per annum, are to a great extent situated in the principal thoroughfares of the town; and as much of the land has been let on building leases, the expiry of these has augmented the income of the charity from L.3300 in 1827, to L.10,000, and this sum will in a few years be considerably increased. About 460 boys are taught in the chief school; and nearly 1600 of both sexes in four branch establishments. The school, which was erected from the designs of Mr Barry, is in the perpendicular Gothic style, 174 feet long and 60 feet high. The front elevation consists of two stories, with traceried windows, and is divided into compartments by buttresses, which terminate, above an embattled parapet, in pinnacles enriched with crockets and finials. The building cost, including the expense of additional land for the site, L.71,000. In consequence of this great outlay, and the establishment of an extended and more liberal system of education, the debts of the charity amounted to L.98,000, but the whole of this sum has been paid from the proceeds of sales of land to the railway companies. The tercentenary anniversary of the foundation of the school was celebrated in April 1852 with great *éclat*. The Queen's College (which had its origin in a school of medicine, founded in 1828) obtained a royal charter in 1843, and is a flourishing institution. Though originally limited to medical students only, it has now its departments of arts, law, and engineering, and has an efficient staff of highly talented professors. Affiliated to the institution is the Queen's Hospital, erected in 1840. The collegiate buildings, which have but a limited frontage, are in the perpendicular style, but the effect of the façade is greatly impaired by the proximity of adjacent houses. The Blue-Coat school, founded in 1724, supports and educates from 200 to 300 boys and girls, who are trained in the principles of the Established Church, and apprenticed at the age of fourteen. The annual income is about L.2500. There is also a Protestant-dissenters' charity-school, supported chiefly by the Unitarian body; and a large and flourishing free industrial school, besides numerous minor ones. In 1831 a proprietary school was established at Edgbaston, the building being a handsome Elizabethan structure. There is a college also, established in 1838, belonging to the Congregationalists: the number of students is about twenty. In the vicinity of the town, a training college for the diocese of Worcester, and a reformatory institution for juvenile criminals, have likewise been recently established. The census returns of 1851 show the number of day-schools in the borough to be 454, of which 66 are public and 388 private; scholars on the books, 22,183, and in actual attendance, 17,985; while of Sunday-schools the number is 70, and of scholars on the books, 21,406, and in actual attendance, 14,376. The proportion of children attending school to the entire population, is, of day-scholars, 1 in 11·02, and of Sunday-scholars, 1 in 10·42.

The charitable institutions of the town are numerous and important. They consist of two hospitals, which administer relief to 20,000 out-patients, and 3700 in-patients annually; a general dispensary; a lying-in hospital; and a variety of other benevolent institutions. A savings-bank, with 23,674 depositors, and L.421,574 invested in government securities, has been in operation for 27 years.

To the staple commodities of iron manufacture, brass goods were added about the seventeenth century. This branch now forms one of the most important in the town. Every description of article in this metal is produced in immense quantities both for the home and foreign markets. Metallic bedsteads in brass and iron—this department being exclusively cultivated by some of the largest houses—chandeliers, gas-brackets, cornice-poles, ornamental railings, metallic picture frames, and curtain bands; in addition to the humble but not less useful articles of door-knobs, candlesticks, and hinges, find employment for many thousands of men, women, and boys. The universal application of steam-power has led to the invention of numerous contrivances for economizing labour, and the result has been a greatly augmented faculty of production, which, by diminishing the cost of manufacture, has materially increased the demand. Another result has been that many branches of labour are now brought within the range of female industry; and it was given in evidence before a government commissioner in 1841, that in one manufactory in the button trade the proportion of females to males was ten to one; while in another, in the same trade, the numbers were 60 males and 300 females. Nearly one-half

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of the married females are engaged in factory labour; the percentage of deaths of children under five years of age is 48, or nearly one-half of the entire number registered in the whole borough. This awful rate of mortality can only be accounted for by the fact just adverted to. Among the more elegant productions of the brassfoundry trade may be classed the manufacture of lamps. These tasteful articles are produced in immense quantities: enamelled and gilt glass entering largely into their composition. The buckle trade, for which Birmingham was at one time so famous, has entirely disappeared; and the manufacture of metal buttons has considerably diminished, in consequence of the general substitution of Florentine ones. The glass trade (including stained glass for windows) is very successfully cultivated; and in the vicinity of the town is the gigantic establishment of Messrs Chance, who supplied the whole of this material required for the glazing of the Crystal Palace for the Exhibition of 1851. In near proximity also is the immense foundry of Messrs Fox and Henderson, the contractors for the erection of the entire building. The wondrous process of electro-plating, which has sprung up entirely within the last few years, is now carried on to an almost incredible extent. The manufactory of Messrs Elkington is the parent establishment in the town; and articles of the most dazzling description, and in immense variety, are produced. Jewellery, in the fabrication of which female labour largely enters, is made in great quantities. Of steel pens fully seven hundred millions are annually sent into the market. The consumption of steel in the establishment of Mr Gillott for 1853 was 90 tons; the number of pens manufactured, 261,273,600. The papier-maché trade is cultivated very extensively. Many of the articles composed of this material, consisting of sofas, tables, and other kinds of furniture, in addition to the smaller descriptions, such as desks, workboxes, and inkstands, are ornamented with figures, flowers, and landscapes, in a good style of art, and inlaid with pearl—the effect produced being exquisitely beautiful. The gun trade, first stimulated by government patronage in the time of William III., retains its pristine reputation; and a proof-house, where all gun-barrels manufactured are required to be proved, was established by an act of parliament in 1813. The ordnance department of government have also an establishment in the town. Metal-rolling, wire-drawing, and pin-making, are extensively carried on; but to enumerate more than a few of the more important trades, where the entire number is 250, were unnecessary. The great agent of production, the steam-engine, was introduced in 1767 by Mr Boulton, who, in conjunction with his partner James Watt, acquired so wide a celebrity. The Soho, two miles distant from the town, where the manufacture was formerly carried on, is now dismantled; but the successors of the firm still conduct the business at Smethwick, a thriving locality in the neighbourhood. The steam-power in the borough is nearly equal to that of 6000 horses, or 90,000 men.

The town was first lighted with gas in 1819. There are now two companies, whose annual production amounts to more than 300,000,000 cubic feet; and many of the larger establishments manufacture their own supply. Canals were first introduced in 1767, and are still used to a considerable extent, notwithstanding their formidable rivals the railways. The Grand Junction, connecting the town with Liverpool, was the first line of railway completed to Birmingham, having been opened in July 1837. This was followed by the London and Birmingham in the following year, and subsequently by the Derby, and Gloucester. For a considerable period the various lines had separate stations, but the inconvenience arising from this cause has been remedied, and all the old lines now unite at one point, in New Street. The length of the great central station (now nearly completed) is more than 1100 feet, the width varying from 188 to 211 feet. The structure (with the exception of the necessary offices, which are of white brick) is composed of iron; and the roof, forming a segment of a circle, is covered with fluted glass. Beneath the span of this immense fabric are ten lines of rails, four platforms for passengers, and a roadway for cabs; but though the span is so great, the roof is unsupported by a single pillar except those on either side. The Stour Valley trains depart from this station; and the whole of the passenger traffic of the London and North-Western and Midland lines will be transferred to it in the course of the present year (1854). The Oxford junction, a line belonging to the Great-Western Company, furnishes a second route to the metropolis; and for this, in conjunction with the Dudley and Wolverhampton, a large station will be erected on Snow Hill. The destruction of house property for the purposes of the different lines has been immense; in one instance the whole of one side of a street a mile in length having been removed.

Biron || Biscay.

In 1801, the population of Birmingham was 73,670; in 1811, 85,755; in 1821, 106,721; in 1831, 142,251; in 1841, 182,922; and in 1851, 232,841, of whom 113,916 were males, and 118,925 females. The number of persons to a square mile is 41,853, being greater than that of any other town in England except London and Liverpool. The area in statute acres is 7831, and the rateable property is assessed at L.655,621. The number of houses in 1841 was 30,291, and in 1851, 48,892. The increase, however, would have been much more considerable but for the cause already stated. (A. D—N.)

BIRON, Armand de Gontault, Lord of, marshal of France, and a celebrated general in the sixteenth century, who signalized himself by his valour and conduct in several sieges and battles. He was made grand master of the artillery in 1569; and so much was he respected or feared on account of his valour, that nobody dared to assault him at the massacre of St Bartholomew. He was the first who declared for Henri IV.; brought a part of Normandy under his subjection; and dissuaded him from retiring to England or Rochelle. Biron was killed by a cannon-ball at the siege of Epernay, July 26. 1592, at the age of sixty-eight. He was a sort of universal scholar; and used to carry a pocket-book, in which he noted everything that appeared remarkable. This gave rise to a proverb at court, when a person happened to say anything uncommon, "You have found that in Biron's pocket-book."

Biron, *Charles de Gontault*, created duke of Biron by Henri IV., was a man of great intrepidity, but fickle and treacherous. In 1601 he was sent as ambassador to the court of Queen Elizabeth to announce his royal master's marriage with Mary of Medici; but being discovered in a treasonable correspondence with Spain, he was beheaded in the Bastille at Paris, July 31. 1602.

BIRR. See Parsonstown.

BIRS NIMRUD. See Babylon.

BISACCIA, a city in the Principato-Ulteriore of the kingdom of Naples. It is a bishopric in conjunction with St Angelo, and contains 5500 inhabitants.

BISACUTA, in the middle-age writers, an axe with two edges, to cut either way; or a missile weapon pointed at both ends. Walsingham represents the *securis bisacuta* as peculiar to the Scottish nation.

BISCARA, a town of Algeria, capital of the southern province of Zaab, and about 200 miles S.E. of Algiers. It is now in the possession of the French. Pop. about 4000.

BISCAY (Vizcaya) Seignory of, one of the three *Provincias Vascongadas* or Basque provinces in the north of Spain. It is bounded on the north by the Bay of Biscay, east by Guipuzcoa, south by Alava, and west by Santander. Area 1272 square miles; pop. (1850) estimated at 150,000. The surface is highly picturesque, being very mountainous, and diversified with numerous narrow valleys and fertile plains. The mountains are generally covered with forests to their summits, while others consist almost entirely of naked calcareous rock. This province is well cultivated, and produces wheat, maize, barley, rye, flax, chestnuts, grapes, peaches, and other fruits. The farms are generally small, but are cultivated with great care, and almost entirely by manual labour. Among its forest-trees are the oak, holly, arbutus, and chestnut; and furze and heath abound in the poorer parts. The wild-boar, lynx, fox, and other beasts of prey, are still found in several of the forests; and deer, rabbits, partridges, woodcocks, and other kinds of game, are plentiful. The principal river is the Nervion or Ibaizabal, on which the capital, Bilbao, is situated: it has, besides, several smaller rivers, and numerous mountain streams. The coast presents a bold and rugged aspect, and in several places is deeply indented. Its

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principal ports are Portugalete at the mouth of the Nervion, Plencia, Bermeo, and Hea. Biscay is very rich in minerals. Iron of the finest quality is found in almost every part of the province; and marble, lime, and sandstone, are abundant. The Biscayans, who represent the ancient Cantabrians, are an industrious, bold, and hardy race; primitive in their manners, as well as gay, friendly, and hospitable. They are characterized by an innate love of freedom, and an intense jealousy of everything having the appearance of an encroachment upon their liberties. In manners and habits they have a considerable resemblance to the Irish, and were supposed to be of the same Celtic origin; but the Basque is not a Celtic language.

The manufacture of iron is the chief branch of industry, but at present it is less flourishing than formerly, though their gun-barrels are still in high repute. Among the other manufactures are porcelain, linens, hats, copper and brass wares, straw and rush chairs, ropes, leather, &c. The fishings are actively prosecuted along the coast. The earliest whale-fishery of Europe was pursued on this coast by the hardy Biscayans; but the whale has long ago retired farther to the north, and deprived them of this species of industry.

The Cantabrians in the time of the Romans were a fierce and warlike people, and were only subdued after a severe struggle by Augustus. This province afterwards fell successively into the hands of the Suevi, Franks, and Goths; and it formed for some time an independent lordship. In the fourteenth century it came into the power of the king of Castile, and since that time it has formed a part of the Spanish kingdom. Although subject to Spain, the Biscayans still maintain a republican form of administration, nominating their own governors and magistrates, regulating the amount of taxation, &c. The term Biscay is frequently used as synonymous with Basque, to include the three Basque provinces.—Madoz, *Dic. Geograf. de España.*

Biscay, *Bay of*, an extensive gulf or bay of the Atlantic, between the northern coast of Spain and the western coast of France. It extends from the island of Ushant, off Brest, to Cape Ortegal on the north coast of Galicia. The Spanish coast is almost wholly bold and rocky; the French is more varied, and from the mouth of the Gironde southward to the Adour is low and sandy. The openness of this bay, the strong westerly winds, and the current (Rennel's) which sets in from the west and sweeps along its southern and eastern shores, impede its navigation. It receives the waters of the Loire, Charente, Gironde, and Adour.

BISCEGLIA, a fortified seaport of Naples, in the province of Terra di Bari, situated on a rocky promontory on the Adriatic, 21 miles W.N.W. of Bari. It is the seat of a bishopric, and has a cathedral, numerous churches and convents, a hospital, and a theatre. Its harbour is only accessible to small vessels, and it has little trade. Being destitute of springs, it has numerous reservoirs for the collection of rain-water. Pop. 14,000.

BISCHOP, or Biskop, John de, an artist, born at the Hague in 1646. He excelled in making copies of the pictures of the great masters; but he is best known as an engraver. His works are chiefly etchings, harmonized with the graver; and though slight, yet free, spirited, and pleasing. He worked chiefly at Amsterdam, where he died in 1686.

BISCHWILLER, a town of France, capital of a canton of the same name, department of Lower Rhine, 14 miles north of Strasburg. It has manufactures of woollen and linen stuffs, oil, soap, earthenware, &c., and some trade in hops, hemp, leather, and tobacco. Pop. (1846) 6242. Its fortifications were destroyed by the imperialists in 1706.

BISCUIT. See Baking.

BISHAREEN, the name of several tribes inhabiting the desert on the western side of the Red Sea, as far north as Lat., 21°, and south to the Taccaze, a branch of the Atabara, the ancient Astaboras. According to Burckhardt, they are not of Arabian origin, although they have the manners of the Bedouins; but, like their more polished neighbours the Abyssinians, they devour raw flesh.

Bishop.

BISHOP, one of the superior order of pastors in the Christian church, consecrated for the spiritual government of the ordinary pastors in a certain district or diocese. The word comes from the Saxon *bischop*, which again is derived from the Greek ἐπίσκοπος, an *overseer, inspector,* or *superintendent,* a title given by the Athenians to those whom they sent into the provinces subject to them, to see whether everything was kept in order. The Romans applied the same designation to those who were appointed inspectors of bread and provisions.

A bishop discharges the same relative functions as an archbishop, though of course in a lower sphere. An archbishop with bishops consecrates a bishop; a bishop with priests ordains a priest; the archbishop visits a province, the bishop a diocese; the archbishop convocates a provincial synod, the bishop a diocesan one; and the archbishop has canonical authority over all the bishops of his province, the bishop over the priests in his diocese.

The election of bishops was anciently placed in the clergy, and the people of the parish, province, or diocese; but afterwards, princes and magistrates, patriarchs, and popes, usurped the power. The election was required to be within three months after the vacancy of the see; and the bishop to be chosen from among the clergy of that church. Formerly the bishop claimed a share in the election of an archbishop; but this was set aside by the popes.

In England, during the Saxon times, all ecclesiastical dignities were conferred by the king in parliament. At length, however, after several contests, especially between Archbishop Anselm and Henry I. in consequence of a grant of King John, recognised in Magna Charta, and established by the 25th Edw. III., stat. 6, § 3, bishops were elected by the chapters of monks or canons—some shadow of which still remains in the present method of disposing of bishoprics; but by the 25th Henry VIII. cap. 20, the right of nomination was restored to the crown.

Ordinarily, three bishops at least are required in the ceremony of consecrating a bishop; but in some cases one bishop will suffice. The English succession of Protestant bishops stands on this last ground. In England, the king being certified of the death of a bishop by the dean and chapter, and his leave requested to elect another, the *congé d'élire* is sent to them, with a letter missive, nominating the person whom he would have chosen. The election is to be within twelve days after the receipt of it, otherwise the king by letters patent appoints whom he pleases; and the chapter, in case of refusing the person named by the king, incurs a *præmunire.* After election, and its being accepted by the bishop, the king grants under the great seal a mandate for confirmation, which the bishop consigns to his vicar-general. This consists mostly of a solemn citation of such as have any objections to the bishop-elect, a declaration of their contumacy in not appearing, and an administration of the oaths of allegiance and supremacy, of simony, and canonical obedience. Sentence being read by the vicar-general, the bishop is installed in the province of Canterbury by the archdeacon; the fact is recorded by a public notary; and the bishop is invested with full powers to exercise all spiritual jurisdictions, though he cannot sue for his temporalities till after consecration. Then follows the consecration by the archbishop or some other bishop appointed by lawful commissions, and two assistant bishops. The ceremony is much the same as in the Roman Catholic church, save that after investiture in the episcopal robes, the archbishop and bishops lay their hands on the new prelate's head, and consecrate him with a certain form of words. The process of the translation of a bishop to another bishopric differs only in this, that there is no consecration. The age of a bishop is to be at least thirty years; and, by the ancient discipline, none were to be chosen but

Bishop.

those who had passed through all the inferior orders; but in some cases of necessity this was dispensed with, and deacons, nay laymen, were raised at once to the episcopal dignity.

The form of consecrating a bishop is different in different churches. In the Greek church, the bishop-elect being by the assistant bishops presented for consecration, and the instrument of election put in his hand, after several prayers, the first of which is called *diaconicum*, he demands consecration; and after making profession of his faith, he receives a benediction. He is then interrogated as to his belief of the Trinity; to which he answers by a long profession of faith, and receives a second benediction. Lastly, his opinion regarding the incarnation is demanded; to which he answers in a third profession of faith, which is followed by a third benediction; after which the consecrator gives him the pastoral staff. He is then led up to the altar, where, after certain prayers, and three crosses on his head, he receives the *pallium*, if he be an archbishop or patriarch; then the kiss of peace from his consecrator and two assistants; and sitting down, he reads, prays, and gives the communion to his consecrator and others.

In the Roman Catholic church, the bishop-elect, being presented by the elder assistant to the consecrator, takes the oath; he is then examined as to his faith; and after several prayers, the New Testament is drawn over his head, and he receives the chrism or unction on his head. The pastoral staff, ring, and gospel, are then given him, and after communion the mitre is put on his head; each ceremony being accompanied with suitable prayers. The consecration ends with the *Te Deum*. These last-mentioned ceremonies are laid aside in the consecration of English bishops. Nevertheless, the book of consecration set forth in the time of Edward VI. and confirmed by act of parliament, in which some of them are enjoined, is declared to be the standard for this purpose by the thirty-sixth article.

The function of a bishop in England may be considered as twofold, namely, what belongs to his order, and what belongs to his jurisdiction. To the episcopal order belong the ceremonies of dedication, confirmation, and ordination. By the common law, the bishop is to certify the judges touching legitimate and illegitimate births and marriages; and by that and the ecclesiastical law he is to take care of the probate of wills and granting administrations, to collate to benefices, grant institutions on the presentation of other patrons, command induction, order the collection and preservation of the profits of vacant benefices for the use of the successors, defend the liberties of the church, and visit his diocese once in three years. To the bishop also belongs the power of suspension, deprivation, deposition, degradation, and excommunication.

The incomes of the various sees till of late differed exceedingly in amount; but the ecclesiastical commissioners for England have adjusted, or are now adjusting, these to a nearer approach to equality. They have assigned or contemplated fixing the income of the archbishop of Canterbury at L.15,000; that of the archbishop of York at L.10,000; London, Durham, and Winchester, at L.8000; and the rest at from L.5500 to L.4500.

All bishops of England are peers of the realm, except the last consecrated; and, as such, sit and vote in the House of Lords. They are barons in a threefold manner; feudal, in regard to the temporalities annexed to their bishoprics; by writ, as being summoned by writ to parliament; and lastly, by patent and creation. Accordingly, they have the precedence of all other barons, vote as barons and bishops, and claim all the privileges enjoyed by the temporal lords; excepting that they cannot be tried by their peers, because in cases of blood they themselves cannot pass upon the trial, for they are prohibited by the canons of the church from being judges of life and death. They have the title of *Lords* and *Right Reverend Fathers in God* in England. Besides two archbishops, there are twenty-five bishops, exclusive of the bishop of Sodor and Man. The bishops of London, Durham, and Winchester, take precedence of other bishops, who are to rank after them according to their seniority of consecration. In Ireland there are two archbishops and twelve bishops. In Scotland, before the Presbyterian establishment, there were two archbishoprics and twelve bishoprics. The bishops of the Scottish Episcopal, and of the Roman Catholic church, are not recognized by the state.

Bishop's Court || Bishop's Castle.

The following is a return of the number of colonial bishops, stating the salaries of each, and sources whence those salaries are derived, made to the House of Commons 11th June 1852:—

Diocese.	Salary.	From what source derived.
	L.	
Quebec	1990 *	Imperial parliamentary vote.
Toronto	1250	Clergy reserves in Canada West.
Montreal.....	800	Colonial Bishoprics Fund; the interest of investments in the colonies, and in this country.
Nova Scotia	550	Trust funds held by the Society for the Propagation of the Gospel, and the rent of a farm in Nova Scotia.
Frederickton	1000	Colonial Bishoprics Fund.
Newfoundland	1200	L.700 Imperial parliamentary vote. L.500 Society for the Propagation of the Gospel.
Rupert's Land	700	The interest of a bequest by the late James Leith, Esq., and an annual allowance by the Hudson's Bay Company.
Jamaica	3000	Consolidated fund.
Barbadoes ...	2500	ditto
Antigua	2000	ditto
Guiana	2000	ditto
Sydney	1500	General Colonial Revenue, under Schedule (C.), annexed to Act 5th and 6th Vict. cap. 76.
Melbourne ...		L.500 Colonial Treasury. L.333, 6s. 8d. Colonial Bishoprics Fund.
Newcastle ...		L.500 Colonial Treasury. L.333, 6s. 8d. Colonial Bishoprics Fund.
Adelaide.....	800	Colonial Bishoprics Fund; interest of monies invested in the colony and in this country.
Tasmania ...	800 L.200 for house allowance, also forage allowance.	Part from colonial funds, and interest of L.5000 invested in securities in the colony by the Colonial Bishoprics Fund.
New Zealand	1200	L.600 Imperial parliamentary vote. L.600 paid by the Church Missionary Society to the Colonial Bishoprics Fund.
Cape Town...	800	Colonial Bishoprics Fund; interest of monies invested in the colony and in this country.
Colombo	2000	Colonial Funds.
Victoria	1000	Colonial Bishoprics Fund.
Gibraltar ...	1200	Colonial Bishoprics Fund.

* This includes the salary to the Bishop as rector of the parish.

Bishop's *Court*, an ecclesiastical court, held in the cathedral of each diocese, the judge in which is the bishop's chancellor, who decides according to the civil and canon law; and if the diocese be large, he has his commissaries in remote parts, who hold what are called *consistory courts*, for matters limited to them by their commission.

Bishop Auckland. See Auckland Bishop.

Bishop's Castle, a market and borough town in the hundred of Purslow and county of Salop, on the declivity of an eminence on the river Clun, 159 miles from London. Being

Bishop's Stortford || Bissagos.

on the main road between England and Wales, it has some trade, especially at its market, which is held every Friday. The town-house is a neat structure, as is also the church, which stands below the town. The bishops of Hereford had formerly a castle here. Pop. in 1851, 1699.

BISHOP'S STORTFORD, a market-town of the hundred of Braughin, in the county of Hertford, 32 miles from London. It is situated on the banks of the river Stort, and consists of four principal streets. By means of the canal it communicates with the metropolis, to which it sends much malt, corn, &c. Market-day Thursday. Pop. (1851) 5280.

BISHOP'S WALTHAM, a market-town in the hundred of the same name, county of Southampton, 65 miles from London. Here are the remains of the palace of the bishops of Winchester, and of the forest of Waltham. Principal trade, leather. Market-day, Friday. Pop. of parish (1851) 2265.

BISHOP'S WEARMOUTH, a large parish adjoining the town of Sunderland, in the county of Durham. Pop. (1851) 31,824. See SUNDERLAND. It stands on the Wear, and has several manufactories of different kinds. Over the Wear there is a magnificent iron bridge 236 feet in length, consisting of a single arch.

BISHOPING, a term to denote the devices used by horse-dealers to make an old horse appear young, or a bad one seem good.

BISIGNANO, a city and bishop's see, province of Calabria Citeriore, in the kingdom of Naples, 15 miles N. of Cosenza; pop. 3200. It has a castle, a cathedral, and several churches, with some trade in silk.

BISLEY, a market-town in the county of Gloucester, 103 miles from London. It is situated in the vale of Chalford (where the manufacture of broad cloth is extensively conducted), and is irregularly built. The Stroud Canal, which unites the Thames and Severn, passes through the parish. The church is handsome, and stands on a conspicuous eminence. Pop. (1851) 4801.

BISMILLAH, a solemn form used by Mahommedans at the beginning of all their books and other writings, signifying, "In the name of the most merciful God."

BISMUTH, one of the metals. See CHEMISTRY. By imparting hardness, it is a useful compound in the formation of several metallic alloys, as in the fabrication of printers' types, and the composition of foreign pewter. Eight parts of bismuth, five of lead, and three of tin, constitute what is called, after its discoverer, Newton's metal, which melts at the heat of boiling water, and may be fused over a candle in a piece of stiff paper without burning the paper. Plumbers' solder consists of one part of bismuth with five of lead and three of tin. With an equal weight of lead, it forms a brilliant white alloy, much harder than lead, and more malleable than bismuth, though ductile; and if the proportion of lead be increased, it is rendered still more malleable.

BISOMUM (*bis* and *σῶμα*), or DISOMUM, in *Roman Antiquity*, a sarcophagus or tomb, for two dead bodies, or their ashes. The sepulchres of the primitive Christians were inscribed with the words *bisomi*, *trisomi*, *quadrisomi*, &c., to indicate the number of bodies deposited in them.

BISON. See MAMMALIA, *Index*.

BISSAGOS, a group of small, low, fertile islands, situated at or near the mouth of the Rio Grande, in Western Africa. The entire number of these islands is very great, but there are only sixteen of any considerable magnitude. These are, Bissao, Bulama, Jate, Bussi, Manterre, Canabac, Galpineis, Arcas, Formosa, Carache, Corbelle, Genthera, Cavallo, Mel, Casegu, and Cove. The first five are mere alluvial islands, separated by river-branches from the continent, of which they properly form part. The others lie twenty or thirty miles out at sea, extending in a north-westerly direction towards the Gambia. Among the many smaller islands may be mentioned Bourbon, Sarcieri, Poelon, Papaygo, and Los Poarcos. Along the exterior side of these islands, where they face the ocean, extend numerous banks, which render the navigation very dangerous.

Bissat || Bitche.

These islands produce abundantly millet, rice, and fruits, and are all well stocked with a peculiar breed of oxen with a hump on the back, and remarkable for size and strength. The inhabitants, who are tall and robust, are fierce and warlike. This character applies to the Papels, who occupy Bissao and the adjoining continent, and still more to the Bissagos or Bijugas, who possess most of the remaining islands. They have almost entirely driven out the Biafaras, a mild and industrious race, who have been obliged to seek refuge on the continent along the banks of the Rio Grande. In 1792 some English adventurers formed the Bulama association, with the view of forming a settlement on the island of that name; and on the 11th April three vessels with 275 colonists sailed for Africa, under the command of Mr Dalrymple. They sailed to Bulama, and were quietly taking possession of the island, when the Bissagos from Canabac attacked the party, and killed several of their number. Mr Dalrymple then retired to Bissao, and induced the king of Canabac, for a trifling consideration, to cede to Great Britain the island of Bulama. A settlement was then effected; but finding that, instead of being placed in a situation of ease and luxury, they were obliged to cultivate the soil, the colonists lost courage, and most of them returned home in the vessel which brought them to Bulama. Captain Beaver being now left with little more than twenty men, and only half of these effective, was attacked by the king of Canabac. The enemy was gallantly beaten off; but the difficulties and distresses of the colony continuing to increase, Beaver took the first opportunity of conveying the remnant of his colony to Sierra Leone.

BISSAT, PATRICK, descended from the earls of Fife in Scotland, was born in that county in the reign of James V. From the university of St Andrews he removed to that of Paris; and he afterwards proceeded to Bologna, where he was appointed professor of canon law. Having filled this office for several years with great reputation, he died in 1568. He was also distinguished as an orator, a poet, and a philosopher. *Patricii Bissatti Opera omnia* were published at Venice in 1565, 4to.

BISSEXTILE, a year consisting of 366 days, corresponding to leap year. See CALENDAR, *Solar Year*.

BISTOURY (French *bistouri*, from the city Pistoia), a surgical instrument for making incisions. Some have the form of a lancet, others are straight and fixed in the handle like a knife, and others are crooked, with the sharp edge on the inside.

BISTRE (French *bis*, brown), a pigment of a brown transparent colour, which is best prepared from the soot of beech-wood, by boiling it in water (in the proportion of two pounds to a gallon) for half an hour. After standing to settle, and while still hot, the clearer part is poured off, and evaporated to dryness. The residuum is bistre.

BISUTUN, or BESSATUN, the plateau of Kermanshaw, the plain of the ancient Media. Its northern boundary is a precipitous ridge, generally 1500 feet above the plain. On this natural escarpment, Sir R. Ker Porter found the remains of a remarkable bas-relief, representing a Median king or warrior passing sentence on nine captives before him, while one prostrate at his feet is in the act of imploring mercy with outstretched hands. In another portion of this surface are the remains of a Greek inscription, that has been nearly effaced by a Persian one of modern date.

BISZTRITZ, a fortified town of Transylvania, pleasantly situated on a river of the same name, in Long. 24. 34. E. Lat. 47. 5. 46. N. It has several churches, a gymnasium, and other schools, a considerable trade in cattle, and about 6000 inhabitants.

BITCHE, a town and fortress of France, department of

Moselle, and capital of a canton of the same name. It stands in a pass of the Vosges, and the citadel occupies the summit of an almost inaccessible rock in the centre of the town. It mounts 80 pieces of cannon, and is regarded as almost impregnable. It has manufactures of earthenware, with extensive glass-works in the vicinity. Pop. 3131.

BITHYNIA (Βιθυνία), a province in the N.W. of Asia Minor, stretching along the Propontis, the Thracian Bosporus, and the Euxine, between the rivers Rhyndacus in the west, and the Parthenius in the east. In the south it bordered on Galatia and Phrygia Epictetus. The country derived its name from its inhabitants, the Bithyni, whose original home was the country about the Strymon in Thrace. Remnants of this nation remained in Thrace, and are frequently spoken of under the name of Thyni, or Thraces Bithyni. On their arrival in Asia, they expelled or subdued the native tribes of the Mysians, Bebryces, Caucones, and Mygdones; the Mariandyni, however, maintained themselves on the coast in the north-eastern part of the country. The Bithyni, after their conquest of the new country, appear to have been divided into two branches, the Thyni on the coast about the river Sangarius, and the Bithyni in the southern parts of the country. In the reign of Crœsus, Bithynia was incorporated with the Lydian empire, together with which it soon after fell into the hands of the Persians. Under the dominion of the latter, who probably made no great changes in the constitution of the country, it was governed by the Satrap of Phrygia; for at that time it scarcely contained any towns except the Greek colonies of Chalcedon and Astacus. During the subsequent disturbances in the Persian empire, some native princes of the Thyni made themselves independent, and maintained this independence even against Alexander the Great and his successors. Nicomedes, the first who assumed the title of king, reigned until B.C. 246. His successor, Prusias I., who died in B.C. 192, and Prusias II. (who probably died in B.C. 150) did much to establish the kingdom on a firm basis, and to extend its boundaries. The last king, Nicomedes III., in B.C. 75, bequeathed his kingdom to the Romans, who at first united it with their province of Asia, and afterwards with Pontus, until Augustus constituted it as a separate proconsular province. At the same time that emperor united the western part of Paphlagonia, under the name of Pontus, with Bithynia. Theodosius II. again divided the province, restricting the name of Bithynia to the western half, which contained the cities of Nicomedia, Nicaea, and Chalcedon, while the eastern part, with the cities of Heraclea and Claudiopolis, received the name of Honorias.

The country of Bithynia is traversed in all directions by woody mountains, the highest of which is the Mysian Olympus, which furnished abundance of timber for shipbuilding. The plains and valleys are very beautiful and fertile, producing barley, wheat, beans of various kinds, figs, and wine, but no olives. The district about Bithynium was distinguished for its excellent pasture; and the cheese made there was in great repute among the ancients. The principal river was the Sangarius, traversing the country from south to north. (See Cramer, *Asia Minor*, i. 167–215; Leake, *Asia Minor*, p. 306; Forbiger, *Handbuch der Alten Geographie*, vol. ii. p. 374, where all the ancient authorities referring to Bithynia are cited.) (L. S.)

BITLIS, a town of Asiatic Turkey. See BETLIS.

BITONTO, a city, the see of a bishop, in the province of Bari, in the kingdom of Naples, on the great road from Foggia to Bari. It contains, besides the cathedral, twenty-four churches, and 14,500 inhabitants, who export the excellent wine known by the name of Zagarello.

BITTERFELD, a walled town of Prussia, capital of a circle of the same name, in the province of Saxony and government of Merseburg. It is situated on the river Löber, near the Mulde, and has manufactures of woollen cloth and hardware. It was founded by a colony of Flemings in the twelfth century. Pop. (1849) of town 3890, of circle 44,625.

BITTERN. See ORNITHOLOGY, *Index*.

BITTS, perpendicular pieces of timber fixed in the deck of a ship for fastening ropes to. There are also bitts to secure the windlass and the heel of the bowsprit.

BITUMEN (*Mineral Pitch, Asphaltum, Erdpech*), the most perfectly inflammable mineral known. Of this there are three varieties, elastic, earthy, and compact; the first is distinguished by its softness and elasticity, which, however, it partly loses on exposure to the air; the second, by its dull earthy appearance, and softness sufficient to take an impression from the nail; and the third, from its more or less conchoidal fracture, corresponding to the degrees of lustre it possesses. The component parts of these, however, are nearly the same; and, except in appearance and consistency, they do not differ from naphtha, a fine colourless fluid, which when first inspissated, becomes brown, and is then changed into mineral pitch by exposure to the air. Bitumen is usually of a black or brownish hue, is easily inflammable, and burns with a bituminous smell, much smoke, and a clear flame: some varieties even melt at a higher temperature. In specific gravity it varies considerably, from 0·828 to 1·160 according to its density; and in composition it consists chiefly of hydrogen and carbon. The substance called petroleum is a liquid bitumen, apparently formed of asphaltum dissolved in naphtha. The elastic variety has been found principally in the Odin mine at Castleton, in Derbyshire; and from its property of taking up the traces of a pencil in the same manner as Indian-rubber, it has obtained the appellation of *mineral caoutchouc*. The semi-liquid species abounds in Trinidad, where it forms a lake said to be three miles in circumference, and where, when mixed with grease or common pitch, it is used for paying the bottoms of ships. It has also been met with in Persia, in Dalmatia, and in the Hartz. The compact variety again, occurs, forming nodules, in the lead mines of Matlock in Derbyshire, at Hurlet near Paisley, in sandstone near Bathgate in Linlithgowshire, imbedded in sandstone in Albania, Hanover, and in many parts of the Continent. The more liquid varieties of this mineral admit of considerable application for illuminating, for fuel, in the manufacture of varnish, &c., besides its common application to pavements.

The bitumen employed by the ancient Babylonians, instead of mortar, to unite the sun-dried bricks in their colossal structures, was evidently the semi-liquid bitumen which we now designate petroleum; and the state in which the mighty ruins still exist shows how imperishable a cement this material afforded. The principal source whence this bitumen was obtained was the fountains of Is, the modern Hit, on the right bank of the Euphrates. These fountains, which are considered as an inexhaustible source of bitumen, still continue to pour it out copiously, mingled with intensely saline sulphureous thermal waters. Much fine salt is now made there by a rude process of spontaneous evaporation; but the bitumen floating on the waters is now only employed to pitch the wicker boats and coracles of the Euphrates and the Tigris. The celebrity of these fountains caused them to be visited by Alexander the Great, by Trajan, and by Julian. The geology of the district presents little peculiarity; the principal rock being an argillaceous limestone, over which in many places lies a coarsely-granular gypsum: but the cause which has for several thousand years produced a perennial distillation of bitumen in this spot, lies probably at a considerable depth below the surface.

BIVALVE, a term in Conchology for a shell which consists of two valves. It is also applied in Botany to a pericarp in which the seed-case opens into two parts.

BIVOUAC (German *beiwacht*), the watch or guard of an army by night during a siege, or in the presence of an enemy. When an army does not regularly encamp, but lies under arms all night, the soldiers passing the night around the

Bizari || Black.

watch-fires, or with such shelter as they can find or construct upon the spot, it is said to *bivouac*.

BIZARI, PIETRO, a poet and historian of the sixteenth century, born near Ancona. Having adopted the doctrines of the Reformation, he took refuge in Scotland, where he was well received by the Regent Murray. (Tiraboschi.)

BIZERTA, or BENZERT, a seaport in the kingdom of Tunis, on a gulf of the same name, which communicates with a lake in the interior. It occupies the site of the ancient Hippo Zaritus, the harbour of which, by means of a spacious pier, protecting it from the north-east wind, was rendered one of the safest and finest on this coast. This important work, however, has been entirely neglected by the Turks, whence the port has been choked up, and now receives only small vessels. The place, however, is still about a mile in circuit, defended by several strong castles and batteries. The principal employment of the inhabitants consists in fishing. The adjoining lake abounds in fish, particularly mullets, the roes of which, dried and formed into the substance called botargo, form a considerable article of Mediterranean commerce. It is situated 38 miles north-west of Tunis. Long. 9. 50. E. Lat. 37. 17. N.

BLABY, a parish and village in Leicestershire, hundred of Guthlaxton. The village, $4\frac{1}{2}$ miles S.W. of Leicester, contains a fine old parish church, a Wesleyan and a Baptist chapel, and a handsome national school. It is near the line of the Midland railway. Pop. of parish in 1851, 1952, chiefly engaged as framework-knitters and glove-makers.

BLACK, Dr JOSEPH, distinguished for his discoveries in chemistry, was born in France, on the banks of the Garonne, in the year 1728. His father was a native of Belfast, but descended from a Scottish family which had been some time settled there. Mr Black, the father, was engaged in the wine trade, and resided chiefly at Bordeaux.

He is represented as a man of extensive information, of candid and liberal sentiments, and of amiable manners; but particularly distinguished by the strength of his attachments, and the warmth of his heart. These estimable qualities procured him the friendship and intimacy of Montesquieu, who was one of the presidents of the court of justice in the province while Mr Black resided at Bordeaux.

Some time before Mr Black retired from business, he sent his son Joseph, then in his twelfth year, to Belfast, to prosecute his studies; and when he had completed the usual course of instruction in a grammar school, he was sent to the university of Glasgow, in the year 1746. During the time he studied at that seminary, his attention seems to have been principally directed to physical science; and he became a favourite pupil of Dr Dick, then professor of natural philosophy. After having completed the ordinary course of general study at the university, he made choice of the profession of medicine; and directed his views to those pursuits and studies which were necessary to qualify him for that profession.

About this time Dr Cullen was appointed to the lectureship of chemistry in the university of Glasgow. Hitherto the science had been treated as a curious, and only in some respects as a useful art. That great man, conscious of his own strength, and taking a wide and comprehensive view, saw the unoccupied field of philosophical chemistry expanded before him. He was satisfied that the science was susceptible of very great improvement by means of liberal inquiry and rational investigation. He was therefore determined to enter the unbeaten path, and to conduct his followers to those unexplored regions which are included in the wide range of this comprehensive and attractive science. While these views were opening in the mind of Dr Cullen, Black became his pupil; and it was perhaps to this fortunate circumstance that he was indebted for the foundation of his future reputation as a philosopher and a chemist. The liberal and extensive views of Cullen happily accorded with the enlarged habits of thought which the young philosopher had previously acquired. Dr Cullen took a deep interest in the progress of his students. He delighted in encouraging and aiding their efforts; and, therefore, perceiving the bias of Black's pursuits, soon attached him to himself. By the intercourse and intimacy which followed, Black was led into the same train of thought, and conducted into the same course of studies; he was received into a closer connection, and became a most valuable assistant in all Dr Cullen's chemical operations. The experiments of Black were frequently adduced to prove facts which were stated in the lecture, and they were considered as unexceptionable authority. Thus commenced a mutual confidence and friendship, which was highly honourable to both, and was never afterwards mentioned by Dr Black but with gratitude and respect.

Black, Dr Joseph.

In the year 1751, Mr Black went to Edinburgh to complete the course of his medical studies. There he resided in the house of his cousin-german, Mr Russell, professor of natural philosophy in that university, a gentleman of enlarged views and liberal sentiments, whose conversation and studies must have been both agreeable and profitable to his young friend.

At this time the mode of action of lithontriptic medicines, but particularly lime-water, in alleviating the pains of stone and gravel, divided the opinions of professors and practitioners. This subject became extremely interesting both to the physician and chemist. And as it is usual for the students to enter warmly into those discussions which give rise to much difference of opinion among their teachers, this subject, being quite suited to his taste, particularly attracted and interested the attention of Mr Black, who was then one of Dr Cullen's most zealous and intelligent pupils. It appears from some of his memorandums, that he at first held the opinion that the causticity of alkalies was owing to the igneous matter which they derived from quicklime. But having prosecuted his experiments on magnesia, this grand secret of nature was laid open to his view, and he was led to conclude that the acrimony of these substances was not owing to their combination with igneous particles; that it formed their peculiar property; and that they lost this property and became mild by combining with a certain portion of air, to which he gave the name of *fixed air*, because it was fixed or became solid in the substances into the composition of which it entered.

This grand discovery, which marks one of the most important eras of chemical science, formed the subject of his inaugural dissertation, published at the time when he was admitted to his medical degree in the university of Edinburgh. He had not availed himself of the time he had studied at Glasgow, but took the whole course prescribed by the rules of the university. This delay, it has been supposed, may have been owing to the investigation of the subject in which he had engaged not having been completed; which determined him to proceed with caution till he had established his doctrine by a train of decisive experiments.

About the time that Dr Black took his medical degree, Dr Cullen was removed to Edinburgh, which created a vacancy in the chemical chair at Glasgow. While he remained at that university, Dr Black had been a diligent and attentive student; and the discovery published in his inaugural essay had added much to his reputation. He was therefore looked up to as a person amply qualified to fill the vacant chair; and accordingly, in the year 1756, he was appointed professor of anatomy and lecturer on chemistry in the university of Glasgow. And it was perhaps fortunate for himself, fortunate for the public and

Black, Dr Joseph.

for science, that a situation so favourable presented itself; a situation which allowed him full time to dedicate his talents to the cultivation of chemistry, which had now become his favourite science.

Along with the lectureship on chemistry, Dr Black's first appointment in the university of Glasgow was to the professorship of anatomy. But the latter branch of medical study was either not so suitable to his taste, or he did not consider himself so well qualified to be useful in it; for, soon after, arrangements were made with the professor of medicine, by which the professors exchanged departments, Dr Black undertaking that of the institutes and practice of medicine.

At this time his lectures on medicine formed his chief occupation; while the perspicuity and simplicity, the caution and moderation, which he discovered in the doctrines which he delivered, gave great satisfaction. The time and attention which were occupied in these lectures, and in the medical practice in some measure necessarily connected with his situation, are supposed by some to have been the principal cause of Dr Black's having suddenly stopped short in that brilliant career on which he had at first so successfully entered. It is more probable, however, that the calm and unambitious temper which seems to have formed a striking feature of his character, and which a less friendly hand than his learned biographer might have set down as nearly allied to indolence, checked the ardour and perseverance which were necessary to excite and carry him forward in the path of research and discovery. Whatever may have been the cause, it is to be regretted that Dr Black, so conspicuous for his patient, judicious, and elegant mode of investigation, and so distinguished for the simplicity, perspicuity, and precision of his reasonings and deductions, should have contributed so little in rearing the noble superstructure of chemical science, the foundation of which he had been the means of establishing on a firm and solid basis.

The theory of the nature of quicklime, and the cause of its causticity, soon became known to the German chemists, and from them it met with strong opposition. Various mysterious doctrines at this time prevailed in the German schools concerning the peculiar nature of fire; and as the notions there entertained of the causticity of alkaline substances involved some of these doctrines, a great many objections were started to a theory which threatened to overthrow long established and favourite opinions. The most formidable opponent of the new theory was Professor Meyer of Osnaburg. All the phenomena of the causticity and mildness of lime and alkali were, according to his explanation, to be accounted for by the action of a substance of a peculiar nature, to which he gave the name of *acidum pingue*. This substance, which was supposed to be formed in the lime during calcination, consisted of an igneous matter in a certain state of combination with other substances. It is a matter of some surprise that Dr Black should have experienced any uneasiness on account of the opposition made to this discovery on mere hypothesis unsupported by facts or even by plausible arguments, when his own doctrine had been fully and irrefragably established by the test of decisive experiment. Nor is it less surprising that, in the course of his lectures for several years, he should have taken great pains in refuting the arguments and in combating the objections of Meyer.

Dr Black's reception at the university of Glasgow was highly flattering and encouraging. As a student he had not only done himself much credit by his successful progress in the different pursuits in which he was engaged, but he had also during his residence there conciliated, in a high degree, the attachment and affection of the professors. When he returned as a professor, he immediately became connected in the strictest friendship with Dr Adam Smith, then professor of moral philosophy in that university; and the friendship thus commenced grew stronger and stronger, and was never interrupted throughout the whole of their lives. A simplicity and sensibility an incorruptible integrity, the strictest delicacy, and singular correctness of manners, marked the character of each of these philosophers, and firmly bound them together in the closest union.

Black, Dr Joseph.

At Glasgow Dr Black soon acquired great reputation as a professor, and became a favourite physician in that large and active city. His engaging countenance, his agreeable and attractive manners, free from all studied endeavours to please, and the kind concern he took in the cases intrusted to his care, made him a most welcome visitor in every family.

It was between the years 1759 and 1763 that he brought to maturity his speculations concerning heat, which had occupied his attention at intervals, from the very first dawn of his philosophical investigations. His discoveries in this department of science were by far the most important of all that he made, and perhaps indeed among the most valuable which appeared during the busy period of the eighteenth century. To enter fully into the nature of his investigations would be improper in this place; but the sum of them all was usually expressed by him in the following propositions.

When a solid body is converted into a fluid, there enters into it and unites with it a quantity of heat, the presence of which is not indicated by the thermometer; and this combination is the cause of the fluidity which the body assumes. On the other hand, when a fluid body is converted into a solid, a quantity of heat separates from it, the presence of which was not formerly indicated by the thermometer; and this separation is the cause of the solid form which the fluid assumes.

When a liquid body is raised to the boiling temperature, by the continued and copious application of heat, its particles suddenly attract to themselves a great quantity of heat; and by this combination their mutual relation is so changed that they no longer attract each other, but are converted into an elastic fluid like air. On the other hand, when these elastic fluids, either by condensation or by the application of cold bodies, are reconverted into liquids, they give out a vast quantity of heat, the presence of which was not formerly indicated by the thermometer.

Thus water, when converted into ice, gives out 140° of heat; ice, when converted into water, absorbs 140° of heat; and water, when converted into steam, absorbs about 1000° of heat, without becoming sensibly hotter than 212°. Philosophers had long been accustomed to consider the thermometer as the surest method of detecting heat in bodies; yet this instrument gives no indication of the 140° of heat which enter into air when it is converted into water, nor of the 1000° which combine with water when it is converted into steam. Dr Black, therefore, said that the heat is concealed (*latet*) in the water and steam; and he briefly expressed this fact by calling the heat in that case *latent heat*.

Dr Black having established this discovery by simple and decisive experiments, drew up an account of the whole investigation, and read it to a literary society which met every Friday in the faculty-room of the college, consisting of the members of the university, and several gentlemen of the city who had a relish for philosophy and literature. This was done on the 23d of April 1762, as appears by the registers. The doctrine in question was immediately applied by its author to the explanation of a vast number of natural phenomena; and in his experi-

Black, Dr Joseph.

mental investigations he was greatly assisted by his two celebrated pupils, Mr Watt and Dr Irvine.

As Dr Black never published an account of his doctrine of latent heat, although he detailed it every year subsequent to 1762 in his lectures, which were frequented by men of science from all parts of Europe, it became known only through that channel; and this gave an opportunity to others to pilfer it from him piece-meal. Dr Crawford's ideas respecting the capacity of bodies for heat were originally derived from Dr Black, who first pointed out the method of investigating that subject.

The investigations of Lavoisier and Laplace concerning heat, published many years after, were obviously borrowed from Dr Black, and indeed consisted in the repetition of the very experiments which he had suggested. Yet these philosophers never mention Dr Black at all; every thing in their dissertation assumes the air of entire originality; and indeed they appear to have been at great pains to prevent the opinions and discoveries of Dr Black from being known among their countrymen. But perhaps the most extraordinary proceeding was that of M. Deluc. This philosopher had expressed his admiration of Dr Black's theory of latent heat, and had offered to become his editor. Dr Black, after much entreaty, at last consented, and the proper information was in consequence communicated to M. Deluc. At last the *Idée sur la Météorologie* of that philosopher appeared, in 1788. But great was the astonishment of Dr Black and his friends when they found the doctrine claimed by Deluc as his own, and an expression of satisfaction at the knowledge which he had acquired of Dr Black's coincidence with him in opinion. M. Deluc has, in his own vindication, published an answer to this charge. See *Edinburgh Review*, No. 12, 1805.

Dr Black continued in the university of Glasgow from 1756 to 1766. In 1766 Dr Cullen was appointed professor of medicine in the university of Edinburgh, and thus a vacancy was produced in the chemical chair of that university. Dr Black was with universal consent appointed his successor; and in the new scene on which he entered his talents became more conspicuously and more extensively useful. But whilst he could not fail to be highly gratified by the great concourse of pupils which the high reputation of the medical school of Edinburgh attracted to his lectures, his mind was forcibly impressed with the importance of his duties as a teacher. This had an effect which, perhaps, was on the whole rather unfortunate. He directed his attention exclusively to his lectures, and his object was to make them so plain as to be on a level with the capacity of the most illiterate of his hearers. The improvement of the science seems to have been altogether abandoned by him. And never did any man succeed more completely. His pupils were not only instructed, but delighted. Many became his pupils merely in order to be pleased; and this contributed greatly to extend the knowledge of chemistry. It became in Edinburgh a fashionable part of the accomplishment of a gentleman.

Perhaps also the delicacy of his constitution precluded him from exertion; the slightest cold, the most trifling approach to repletion, immediately affected his chest, occasioned feverishness, and, if continued for two or three days, brought on a spitting of blood. Nothing restored him but relaxation of thought, and gentle exercise. The sedentary life to which study confined him was manifestly hurtful, and he never allowed himself to indulge in intense thinking, without finding these complaints sensibly increased.

So completely trammelled was he in this respect, that although his friends saw others disingenuous enough to avail themselves of the novelties announced by Dr Black in his lectures, and therefore repeatedly urged him to publish an account of what he had done, this remained unaccomplished to the last. Dr Black often began the task, but was so nice in his notions of the manner in which it should be executed, that the pains he took in forming a plan of the work never failed to affect his health, and oblige him to desist. Indeed he peculiarly disliked appearing as an author. His inaugural dissertation was the work of duty. His *Experiments on Magnesia, Quicklime, and other Alkaline Substances*, was necessary to put what he had indicated in his inaugural dissertations on a proper foundation. His *Observations on the more ready Freezing of Water that has been Boiled*, published in the Philosophical Transactions for 1774, was also called for; and his *Analysis of the Waters of some Boiling Springs in Iceland*, made at the request of his friend T. I. Stanley, Esq. was read to the Royal Society of Edinburgh, and published by the council. And these are the only works of his which appeared in print during his lifetime.

Black, Dr Joseph.

The aspect of Dr Black was comely and interesting. His countenance exhibited that pleasing expression of inward satisfaction, which, by putting the beholder at his ease, almost never fails to please. His manner was wholly unaffected and graceful. He was affable, and readily entered into conversation, whether serious or trivial. He was a stranger to none of the elegant accomplishments of life. He had a fine musical ear, with a voice which obeyed it in the most perfect manner; for he sung, and performed on the flute, with great taste and feeling, and could execute a plain air at sight, which many instrumental performers cannot do. Without having studied drawing, he had acquired considerable power of expression with his pencil, and seemed in this respect to have the talents of an historical painter. Figure indeed of every kind attracted his attention; even a retort, or a crucible, was to his eye an example of beauty or deformity.

He had the strongest claim to the appellation of a man of propriety and correctness. He did every thing in its proper season, and he always seemed to have leisure in store. He loved society, and felt himself beloved in it; and, throughout his whole life, he never lost a friend, except by the stroke of death.

The only apprehension he entertained was that of long-continued sickness, less, perhaps, from any selfish feeling, than from the consideration of the trouble and distress which it would occasion to attending friends; and never was this generous wish more completely gratified. On the 26th of November 1799, and in the seventy-first year of his age, he expired without any convulsion, shock, or stupor, to announce or retard the approach of death. Being at table with his usual fare, some bread, a few prunes, and a measured quantity of milk diluted with water, and having the cup in his hand when the last stroke of the pulse was given, he set it down on his knees, which were joined together, and kept it steady with his hand in the manner of a person perfectly at his ease; and in this attitude he expired without a drop being spilt, or a feature in his countenance changed, as if an experiment had been required to show to his friends the facility with which he departed. His servant opened the door to tell him that some one had left his name; but getting no answer, stepped about half-way towards him, and seeing him sitting in so easy a posture, supporting his basin of milk with one hand, he thought that he had dropt asleep, which sometimes happened after his meals. He went back and shut the door; but before he went down stairs, some anxiety which he could not account for made him return and look again at his master. Even then he was satisfied after coming pretty near, and turned to go away; but returning a second time, and going close up, he found his master a corpse. Sleep, says the poet, is the kinsman of death. Dr Black found the

Black Black-Mail.

relationship very close indeed, and slept (we had almost said *slipt*) away from time to eternity, by a transition so easy as to be imperceptible even to the eye of affection.

BLACK is the negation of colour; or the deprivation of light, resulting from a peculiarity in certain substances, by which they absorb the rays of light instead of reflecting them.

Black, from a remote antiquity, has been regarded as the symbol of mourning and calamity. It is sometimes imposed as a mark of humiliating distinction; the most familiar instance of which is the obligation laid upon the Jews in Turkey of wearing black turbans.

BLACK Act, the statute 9th Geo. I. by which it is felony to appear armed, and with the face blackened or disguised, in any park, warren, &c., for the purpose of hunting or stealing deer, &c.

The *Black Acts* are the Acts of the Scottish parliament during the reigns of the five Jameses, of Mary, and of James VI., down to the year 1586 or 1587; so styled because written in the Saxon character.

BLACK-Bird, Black-Cap, Black-Cock. See ORNITHOLOGY.

BLACK-Book of the Exchequer. See ENGLAND.

BLACK-Books, a name given to those which treat of necromancy. The black-book of the English monasteries was a detail of the enormities practised in religious houses, compiled by order of the visitors under Henry VIII. to blacken them, and thus hasten their dissolution.

BLACK-Forest, a forest of Suabia, in Germany, running from north to south between Ortnau, Brisgau, part of Wirtemburg, and the principality of Furstenburg, towards the source of the Danube as far as the Rhine above Basle. It is part of the ancient Hercynian forest.

BLACK-Friars, a name given to the Dominican order, called also predicants or preaching friars, and in France *jacobins*.

BLACK-guard, a common term for an ill-behaved and disreputable person. It is derived, according to some, from the French *blagueur*; others make it a corruption of *blackard*, black-kind; Dr Johnson simply a compound of "black" and "guard."

BLACK-Lead a name improperly applied to plumbago. Plumbago, or, as it is technically called, graphite, the mineral used in the formation of pencils, crucibles, &c., has no relation to any ore of lead.

BLACK-Letter, a term derived from the dark appearance of the page in books printed or written in the old English or modern Gothic character, which was introduced into England about the middle of the fourteenth century.

BLACK-Mail, a certain rate of money, corn, cattle, or other valuable, anciently paid in the north of England to certain persons who were allied with robbers and plunderers, in order to be by them protected from pillage. This composition with the protectors and supporters of thieves was prohibited by the 43d Elizabeth, cap. 13, and it seems to have been early checked in the English border counties. But in the Highlands of Scotland the exaction of black-mail from the lowland borderers continued in spite of every effort to put it down, till after the Rebellion of 1745.

Black-mail is defined by Dr Jamieson "a tax or contribution paid by heritors or tenants, for the security of their property, to those freebooters who were wont to make inroads on estates, destroying the corns, or driving away the cattle." Rob Roy Macgregor, one of the most noted of these, overawed the country as late as the year 1744, and frequently robbed the Duke of Montrose's factor of the rents after they had been collected from the tenants. Spelman thinks that this illegal imposition received the name of black-mail from the poverty of those who were thus assessed, and as being paid in *black* money, not in silver; and Du Cange adopts this idea with little variation, stating that while brass money is called *blanque* or *blanche maille*, or white money, by the French, the Saxons and English denominate it *black*, in opposition to silver, which they account *white* money. But the more probable opinion is, that the epithet *black* is here used in a moral sense, to indicate the illegality or iniquity of the exaction. Wachter, however, defines "black-mail" *tributum pro redimenda vexa*, deriving it from the German "placken," *vexare, exagitare*, whence "baurenplacker," *rusticorum exagitator*; and Schilter says that "black-en" signifies *prædari*.

Black-Monks ‖ Black Sea.

BLACK-Monks, a denomination given to the Benedictines; in Latin *nigri monachi*, and sometimes *ordo nigrorum*.

Boundaries.

BLACK SEA, or EUXINE SEA, *Pontus Euxinus* of the ancients, is a large inland sea, bounded on the west by Rumelia, Bulgaria, and Bessarabia; on the north by Russian Tartary; on the east by Mingrelia, Circassia, and Georgia; and on the south by Anatolia. It is entered from the Mediterranean through the channel of the Dardanelles, anciently the *Hellespont*, the Sea of Marmora or *Propontis*, and the channel of Constantinople or *Thracian Bosporus*; and it is connected with the Sea of Azof, or *Palus Mæotis*, by the strait between the Crimea and the isle of Taman, anciently the *Cimmerian Bosporus*, and known by the various modern names of the Strait of Kertch, of Yenikale, and of Taman.

Progressive geography.

Till within less than half a century, the extent of the Black Sea, and the position of several of its principal capes, gulfs, and ports, were very imperfectly ascertained. But soon after the commencement of the French Revolution, the National Institute sent M. Beauchamp to examine this sea, and especially its southern shores. In this enterprise he was much impeded by the jealousy of the Turks: nevertheless, he ascertained that Cape Kerempe, *Carambis*, was placed in the charts too far to the south; that the Gulf of Sansoun, *Amisenus Sinus*, was deeper than it is commonly represented; and that Trebizond, the Tarabazan of the Turks, anciently *Trapezus*, was five or six leagues farther to the west than it appeared in the charts. But recent travellers have discovered that even the Parisian charts are inaccurate. According to Dr Clarke, the Isle of Serpents, the Ulan-Adassi of the Turks, the Fidonisi of the modern Greeks, and ancient *Leuce*, lies fifteen minutes, and the port of Odessa twenty-seven minutes, too far towards the north (Clarke's *Travels*, i. 653); and Mr Macgill ascertained, from two observations of his own, compared with those of some captains who had navigated this sea, that in the French charts even Cape Kerempe is set down fifteen miles too far north, whilst Cape Aria or Saritch or Careza, *Kriu-Metopon*, in the Crimea, is placed twenty-two miles too far south. This, of course, makes a difference in the width of the sea at this place of thirty-seven miles. (Macgill's *Travels*, i. 195.)

Extent.

According to the best authorities, which Mr Arrowsmith has followed in his maps of this sea, it lies between 41 and 46½ degrees of north latitude (the bottom of the Bay of Sansoun penetrating nearly to the 40th degree, and Cape Kerempe stretching out nearly to the 42d), and between 28 and 41½ degrees of east longitude from Greenwich. This will give for its extreme breadth, from Cape Baba in Anatolia to Odessa, about 380 miles, and for its extreme length, from the coast of Rumelia to the mouth of the Phasis, 700 miles. The Black Sea, however, may be considered as divided into two parts, by Cape Aria on the south of the Crimea, and Cape Kerempe on the coast of Paphlagonia; the former lying in about 44½, and the latter in about 42 degrees of north latitude. Both these capes being high land, vessels sailing between them can discover the coast on either side. The circumference of the Black Sea is about 3800 miles.

Name.

The first navigators of Greece who ventured into this sea having been repulsed or massacred by some of the fierce tribes inhabiting its coasts, their countrymen gave it the name of *Pontus Axenos*, or "sea unfriendly to strangers." But when the repeated visits of the Greeks had rendered

Black Sea.

these tribes more familiar with strangers, and commercial intercourse had softened down the original ferocity of their character, Grecian colonies were established at different points on the shores of this sea, and the epithet *Axenus* was changed into *Euxinus*, which has the opposite import, and means "friendly to strangers." It derives its modern name either from the dense fogs which frequently cover it, or from the dangers of its navigation arising from these fogs; from the sudden and violent storms to which it is exposed; and from the shallows hitherto unnoticed in any chart.

Former tate.

The opinion of the ancients, that the Black Sea was formerly much more extensive than it is at present, and that it did not originally communicate with the Mediterranean, is adopted by many modern authors of note, particularly by Tournefort, Buffon, Pallas, and Dr Clarke, and seems to be confirmed by several circumstances. Immense strata of limestone, consisting almost entirely of mineralized sea-shells, may be traced from the Black Sea to the northward as far as the 48th degree of latitude, or about a degree and a half beyond the most northerly point of its northern shore; and Pallas, in the third and seventh volumes of his *Travels*, has pointed out traces of its having formerly extended over the whole desert of Astracan and Jaik. The evidences derived from the appearance of the present coast of this sea are still less equivocal in support of the diminution of its waters. Pliny expressly states that *Taurida* or the Crimea was once not only surrounded by the sea, but that the sea covered all that portion of it which is at present champaign country. Now, from the mouths of the Dnieper to those of the Don there are found continuous layers of marine shells; and if we suppose the waters of the Black Sea to be restored only to the level of these layers, the Crimea will again appear as an island. The alluvial nature of more than three-fourths of the soil of Crimea Proper to the north, the numerous salt lakes and marshes and the remains of marine productions of various kinds which are found there, sufficiently confirm the latter part of Pliny's statement.

Bursting of the Thracian Bosporus.

The ancients also believed that the communication between the Black Sea and the Mediterranean, and the consequent diminution of the waters of the former, was effected by the bursting of the Thracian Bosporus at the period of the great deluge which inundated Greece; and this tradition seems to be confirmed by a reference to existing natural phenomena. The cliffs and hills at the mouth of the Bosporus are composed of enormous pebbles, which appear to have undergone the action of fire, and afterwards to have been rounded by long attrition in water. On the point of the European lighthouse there are immense masses of hard and compact lava; and the rock of which the Cyanean Isles consist appears to have been more or less modified by fire, and to have been cemented during the boiling of a volcano. On the Asiatic side of the strait, a little to the eastward of the Anatolian lighthouse, there is also a range of basaltic pillars, exhibiting very regular prismatic forms. From the consideration of all these circumstances, and from comparing events recorded in history with the phenomena of nature, Dr Clarke considers it more than a conjectural position, "that the bursting of the Thracian Bosporus, the deluge mentioned by Diodorus Siculus, and the draining of the waters which once united the Black Sea to the Caspian, and covered the great oriental plain of Tartary, were all the consequences of earthquakes caused by subterranean fires, described as still burning at the time of the passage of the Argonauts, and the effects of which are visible even at this hour." (Vol. i. p. 680.) It is proper to mention, that Olivier does not coincide with other naturalists respecting the former extent of the Black Sea, or the bursting of the Thracian Bosporus. According to the most recent survey, made in 1840 by Mr Xavier Hommaire de Hell, the difference in level between the Black Sea and the Caspian is 34 feet.

Black Sea.

Changes in its coasts.

The northern and western coasts of this sea have undergone, and are still undergoing, considerable changes; but the southern coast, consisting chiefly of calcareous rocks, is nearly in the same state in which it was in the time of the ancients. According to Valerius Flaccus, the gulfs and bays in the northern and western coasts were extremely deep; most of these, however, are now all either entirely filled up or very much contracted. In proof that the Black Sea and the Sea of Azof are still sustaining a diminution of their waters, it may be stated that ships which formerly sailed to Taganrog and the mouths of the Don, are now unable to approach either the one or the other; that the Sea of Azof has become so shallow, that, during certain winds, a passage may be effected by land from Taganrog to Azof through the bed of the sea; and that the isthmus connecting the Cyanean Isles with the Continent, which does not appear to have existed in the time of Strabo, appears to be increasing. On the southern coast of the Black Sea there is, as far as we know, only one instance of a recession of the waters: the channel which formerly divided the village of Amasrah, *Amastris*, is now entirely filled up, and forms a low isthmus.

Currents, winds, and climate.

A rapid current, which generally flows at the rate of a league an hour, the influence of which is felt at the distance of ten miles from land, where it begins to take another direction, sets from the Black Sea into the Bosporus. Sometimes, however, the long continuance of a strong south-westerly wind effectually counteracts this current. The Black Sea, from its particular form, being like a basin, into which many large rivers pour their streams, is full of currents, particularly in summer, when the rivers are increased by the melting of the snows; and when strong winds act against these currents, a high sea is produced. North-east winds prevail from June to August inclusive; but the most prevalent winds at other seasons of the year are from the S. and S.W. The general climate of the Black Sea is cold and humid; the winters are long, and frequently very severe; but the navigation is free of impediment from ice till the beginning of November, and often much later. The quantity of fresh water conveyed into this sea renders it brackish, and liable to freeze with a moderate degree of cold. It is calculated by some authors, particularly Tournefort (ii. 404), and the Abbé Barthélemy (*Voyage d'Anacharse*, tome i. c. 1), that the volume of water it receives is much greater than that which it discharges into the Mediterranean. Dr Clarke, however, is of opinion that the rivers which fall into the Black Sea and the Sea of Azof do not communicate more water than flows through the canal of Constantinople; and hence he concludes, that admitting the effect of evaporation, the level of the Black Sea is insensibly falling.

Rivers.

The Black Sea receives a considerable portion of the fresh waters of Europe, as well as of Asia Minor. The Danube collects the waters of a great part of Germany, Hungary, Bosnia, Servia, Transylvania, Moldavia, Wallachia, and Bulgaria. The Dniester, Bog, Don, and Dnieper, discharge into it those of a part of Russia and Poland. The Phasis collects those of Mingrelia; and the Sangaris, and Kisil-Irmak, or *Halys*, part of those of Anatolia.

Fishes.

In the Black Sea are found the tunny fish, which enters it to spawn; sturgeon, sterlet, porpesse, mackerel, sole, turbot of two kinds, whiting, and roach. Some writers also speak of herrings entering this sea in shoals, but it is probable that they are only large sprats. Their appearance, however, is considered symptomatic of a good sturgeon season. It abounds with a species of sea-worm, four or five inches long, with a head like an arrow, and a body consisting of a whitish mucilage. This worm is very destructive to ships. It does not confine itself to salt-water, and is therefore not the *Teredo navalis* or *terebranes*.

We shall begin our survey of the coasts and ports of this

Black Sea.

sea, at its entrance from the Bosporus, and proceed along its western shores. Off each point of the entrance of the Bosporus from the Black Sea is a group of rocky islets, which retain their ancient name of Cyanean Islands. These have been already described. From the Bosporus to Kara-Kerman, which lies within a few miles of the southern-most branch of the Danube, the coast is lined by the mountainous ridge of the Balkan or *Hæmus*, which terminates at Cape Emeniah, *Hæmi extrema*. The valleys between these mountains form little coves, where vessels are laden with the timber of the Balkan for Constantinople. The forest of Belgrade, which takes its name from a village near Constantinople, extends along the south-western side of the Black Sea for about 100 miles. Incada lies on this coast in 41. 52. north latitude. Pliny and Ptolemy make mention of this town under the name of Thenias; they also call by the same name a promontory which can only be the Cape Kouri of the present day. On the northern side of the harbour there is fair anchorage; it is only exposed to winds from the E. and S.E., and is sufficiently spacious to contain a fleet; but a heavy sea enters it when those winds blow to which it is exposed. Its chief export is charcoal to Constantinople. At the head of the Gulf of Foros, which is bounded on the north by Cape Emeniah, and runs into the land nearly the same distance, is Bourgas, which exports a considerable quantity of wool, iron, corn, butter, cheese, and wine, to Constantinople. The Gulf of Foros, which is four or five leagues wide, contains several roads fit for the largest ships, and affords the only safe anchorage upon the western coast of the Black Sea.

Coasts and ports of Rumelia.

Coast and ports of Bulgaria.

On the coast of Bulgaria is Varna, or Barna, anciently *Odessus*, a Milesian colony, situated at the mouth of a river which forms a large lake called Dewina, and extensive marshes. There is no anchorage whatever between Cape Emeniah and Varna. This town, which derives its modern name from the small river that discharges itself into the sea below its ramparts, anciently *Ziras*, is celebrated for the siege it sustained, and the long and gallant defence it made during the late war between Russia and Turkey. The possession of the place was indispensable to the Russians, in order to insure their communications by sea; but had it not been for the treason of Jussuf Pasha, the second in command, there is no reason to believe they would ever have succeeded in making themselves masters of it. Varna formerly exported provisions to Constantinople. Between Varna and Mangalia (formerly Galatis) is supposed to have been situated Dionysiopolis. The exports of Varna in 1847 amounted to L.600,000. To the north of Mangalia is situated the port of Kustendji, formerly Tomi, celebrated by the exile of Ovid. The position of this town invests it with a high political importance, now that Russia has possessed herself of the mouths of the Danube. No physical impediment exists to prevent the formation of a ship canal from this point to Tchernavoda on the Danube; the distance is only forty miles; and the remains of Trajan's canal still exist. Were this enterprise carried out, it would be attended with results disastrous to the policy of Russia in this direction, but eminently beneficial to the commerce of Europe.

All this coast of Rumelia and Bulgaria, from the Bosporus to the mouths of the Danube, formerly belonged to Thrace.

Kara-Kerman, *Istropolis*, is a large village on the beach, off which lie several shoals that oblige vessels to anchor about a league to the south. Its principal export is corn.

Mouths of the Danube.

From Kara-Kerman to Actiar (Sevastopol), in the Crimea, the coast is very low, nowhere exceeding sixty feet in height, and the shoals formed by the rivers run off to a considerable distance. The Danube discharges itself into the Black Sea between Bulgaria and Bessarabia, by seven mouths, among swampy islands and shifting banks; its stream runs out at the rate of three miles an hour. So great is the extent over which the waters of this river diffuse themselves, from the shallowness of the sea, that at the distance of three leagues from its mouth the water is almost fresh, and within one league it is perfectly fit for use. A very singular appearance takes place near the mouths of the Danube: The porpoise, which everywhere else exhibits a dark colour, is there perfectly white; and hence, as soon as the Greek mariners descry the white porpoise, they have no doubt that they are in the current of the Danube, although in thirty fathoms water, and many leagues distant from its mouth. Opposite the mouths of this river is Serpents Island, already noticed, a barren rock, and remarkable as being the only island in the Black Sea at so great a distance from land. The only building which now exists upon it is a lighthouse; but as the island of Achilles, it had formerly a religious sanctity, and the remains of sacred edifices are still to be found upon it.

Black Sea.

The southern or St George's branch of the Danube belonging to Turkey was formerly the deepest; that, however, silted up, and the traffic of the countries bordering on the Danube was forced through the northern or Kilia branch. In the hands of the Russians it silted up also, and the waters thus turned into the middle or Soulina branch, which became the more available; prior to the treaty of Adrianople the depth of water upon the bar at this mouth of the river was about sixteen feet. There is little more than six feet there now. The bar is formed principally of alluvial deposits, and not of sand washed up by the sea. As, however, it was not stipulated by the treaty of Adrianople upon whom the duty of deepening the channel was to devolve, in the year 1840 Austria entered into a convention with Russia, whereby it was agreed that a tax should be levied by this latter power upon all ships entering the river at Soulina; and in consideration of this privilege Russia became bound to keep the mouth of the river free from all such impediments as now exist. If the Soulina mouth should silt up it is probable that the waters would again force a passage through the Kilia branch, and the Russian fortress of Ismael would command the trade of the Danube. When the Soulina mouth was in the possession of Turkey, every vessel leaving the river was obliged to drag a large rake behind her; this was sufficient to stir up the mud, which was then carried away by the mere force of the current. This practice is prohibited by Russia. Treaty does not allow of forts being built by any power upon the Soulina mouth of the Danube.

Coasts and ports of Cherson.

The Russian province of Cherson is divided from Bessarabia by the Dniester, anciently *Tyras*. A bank before it forms two channels; that on the west being called the channel of Constantinople, and that on the east the channel of Ockzakoff. The one is 150 fathoms broad, and the other eighty fathoms; but neither has more than five feet water. Akerman, on the south bank of this river, has some export trade in corn, wool, wine, wood, hides, and butter. Ancient geographers place upon the right bank of the mouth of the Dniester the town of Hermonactis, and upon the left the tower of Neoptolemus.

Ovidiopol is situated about fifteen miles from the mouth of the Dniester. The Niproffski Leman or Lake is here crossed four or five times a day by a steamer. The traject takes an hour.

To the north of the Dniester extend the interminable steppes; and as far as the mouth of the Dnieper the Black Sea is bordered by a low monotonous line of coast, sometimes argillaceous, but generally calcareous. So gentle is the slope of the vast plains of southern Russia that numerous rivulets on their way to the sea lose themselves in the network of lakes which extends along the shore, and for some distance into the interior. Some of these are lagoons separated from the sea only by sand-banks, and they may

Black Sea. once have served as harbours to Greek mariners. After the destruction of the kingdom of Tartary, the only village upon this coast was Kodjabey, a miserable place, but affording a comparatively safe roadstead. When the produce of the fertile provinces of Poland and New Russia sought an outlet, the huts of Kodjabey were exchanged for the palaces of Odessa.

The population of this city exceeds 100,000. It therefore ranks as the fourth in the empire. It was declared a free port in 1817. It owes its prosperity, not so much to any natural advantages, as to the wise administration of the Duke of Richelieu while he was governor of this province. It is situated close to the coast, which is here very lofty, and much exposed to the winds, especially from the east. In order to render it a safe and commodious port, the duke caused a harbour to be formed, in which ships of no small burden might ride secure from every storm. He also built a large mole, extending half a werst into the sea; with several small ones, and a handsome quay, a werst and a half in length. The roads without the port are safe in summer, and the anchorage is good. Odessa labours under the want of a navigable river, and a great scarcity of fresh water. The total value of the exports for the year 1817 amounted to 38,000,000 paper rubles;[1] since then they have been very fluctuating. In 1818 they fell without any transition to 20,000,000. During the war of 1828–29 they sank to 1,673,000. After the treaty of Adrianople, the exports again rose to 27,000,000. In 1838 they reached 41,000,000, and the imports 20,000,000. The year 1839 was the most memorable in the history of Odessa. The exports consisting almost entirely of corn, amounted to 48,000,000 paper rubles. In 1840 there was a diminution of 7,184,021 rubles; and in 1841 the first quarter alone presented a decrease of 6,891,332 rubles in comparison with the corresponding quarter of 1840. The amount of wheat in 1852 shipped in 203 British vessels, was 453,700 quarters. The amount of Indian corn exported to Great Britain in 1851 in 47 vessels was 74,065 quarters. In 1852, in 101 ships, we received 219,170 quarters of the same article. The principal imports are wine, chiefly French, some rum, raw silk, coffee, sugar, oil, soap, sulphur, fruit, linen cloth, &c., but all in rather limited quantities. The great article of export is wheat, which, however, in the opinion of Mr Macgill, is very far inferior to that of Taganrog, being soft, and apt to heat; besides this, grain, rye, barley, oats, tallow, and tallow candles, bees-wax, iron, hemp, &c., are exported.

The Dnieper, *Borysthenes*, which separates the Russian provinces of Cherson and Taurida, forms, near its mouth, a shallow and marshy lake, two and a half miles broad abreast of Ockzakoff, but more at the confluence of the Bog. The entrance is almost closed by shifting sand-banks, between which there are seldom more than five feet water. The river continues frozen from the middle of December till the middle of February; and in the month of May it overflows its banks, leaving stagnant lagoons in all the low country. The Bog, *Hypanis*, falls into the Gulf of Leman, or estuary of the Dnieper. The small island of Berèzane is situated opposite the mouth of the latter river, almost inaccessible on account of its perpendicular cliffs of rock and clay. Ockzakoff is an inconsiderable port, lying at the junction of these rivers; its harbour is perfectly secure, but the little trade it formerly possessed has been drawn away to Odessa. Ockzakoff was founded at the close of the fifteenth century by Mengli Ghiri Khan of the Crimea, on the ruins of the ancient Alektor, under its Turkish name of Ozou; it was twice taken by the Russians, on the 13th June 1737 under Marshal Munich, and 15th December 1788 under Potempkin. All the Turkish buildings have long since been demolished. Opposite to Ockzakoff is Kinburn, which, before the building of Cherson, was intended by the Russians as their principal depôt for the merchandise sent from the provinces bordering on the Dnieper. The extension of the Russian dominions in the west has caused even Cherson, on the right bank of the Dnieper, to be superseded by Odessa. Yet corn, hemp, and other articles of exportation, are so much cheaper and more plentiful here, that many foreign vessels still prefer this port, though they are obliged first to perform quarantine, and unload their cargoes at Odessa. The Dnieper is five miles wide at Cherson, but only vessels drawing six feet can ascend to it. The Russians, however, have a large arsenal here, and build line-of-battle ships, which are floated down the river on machines, and afterwards conveyed to Ockzakoff to be equipped. Cherson was founded by the Empress Catherine in 1788, and contains a population of about 8000 inhabitants. Between Cherson and Nicolaïef is situated the tomb of Howard the philanthrophist. Nicolaïef, on the Bog, a fine river, without bar or cataract, and with deep, still water, is the station for vessels when built; and here they are laid up to be repaired. It has extensive marine arsenals, and, next to Sevastopol, is one of the most important naval stations on the Black Sea. Black Sea.

The long narrow belt of sand Djarib-Agatch, celebrated as the course of Achilles (Δρόμος Ἀχιλλέως), extends into the shallow Gulf of Kerkinit (Temyraces of Strabo), which divides the peninsula of the Dnieper from that of the Crimea.

Southern coast of the Crimea.

The southern coast of the Crimea is lofty and precipitous; the mountains beginning at Balacklava, *Portus Symbolorum*, and extending to Caffa, *Theodosia*. Some of these are celebrated in antiquity, and are no less remarkable for their formation and appearance. The mountain Tchedirdagh, *Trapezus*, rises abruptly from the coast about Alusta to the height of 4740 feet, according to Messrs Englehardt and Parrot; it exhibits a mass of limestone very compact, of a gray colour, and, according to Pallas, yielding a slightly fetid odour on being rubbed. The most remarkable headland of the Crimea is Cape Tarchanskoi, called by the Tartars Aya Burun, or the Sacred Promontory, probably the *Parthenium* of Strabo; one of the loftiest mountains in the Crimea, terminating abruptly in the sea, and forming the western point of the peninsula. It consists entirely of marble. On the southern point is Cape Saritch, *Kriu-Metopon*, formerly noticed.

Western coast of the Crimea.

The first port of note on the western coast of the Crimea is Kosloff, or Eupatoria, from which, in 1793, 176 vessels were freighted with corn, salt, and leather. It is still the most thriving port in the Crimea, and owes its prosperity to the Karaite Jews, who compose the greater part of the population, which amounts to 10,000. Its exports in 1839 were 2,394,867 rubles. Sevastopol, formerly Actiar, *Ctenus*, is the chief station of the Russian Black Sea fleet, to which indeed it is exclusively appropriated, no merchant ship being allowed to enter it except in distress. The natural advantages of this harbour are very great. The largest vessels may lie within a cable's length of the shore. Here the fleets of the world might ride in security, and have convenient anchorage; and in any of the ports, vessels find from 21 to 70 feet depth of water, and good anchorage. The harbour somewhat resembles that of Malta. The principal branch runs eastward for a distance of four miles and three quarters, and has an average breadth of 1000 yards; it is terminated by the valley of Inkerman, and receives the muddy waters of the Tchernoi Retchka. The southern shore of this roadstead is indented by three deep coves. Upon the high ridge which separates two of these (Artillery Bay from South Bay) the town is situated. The barracks and stores, admiralty buildings, and numerous churches, present an imposing appearance. The streets are broad, the houses handsome, and the population exceeds 40,000.

[1] A paper ruble equals 10½d.

Black Sea.

The northern shore presents a line of cliffs of no interest. South Bay is 3000 yards in length, and sheltered by high limestone cliffs. It is here vessels are rigged and unrigged, and a long range of hulks and pontoons are moored along the shore. Beyond South Bay, and communicating with it, is the creek in which the government docks are situated; they were constructed under the superintendence of Colonel Upton. They are five in number, and placed on two sides of a quadrangular basin. The dock basin is supplied with water by a canal which, passing through a tunnel at Inkerman, joins the Tchernoi Retchka at Tchorgouna. From the quarries at Inkerman has been brought the freestone of which these docks were constructed. They are said to have cost the Russian government 9,000,000 rubles. Careening Bay is still further to the eastward. The entrance to the harbour of Sevastopol is narrow, and defended by four forts, consisting each of three tiers of batteries, and mounting from 200 to 300 pieces of artillery. These are said to be badly constructed, and not so formidable as they look. The waters of the harbour are infested with a worm which seems to have its origin in the Tchernoi Retchka. Between Sevastopol and Cape Chersonese, there are six distinct bays running inland parallel to one another, viz., the Quarantine Bay, the Bay of Sands (Pestchannaia), the Bay of Butts (Strelezkaia), Round Bay (Kruglaia), the Bay of the Cossack (Cozatchaia), and Double Bay (Dvoinaia): all these possess good anchorage, but have not been used since the Heraclean colony of Cherson, the ruins of which still exist, flourished upon the peninsula. Upon turning sharply round Cape Chersonese, the monastery of St George, hanging upon the steep mountain side, comes into view, while an opening so narrow as to be imperceptible until reached is the entrance to the harbour of Balaclava, at the head of which is established a colony of Arnaout Greeks. It is one of the most remarkable ports in the Crimea, appearing from the town land-locked by high precipitous mountains. Its entrance is so extremely narrow, that only one ship can pass at a time; but within the port it is three-quarters of a mile long and 400 yards broad. It is secure from storms in all weather, and ships of war of any size or rate may find in it sufficient depth of water. The mountains which surround it are of red and white marble, and the shore in some parts is covered with gold-coloured mica, in a state of extreme division. This port is closed against the vessels of all nations, not excepting Russians, to prevent smuggling. From Balaclava the coast trends to the S.E. to Cape Saritch (Kriu-Metopon), the only anchorage is at Laspi. Cape Saritch, the southern point of the Crimea, is the commencement of that magnificent chain of limestone cliffs, the existence of which has rendered the southern shore of Taurida so renowned for its beauty. Sheltered from the keen winds of the north, the most luxuriant vegetation clothes those banks of detritus which slope gently from the base of stupendous precipices to the sea. Numerous villas belonging to the Russian aristocracy are picturesquely scattered amid the vineyards and olive groves which descend to the water's edge. Orianda, the chateau of the empress, and the castle of Alupka, the residence of Prince Woronzoff, are the most celebrated of these.

Southern shores of the Crimea.

The modern watering-place of Yalta is situated in a bay to the eastward of Cape Aiotodor. Beyond, Alushta (the Alustan Phrurion of the middle ages), and Soudagh (the Soldaya of the Genoese), are the only places worthy of note; at the latter the limestone range terminates, and the coast, which affords no good harbour after rounding Cape Chersonesus, now forms the magnificent Bay of Caffa, or Theodosia, founded by the Milesians. Caffa was afterwards incorporated into the kingdom of Bosporus. In 1280 it became the splendid metropolis of the Genoese dominion in the Black Sea. In 1475 it surrendered to an Ottoman fleet, under Achmet Pasha, and dwindled down into a Turkish garrison, only to rise to greater glory than ever in the middle of the seventeenth century, when the Turks gave it the name of Koutchouk Samboul (Little Constantinople); it then contained a population exceeding 80,000 souls. It has now sunk to the abject condition of a Russian town,—has been sacrificed to Kertch,—and were it not for the associations connected with it, would be unworthy of notice. The exports of Theodosia in 1839 amounted to 955,108 rubles.

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The harbour of Theodosia, and those upon the south-western shore of the Crimea, are the only harbours in Russia which do not freeze in winter. From the Cape of Schouda, which forms the eastern shore of the Bay of Theodosia, the coast upon which Greek colonies formerly flourished, is now deserted, and the whole peninsula of Kertch is a slightly undulating steppe. The straits at their entrance are about twelve miles broad, with an average depth of three fathoms. Upon rounding the Cape of Akbourum, the town of Kertch (Ponticapeum) rising up the hill of Mithridates bursts upon the view. It contains a population of 10,000 inhabitants, and owes its prosperity entirely to the commerce of the Sea of Azof, which finds its outlet through the Cimmerian Bosporus. Upwards of 1000 vessels passed through these straits in 1851. Seven miles to the north of Kertch stands the dilapidated fortress of Yenikale. The straits are here very narrow; the nearest point of the Asiatic shore is the projecting Cape Kammenoi. The depth of water on the bar of Touzla does not exceed two fathoms. The straits are altogether nearly thirty miles in length, and devoid of any remarkable beauty. They are frozen over in winter.

Coast of Anatolia.

The coast of Anatolia, on the Black Sea, extends to the Kisil-Irmak, which falls into the sea a little to the west of the Gulf of Sansoun. It is lined by high mountains, terminating in lofty promontories, and forming a steep and clean coast, with numerous little coves, into most of which small rivulets fall. The most remarkable headlands are Cape Kili-Mili, east of Erekli; Cape Kerempe, the north point of Asia Minor, very high land with breakers off it; and Cape Indji, a low point to the west of Sinope. The principal rivers on this coast, besides the Kisil-Irmak, *Halys*, and the Sakaria, *Sangarius*, already noticed, are the Falios, *Billæus*, and the Barthin, *Parthenius*. The only port of consequence is Sinope or Sinoub, strongly situated on the narrow and low isthmus of a rocky peninsula. The mole which formed its port is nearly in ruins. The depth of water is twelve feet. There is, however, a good road for the largest ships, and Turkish vessels of war were formerly built here. Sinope is the nearest port on the Black Sea to Angora, the only place hitherto known that supplies the fine goats' hair of commerce.

Coast of Roum;

From the Kisil-Irmac to Vona the coast is named Roum by the Turks. The chief places are Sansoun, *Amisus*, on the Jekyl-Irmak, which falls into the deep Gulf of Sansoun. Imports of Sansoun in 1848, L.207,121; in 1849, L.128,115; in 1850, L.199,925; in 1851, L.193,911. Exports in 1848, L.306,000; in 1849, L.280,355; in 1850, L.209,960; in 1851, L.172,804. Fatsa, *Polemonium*, at the mouth of the Sidemus; Budjah and Vona, *Boona*, on the cape of the same name.

of the Laziens.

From Vona the coast takes the name of the tribes that inhabit it. The Laziens, *Lazi*, occupy the coast from Vona to the Tchourouk. The principal port on this coast is Trebizond, which, although it can admit only small vessels, has nevertheless a considerable trade. One hundred and fifty or two hundred small craft annually sail to Taganrog, with *nardek*, a marmalade of grapes, and *beckmiss*, a syrup made for the use of the distilleries there. In 1848, 132 ships entered the port of Trebizond; of these 39 were British. The total imports amounted to L.1,726,052; of which L.997,666 was British. The total exports L.207,545; of which L.71,296 worth were in British ships. In 1851 only 23 British ships out of 172 entered the port, with cargoes to the value of L.319,479. But these cleared out with L.106,844

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worth of cargoes. The total exports of Trebizond in this year amounted to L.496,708. The Turkish trade with this port has greatly increased within the last few years. The anchorage is not very good. Batoum has recently become a place of some importance as a Turkish garrison; it is situated at the mouth of the Tchourouk (Batys, from whence probably the present name), and overhung by the lofty mountains of Akhaltzik. About twenty miles to the south of the Phasis the little river of Natănèby (Isis of Arrian) falls into the sea, and separates the Turkish from the Russian dominions. Fort St Nicholas upon its right bank is the last Russian outpost. Next to the Laziens, the Gurions occupy the coast as far as the Rioni or *Phasis*. At its mouth this river is sixty fathoms deep and half a league broad, but there is a small island in the midst of its channel. The only port in the country of the Gurions is Poti, to which the merchants of Georgia resort. The Mingrelians occupy the country of the ancient Colchians. Redout Kalè at the mouth of the Khopi, has recently risen into importance since it has become the port of Tiflis, and steamers ply between it and Odessa. At the mouth of the Tugour (Megapomo) is situated the fort of Anaklia. The little province of Zamourzakhan intervenes between Mingrelia and Akbassia, which extends from the Galazkha to the fort of Gagra. The most important places in Akbassia are Iskourias (supposed to be ancient Dioscourias), Soutchoum Kalè, one of the best harbours on the coast, and Pitzounda, celebrated for its church founded by the Emperor Justinian. Between Gagra and Anapa the coast is occupied by the Circassian tribes of the Ardonas, Saghis, Oubikhs, and Chapsoukes. The port of Guelendchik is the best upon the Circassian coast, which is here overhung by the towering range of the Caucasus. At Anapa the mountains cease, and a little distance to the west one arm of the Kouban falls into a lagoon connected with the sea by a narrow channel called Boughaze, upon which there is never more than five feet of water. Another arm, the Kara Kouban, falls into the Sea of Azof; it is not navigable. The Kouban was the former boundary of the empire in this direction. The Asiatic shore of the straits of Kertch is low, and Taman is situated at its most western extremity. The Gulf of Taman is about thirty miles long.

Coast of the Gurions.

Coast of Mingrelia.

The Kuban.

Commerce of the Black Sea.

The Phœnicians, and after them the Egyptians, in ancient times possessed the commerce of the Black Sea. It passed to the Greeks at the commencement of the seventh century B.C. The Milesians and Heracleans then laid the foundations of the two states of Bosporus and Cherson.

The commerce of the Greek colonies, which were at first simple factories, found speedy development as the productions of civilization were exchanged for the raw material furnished by the neighbouring tribes. Numerous towns were founded upon the shores of Taurida, and the relations of the mother country became more intimate as the wealth and importance of these latter increased, until at last Athens became in a great measure dependent upon Taurida for her cereal supplies; and Strabo gives an account of a large exportation of corn made to the Athenians by Leucon king of Bosporus (book vii. chap. 5).

After the Greeks the Romans penetrated in their turn into the Black Sea. Under their dominion the Pontus Euxinus was less frequented. Rome, mistress of the entire world, attracted to herself alone all commercial relations, and the shores of Taurida, too far from the capital, and less favoured than the provinces in Africa, were insensibly abandoned.

About the third century after Christ, the empire of the East was founded and Constantinople built upon the shore of the Thracian Bosporus, and trade upon the Black Sea received a new impetus under the auspices of the Byzantine Emperors.

But the thirteenth century formed the most remarkable epoch in the commercial history of the Black Sea. Guided by their ambition and mercantile instinct, the Genoese landed upon the coast of Taurida, and in 1280 founded the brilliant colony of Caffa. Factories were established at Tana on the mouth of the Don, in Colchis, and on the Caucasian coast, and even the imperial town of Trebizond was forced to admit one of the most important factories of the republic. The Genoese colonies thus became the general emporium of the rich productions of Russia, Asia Minor, Persia, and the Indies. They monopolized for more than two centuries all the traffic between Europe and Asia, and presented a marvellous spectacle of thriving greatness. All this glory had an end. By the capture of Constantinople in 1453 this commerce was nearly destroyed; and by the capture of Caffa in 1476 it was completely annihilated. The Venetians, who had obtained from the Turks the right of navigating the Black Sea in consideration of a yearly tribute of 10,000 ducats, strove in vain to take the place their rivals had lost. They were expelled in their turn from the Black Sea, and the Dardanelles were closed against all the nations of the West; and the Turks, and their subjects the Greeks of the Archipelago, alone possessed the privilege of passing through the strait. To obtain a share of the commerce thus restricted to Mussulman subjects was a favourite project with Peter the Great. In 1699 he succeeded in subduing Azof and the country round it; but by the unfortunate battle of Pruth, in 1711, he was compelled to relinquish his conquests. His successors, however, especially Catherine II., aimed at the same object. This enterprising sovereign, by the treaty of Kaïnardgy in 1774, and afterwards by the treaty of Jassy in 1791, completely accomplished her object; the Turks being obliged to surrender a part of Lesser Tartary and the Crimea, to allow the Russians to establish a navy in the Black Sea, and to permit their flag a free passage through the Dardanelles. In 1784 the Porte granted the privilege of navigating the Black Sea to the Austrians. But no other European nation obtained this privilege, although the French carried on a considerable trade under the Russian and Imperial flags, till after the conquest of Egypt by the French, when a treaty was concluded between the French government and the Porte, by which the latter granted to the former the free navigation of this sea. At the peace of Amiens the navigation was opened to the Prussian, Spanish, Neapolitan, Dutch, Ragusan, and English merchant flags; and all these nations were allowed to have resident consuls in the Turkish ports of this sea. The English, however, by secret treaties with the Turks, in the reign of James I. and Charles I., had been allowed to navigate this sea; and in 1799 this privilege was renewed.

Black Sea.

Russian statistical reports are so little to be relied upon that it is difficult to give any very accurate returns of the general trade of the Black Sea. Within the last twenty years a total change has been effected in the aspect of its commerce. This is chiefly to be attributed to the existence of the British market. When importations of corn into England were freed from fiscal influences, the vast and fertile plains of southern Russia, and the rich valley of the Danube, supplied the ever increasing demand; and the requirements of Great Britain, however they may increase, will be met by enormously elastic powers of production. The prohibitive policy of Russia exercises however a most injurious influence upon foreign trade, and combines to render the expense of freight upon the coasts of the Black Sea higher than upon any other eastern sea-board. In consequence of the more liberal commercial policy of Turkey and the Danubian principalities the exports of Rumelia, Moldavia, and Wallachia, are increasing far more rapidly than those of the Russian provinces, while the grain is more highly esteemed in the English market. The total amount of wheat received by Great Britain in 1852 from the Russian shores of the Black Sea was 789·750 quarters in 374 vessels. The total

Black Sea ‖ Black-Whytlof.

amount shipped from Rumelia and the Danubian principalities was 112·650 quarters, in 92 vessels. The general exports of the principalities have been gradually increasing. In 1849 the total value of the imports amounted to L.809,240; in 1850, L.898,715; and in 1851, L.896,895. The total value of the exports in 1849 was L.1,113,272; in 1850 it was L.839,712; and in 1851, L.1,274,525. As the corn trade to the British dominions is the mainly important branch of commerce in the Black Sea, those statistics connected with it which are derived from the English official reports contain all that is most important. Apart from this no very remarkable features in the local trade have been recently developed, nor, if there were, are there any authentic reports of its extent.

Principal articles of commerce.

The principal articles of commerce afforded by the countries on the Black Sea are wheat, rice, tobacco, hides, tallow, hare-skins, honey, wax, iron, and yellow grains for dyeing from Rumelia and Bulgaria, by the ports of Varna and Bourgas. The same articles, with the addition of wool, butter, hemp, masts, ship-timber, and pitch, are exported from Moldavia and Wallachia, by Ibraila and Galatz on the Danube. From Bessarabia by Ovidopol, and from the province of Cherson by Odessa, Akermann, and Cherson, come corn, oak-timber, hides, tallow, tar, shagreen, wax, honey, hemp, sail-cloth, and wool;—from the Crimea by the ports of Actiar, Kosloff, and Caffa, corn, wool, wax, honey, dried and salted hides, deer-skins, morocco leather, sheep-skins, salted and dried fish, potash, felt, caviar, wine, silk, and saltpetre;—from the countries on the Sea of Azof by the ports of Taganrog, Berdianski, and Mariapol, iron (of which Constantinople and Smyrna require about 60,000 quintals each), dried fish, caviar, butter, hides, tallow, wheat, timber, furs, sail-cloth, cordage, hemp, linens, wax, and wool;—from Anatolia by the ports of Erekli, Amasreh, Ineboli, Sinope, and Uniah, hides, dried fruits, linens, linen thread, wax, honey, hemp, copper, and ship-timber;—from the coast of Roum and Sansoun, the same articles;—from the countries of the Laziens and Gurions, principally by Trebizond, all the above articles except ship-timber;—and from Mingrelia, and the country of the Abasses, principally by Soudjuk and Anapa, slaves, timber, box-wood, wool, silk, furs, butter, hides, wax, and honey. The trade to those coasts is entirely carried on by a few Greeks of Constantinople, and is very insignificant.

The Russian fleet in the Black Sea consisted in 1853, according to M. de Haxthausen, of 18 ships of the line, 12 frigates, and 10 corvettes, brigs, &c., exclusive of steamers.

See Clarke's *Travels*, vol. i. 4to edition; Macgill's *Travels in Turkey*, &c. vol. i.; Coxe's *Travels*, vol. iii. 8vo edition; *Essai Historique sur le Commerce et la Navigation de la Mer Noire*, par le Baron de Saint Joseph, Paris, 1820; Rottier, *Itinéraire de Tiflis à Constantinople*, 1829; Alexander's *Travels in the East through Russia and the Crimea in* 1829; Oliphant's *Russian Shores of the Black Sea*, 1853. (W. S—N.) (L. O.)

Black-Tin, tin-ore when dressed, stamped, washed, and ready for smelting. It is the ore comminuted by beating into a black powder, like fine sand.

Black-Wadd, an ore of manganese, of which, according to Klaproth, it contains 68 per cent. It is of a brown or black colour, opaque, sectile, and soils the fingers. Though its specific gravity is as high as 3·706, it appears very light in the hand, but imbibes water with violence, and immediately sinks when immersed. Mixed with linseed oil it inflames spontaneously. The localities of black-wadd are particularly Devonshire and Cornwall. The dendritic delineations, often so beautiful upon limestone, steatite, and other substances, are supposed to derive their colouring matter from this mineral. It is used as a drying ingredient in paints.

Black-Whytlof, in our old writers, bread of a middle fineness between white and brown, called in some parts "ravel-bread." In religious houses it was used as a common sort; the *panis conventualis* being pure manchet, or white bread.

Blackall ‖ Blackburn.

BLACKALL, Offspring, an eminent English prelate, born at London in 1654, and educated at Catharine-Hall, Cambridge. For two years he refused to take the oath of allegiance to William and Mary, but at last submitted, though he seemed to condemn the principles of the Revolution. In a sermon preached before the House of Commons 30th January 1699, he animadverted on Toland's assertion, in his life of Milton, that Charles I. was not the writer of the *Icon Basiliké;* and also on some insinuations against the authenticity of the Holy Scriptures; which produced a controversy between him and that author. In 1700 he was chosen Boyle's lecturer; and in 1707 was consecrated bishop of Exeter. He died at Exeter in 1716, and was interred in the cathedral. His works were published in two vols. folio, 1723.

BLACKBURN, a parish, township, market-town, and since the Reform act a parliamentary borough, is situated on a brook, called in Domesday book "Blackeburn," but now only known as "The Brook," in the hundred of Blackburn, in the northern division of the county of Lancaster, 209 miles from London by railway, 35¾ from Preston, and 21 miles N.N.W. from Manchester. The parish contains 15 townships and 8 chapelries, and is nearly 14 miles long and 10 broad. The living is a vicarage in the gift of the Archbishop of Canterbury, the rector. Its income is marked in the clergy list at L.893, the amount rendered some years back; but as this resulted partly from glebe-lands, which are being yearly let at high rates on building leases, the present value must be far greater. The vicar has 19 livings in his gift, most of them small in money value, though many have large and important populations. The parish church is a very handsome edifice. Almost every form of dissent is here represented, but the Independents are by far the most numerous and influential. There are very many Sunday-schools; but, from the nature of the trade of the town, education is on a rather low scale. Thus, of the 1584 persons married last year (1853) a very small proportion wrote their names. There is a free grammar-school founded by Queen Elizabeth, with a good house but small endowment: it has had no pupils for several years past. There are also a female charity school, several elementary and Sunday schools, a mechanics' institute, a large subscription library, and a small theatre.

Blackburn received a charter of incorporation in the year 1851, when W. H. Hornby, Esq., one of the largest cotton-manufacturers of the place, was elected the first mayor. It returns two members to parliament.

Blackburn is entirely dependent on the cotton trade, and by the industry and skill of its manufacturers, has made wonderful progress during the last few years. By the census of 1801 the population was 11,980; and in 1851 it had increased to 46,536. Several very important inventions have orginated from the firms of Hornby and Kenworthy, and Harrison and Son, by which the trade of Blackburn has assumed a high character in the cotton districts. The names of Peel and Hargrave are identified with the place, as belonging to men who in the last century gave an impetus to manufactures. The Leeds and Liverpool canal passes the town; which is also connected by railways with Burnley, Preston, Liverpool, Bolton, and Manchester.

Blackburn, as a town, is in a state of transition, which, unless untoward events interfere, will in a few years give it an entirely new and improved character. Its old, narrow, and irregular streets are giving way to the hand of improvement, and a new town of considerable architectural pretensions is fast springing up. Under an act of parliament the improvement commissioners are widening the streets, and laying out new ones; and a town-hall and exchange is in the course of erection, on a scale of considerable magnificence. An extensive market-house has been recently erected,

Blacking || Blacklock.

with slaughter-houses adjoining. If with these measures of public utility, means go hand in hand to elevate the operatives, Blackburn may one day become equal to any town in Lancashire.

BLACKING, any factitious black, as lamp-black, shoe-black, and the like. A mixture of ivory or lamp-black with linseed-oil makes the common oil blacking. For a shining blacking, small-beer or water is used instead of oil, in the proportion of a pint to an ounce of ivory-black, with the addition of half an ounce of sugar, and as much gum-arabic. The white of an egg substituted for the gum increases the lustre, but is supposed to render the leather liable to crack. A good blacking is prepared by mixing, in certain proportions, ivory-black, sour beer or porter, Florence oil, molasses, and a small quantity of sulphate of iron.

BLACKLOCK, Thomas, a Scottish poet and divine, was born of humble but respectable parents at Annan, in Dumfriesshire, in 1721. When not quite six months old he lost his sight by the smallpox. Under this misfortune, his father and friends endeavoured to amuse him as he grew up by reading to him various books; among others, the works of Milton, Spenser, Prior, Pope, and Addison. His kind and gentle disposition gained the hearts of his companions, who were very assiduous in their good offices, particularly in reading to instruct and amuse him.

Blacklock, at the age of nineteen, had the misfortune to lose his excellent father, who was killed by the fall of a malt-kiln belonging to his son-in-law. Thus suddenly deprived of that support on which his youth had leaned, destitute of almost every resource which industry affords to those who have the blessing of sight, with a body naturally feeble and delicate, and with a mind peculiarly susceptible, this bereavement was doubly severe.

He lived with his mother for about a year after this event, and began to be distinguished as a young man of genius. To poetry he was devoted from his earliest days; and about this time several of his productions were handed about, which considerably enlarged the circle of his friends and acquaintance. Some of his compositions having been shown to Dr Stevenson, an eminent physician of Edinburgh, that gentleman formed the benevolent design of giving him the benefits of a classical education. Blacklock, in consequence, was enrolled a student of divinity in the University of Edinburgh in 1741, and continued his studies under the patronage of Dr Stevenson till 1745, when he retired to Dumfries, and resided in the house of his married sister during the whole time of the civil war which then agitated the country. When peace had been restored, he returned to the university, and pursued his studies for six years longer. During this residence in Edinburgh, he made the acquaintance of several literary men, particularly Mr Hume, who was particularly useful to him in the publication by subscription of the 4to edition of his poems in 1756. Two editions in 8vo had previously been published at Edinburgh in 1746 and in 1754.

After applying closely for a considerable time to the study of theology, in 1759 he passed the usual trials in the presbytery of Dumfries, and was licensed as a preacher, in which capacity he obtained high reputation.

In 1762 he married Miss Sarah Johnston, the daughter of a surgeon in Dumfries; a connection which formed the great solace and blessing of his future life. A few days after this event, he was ordained minister of the church of Kirkcudbright, by presentation from the crown, through the interest of the Earl of Selkirk. This appointment, however, was so violently opposed by the parishioners, that, after a legal dispute of nearly two years, he resigned his right to the living, and accepted a moderate annuity in its stead. With this slender provision he removed to Edinburgh, where he received into his house as boarders a certain number of young gentlemen, whose studies he superintended. Finding that his advancing age and feeble health required quiet and repose, in 1787 he abandoned the tuition of youth. In 1767 the degree of doctor in divinity was conferred on him by the University and Marischal College of Aberdeen.

Blackmore || Blackstone.

In the summer of 1791 he was seized with a slight feverish disorder, which a frame so little robust proved unable to resist; and after about a week's illness it carried him off on the 7th of July.

His writings consist chiefly of poems, of which a 4to edition was published in 1793; to which was added an *Essay on the Education of the Blind*, translated from the French of M. Haüy.

BLACKMORE, Sir Richard, a physician, and voluminous writer of theological, poetical, and physical works, was born in Wiltshire. Having early declared in favour of the Revolution, King William, in 1697, chose him one of his physicians in ordinary, and conferred on him the honour of knighthood. On Queen Anne's accession, Sir Richard was also appointed one of her physicians, which office he held for some time. Dryden and Pope treated the poetical performances of Blackmore with great contempt; and in a note in the *Dunciad* we are informed that his "indefatigable muse produced no less than six epic poems: *Prince and King Arthur*, in twenty books; *Eliza*, in ten; *Alfred*, in twelve; *The Redeemer*, in six; besides *Job*, in folio; the whole book of *Psalms; The Creation*, in seven books; the *Nature of Man*, in three books; and many more." But notwithstanding that Blackmore was greatly ridiculed by the wits, he is not without merit; and Addison, in the *Spectator*, has bestowed some liberal commendations on his *Creation*. It must be mentioned to his honour that he was a moral writer, and a warm advocate for virtue, at a time when an almost universal degeneracy prevailed. He died on the 9th October 1729.

BLACKSTONE, Sir William, an eminent English lawyer, was born at London, July 10. 1723. His father, Mr Charles Blackstone, a silkman, citizen, and bowyer of London, died some months before the birth of our author, who was the youngest of four children; and his mother also died before he was twelve years old. Even from his birth, the care both of his education and fortune was kindly undertaken by his maternal uncle Thomas Bigg, an eminent surgeon in London, who on the death of his elder brothers succeeded to the family estate at Chilton Foliot in Wiltshire. When about seven years old, young Blackstone was put to school at the Charter-house; and in 1735 he was admitted upon the foundation there by the nomination of Sir Robert Walpole, on the recommendation of Charles Wither of Hall in Hampshire, Esq., his cousin by the mother's side. In this excellent seminary his talents and industry rendered him the favourite of his masters, who encouraged and assisted him to the utmost of their power; so that at the age of fifteen he was at the head of the school, and qualified to be removed to the university. He was accordingly entered a commoner at Pembroke College, Oxford, on the 30th of November 1738. At this time he was elected to one of the Charter-house exhibitions, to commence from the Michaelmas preceding, but was permitted to continue a scholar there till after the 12th of December, when he delivered the usual anniversary oration, by which he acquired very great credit. About this time also he obtained Mr Benson's gold prize-medal of Milton, for verses on that poet. In the February following the society of Pembroke College unanimously elected him to one of Lady Holford's exhibitions for Charter-house scholars in that house. Here he prosecuted his studies with unremitting ardour; and although the classics, and particularly the Greek and Roman poets, were his favourites, they did not entirely engross his attention; for logic, mathematics, and the other sciences, were not neglected. At the early age of twenty he compiled a treatise entitled *Elements of Architecture*, intended for his own use

Blackstone. only and not for publication, but esteemed by those who have perused it as in no respect unworthy of his maturer judgment and more practised pen.

Having made choice of the profession of the law, he was entered in the Middle Temple, November 20. 1741. He now found it necessary to quit the more amusing pursuits of his youth for the severer studies to which he had dedicated himself, and betook himself seriously to reading law. He expressed his disagreeable sensations on this occasion in a copy of verses, afterwards published by Dodsley in the fourth volume of his Miscellanies, entitled *The Lawyer's Farewell to his Muse;* in which the struggle of his mind is expressed so strongly, so naturally, and with such elegance of language and harmony of versification, as must convince every reader that his passion for the muses was too deeply rooted to be laid aside without much reluctance, and that if he had pursued that flowery path he might have taken a very respectable place among English poets. Besides this, several fugitive pieces were at times communicated by him to his friends; and he left, but not with a view to publication, a small collection of juvenile pieces, consisting of both original poems and translations. Some notes on Shakspeare, which just before his death he communicated to Mr Steevens, and which were inserted by him in his last edition of that author, show how well he understood the meaning and relished the beauties of his favourite English poet.

In November 1743 he was elected into the society of All-Souls College. In the November following he spoke the anniversary speech in commemoration of Archbishop Chichelay, the founder, and the other benefactors to that house of learning, and was at the same time admitted actual fellow. From this period he divided his time between the university and the Temple, where he took chambers in order to attend the courts. In the former he pursued his academical studies, and on the 12th of June 1745 took the degree of bachelor of civil law; in the latter he applied himself closely to his profession, both in the hall and in his private studies; and on the 28th of November 1746 he was called to the bar. Though but little known or distinguished in Westminster Hall, he was actively employed, during his occasional residences at the university, in attending to its interests, and in mingling with and improving its interior concerns. In May 1749, as a small reward for his services, and to give him further opportunities of advancing the interests of the college, Blackstone was appointed steward of its manors. In the same year, on the resignation of his uncle, Seymour Richmond, Esq., he was elected recorder of the borough of Wallingford in Berkshire, and received the king's approbation on the 30th of May. On the 26th of April 1750 he commenced doctor of civil law, and thereby became a member of the convocation, which enabled him to extend his views beyond the narrow circle of his own society, to the benefit of the university at large. In the summer of 1753 he took the resolution of wholly retiring to his fellowship and an academical life, still continuing the practice of his profession as a provincial counsel.

His lectures on the laws of England appear to have been an early and favourite idea; for in the Michaelmas term immediately after he quitted Westminster Hall, he entered on the duty of reading them at Oxford; and we are told by the author of his Life, that even at their commencement, the high expectations formed from the acknowledged abilities of the lecturer attracted to these lectures a very crowded class of young men of the first families, characters, and hopes. But it was not till the year 1758 that the lectures in the form they now bear were read in the university. Mr Viner having by his will left not only the copyright of his abridgment, but other property to a considerable amount, to the University of Oxford, in order to found a professorship, fellowships, and scholarships of common law, Blackstone was on the 20th of October 1758 unanimously elected Vinerian professor; and on the 25th of the same month he read his first introductory lecture, which he published at the request of the vice-chancellor and heads of houses, and afterwards prefixed to the first volume of his celebrated *Commentaries*. It is doubtful whether the *Commentaries* were originally intended for the press; but many imperfect and incorrect copies having got abroad, and a pirated edition of them being either published or preparing for publication in Ireland, the learned lecturer thought proper to print a correct edition himself, and in November 1765 published the first volume, under the title of *Commentaries on the Laws of England*. The remaining parts of this admirable work were given to the world in the course of the four succeeding years. It ought to be remarked, that before this period the reputation which his lectures had deservedly acquired for him had induced him to resume his practice in Westminster Hall; and, contrary to the general order of the profession, he who had quitted the bar for an academic life was sent back from the college to the bar with a considerable increase of business. He was likewise elected into parliament, first for Hindon, and afterwards for Westbury in Wilts; but in neither of these departments did he equal the expectations which his writings had raised. The part he took in the Middlesex election drew upon him the attacks of some persons of ability in the senate, and likewise a severe animadversion from the caustic pen of *Junius*. This circumstance probably strengthened the aversion he professed to parliamentary attendance; "where," he said, "amidst the rage of contending parties, a man of moderation must expect to meet with no quarter from any side." When, on the resignation of Mr Dunning in 1770, he was offered the place of solicitor-general, he refused that office; but shortly afterwards, on the promotion of Sir Joseph Yates to a seat in the court of Common Pleas, he accepted a seat on the bench, and by the death of Sir Joseph succeeded him there also. This eminent and excellent man died on the 14th of February 1780, in the fifty-seventh year of his age.

Blackwall ‖ Blackwell.

BLACKWALL, Anthony, A.M., a learned author, who, after completing his academical education at Emanuel College, Cambridge, was appointed head master of the free school at Derby, and rector of All-Hallows there. In 1722 he was appointed head master of the free school at Market-Bosworth in Leicestershire; and in 1725 he published the first volume of his most celebrated work, *The Sacred Classics Defended and Illustrated*, of which the second volume appeared shortly after his death. He was presented to the rectory of Clapham in 1726, by his former pupil Sir H. Atkins, as a mark of his gratitude and esteem. It is related that when Blackwall waited upon the bishop of the diocese he was somewhat pertly questioned by a young chaplain as to the extent of his learning. "Boy," replied the indignant veteran, "I have forgot more than ever you knew." He resigned his living in 1729, and returned to Bosworth, where he died April 8. 1730, aged fifty-six. His other works are, an edition of *Theognis*, 1706; an *Introduction to the Classics*, 1718; and a *Latin Grammar*.

BLACKWELL, Thomas, a Scottish writer, born in 1701 at Aberdeen, where his father was a minister. He studied Greek and philosophy in the Marischal College, and took the degree of A.M. in 1718. Being distinguished for uncommon parts and an early proficiency in letters, he was, in December 1723, made professor of Greek in Marischal College, and continued to teach that language with applause till his death. In 1735 he published anonymously at London, *An Inquiry into the Life and Writings of Homer*, 8vo, a second edition of which appeared in 1736; and not long after he published *Proofs of the Inquiry into Homer's Life and Writings*, being a translation of the Greek, Latin, Spanish, Italian, and French notes, subjoined to the original work. In 1748 he published *Letters concerning Mythology*, 8vo, but without his name. The same year he was made principal of Marischal College in Aberdeen; being the only

Blackwell ‖ Bladum.

layman who had been appointed to that office since the patronage came to the crown by the forfeiture of the Marischal family in 1716. In 1752 he became LL.D.; and the year following published the first volume of his *Memoirs of the Court of Augustus*, 4to. The second volume appeared in 1755; and the third, which was posthumous and left incomplete by the author, was prepared for the press by John Mills, Esq., and published in 1764. At the same time a third edition of the two former volumes appeared, which is a proof that his literary talents found many admirers; although it must be acknowledged that the parade with which it is written, and the peculiarity of its language, exposed it, not without reason, to some severity of censure. He died at Edinburgh, March 8. 1758, of a consumptive disorder, which was probably accelerated by his excessive abstemiousness.

BLACKWELL, *Alexander*, son of a dealer in knit-hose at Aberdeen, where he received a liberal education. He studied physic under Boerhaave at Leyden, took the degree of doctor of physic, and acquired a proficiency in the modern languages. He married the daughter of a gentleman in the neighbourhood; and, after an attempt to establish himself as a practitioner in Scotland, he went to London, where he met with no better success. He then became a corrector of the press, and at length set up a printing establishment of his own, which was carried on till 1734, when he became bankrupt. He appears to have subsisted for a considerable time after this event by the ingenuity of his wife, who published "*A Curious Herbal*, containing 500 cuts of the most useful Plants which are now used in the Practice of Physic, engraved on folio Copperplates after Drawings taken from the Life, by Elizabeth Blackwell; to which is added a short Description of the Plants, and their common Uses in Physic, 1739," 2 vols. folio. About the year 1740 Blackwell went to Sweden, and, renewing his intimacy with a nobleman whom he had met at the Hague, resumed the medical profession. Having laid before his Swedish Majesty a scheme for draining the fens and marshes, considerable sums were expended for that purpose under the doctor's direction. Being suspected, however, of being concerned in a plot for changing the succession to the Swedish throne, he was put to the torture; and this not producing the desired confession, he was beheaded, August 9. 1748. Soon afterwards appeared "A Genuine Copy of a Letter from a merchant in Stockholm to his correspondent in London, containing an impartial Account of Doctor Alexander Blackwell, his Plot, Trial, Character, and Behaviour, both under Examination and at the Place of Execution; together with a Copy of a Paper delivered to a Friend upon the Scaffold." Blackwell possessed good natural genius, but was flighty and conceited. His conversation, however, was facetious and agreeable; and he was allowed to have been a well-bred and accomplished gentleman.

BLADDER, a thin membranous bag in animals, which serves as the receptacle of some secreted fluid; as the urinary bladder, the gall bladder, &c. The air bladder of fishes is supposed to assist respiration and to give buoyancy in swimming.

BLADE, the cutting part of an instrument, as of a knife or sword. The sword-blades of Damascus are very celebrated, and bear a high price.

BLADEN, MARTIN, a translator and dramatic author, was originally an officer in the army, and bore the commission of lieutenant-colonel in Queen Anne's reign, under the Duke of Marlborough, to whom he dedicated his translation of Cæsar's Commentaries. In 1714 he was made one of the lords commissioners of trade and plantations, with a salary of L.1000 a-year, which he enjoyed till his death in May 1746.

BLADUM, in the middle ages, a name for all sorts of standing corn; also written *blatum*, *blava*, and *blavium*. In old charters *bladum* included the whole product of the ground, as fruit, corn, flax, grass; and it was sometimes applied to any kind of grain threshed on the floor.

Blaeu ‖ Blair.

BLAEU, or BLAUW, WILLIAM, a learned printer of Amsterdam, and a disciple and friend of Tycho Brahe. His Atlas, Treatises of the Globes, Astronomical Institutions, and other works, together with his fine impressions, have secured his name from oblivion. He died in 1638.

BLAGRAVE, JOHN, an eminent mathematician, was the second son of John Blagrave of Bulmarsh-court, near Sunning in Berkshire. He was sent to St John's College, Oxford, where he applied himself chiefly to the mathematics; and afterwards retired to Southcote-lodge, near Reading, where he spent the remainder of his life. He died in 1611, and was buried in the church of St Lawrence, where a sumptuous monument was erected to his memory. He is said to have been eminently distinguished for his benevolence, candour, and generosity. His published works are, 1. *A Mathematical Jewel*, Lond. 1585, folio; 2. *Of the Making and Use of the Familiar Staff*, Lond. 1590, 4to; 3. *Astrolabium Uranicum Generale*, Lond. 1596, 4to; 4. *The Art of Dialling*, Lond. 1609, 4to.

BLAINVILLE, HENRI-MARIE DUCROTAY DE, a distinguished naturalist, was born at Arques, near Dieppe, Sept. 12. 1777. About the year 1795 he entered the school of design at Rouen, but after a very short time he went to Paris, where he became a pupil of Vincent the painter. Attracted by the lectures of Cuvier and other eminent professors in the College of France, he commenced the study of Anatomy, and in August 1808 he took the degree of M.D.

He now devoted himself to the study of natural history, more particularly the department of myology, and he soon attracted the attention of Cuvier, who requested Blainville's co-operation in a work on comparative anatomy on which he was then engaged. He was also chosen by that illustrious professor to supply his place at the College of France and at the Athenæum, and he soon afterwards obtained the vacant chair of anatomy and zoology in the Faculty of Sciences at Paris. On that occasion he produced his thesis upon that curious animal the ornithorhyncus, or duck-bill.

Blainville's somewhat irascible disposition was probably one cause of the subsequent estrangement between him and Cuvier, which ended in an open and irreconcilable enmity. In 1825 Blainville was admitted a member of the Academy of Sciences; and in 1830 he was appointed to succeed Lamarck at the museum in the chair of natural history, an honour he had well earned by his important contributions to that science. This he resigned in 1832 to become the successor of Cuvier in the chair of comparative anatomy, which he continued to occupy for the space of eighteen years.

His scientific writings are very numerous, and chiefly relate to the animal kingdom. As a comparative anatomist he proved himself a worthy successor of the celebrated Cuvier. M. de Blainville was found dead in a railway carriage while travelling between Rouen and Caen, May 1. 1850.

Besides a great variety of memoirs published in the *Annales du Muséum d'Histoire Naturelle*, and in similar works, he was the author of *Prodrome d'une Nouvelle Distribution Méthodique du Règne Animal*, 1816; *Ostéographie, ou Description Iconographique Comparée du Squelette et du Système Dentaire des Cinque Classes d'Animaux Vertèbres Récents et Fossiles*, &c.; *Faune Française*, Paris, 1821–1830; *Cours de Physiologie Générale et Comparée*, Paris, 1833; *Manuel de Malacologie et de Conchyliologie*, Strasbourg, 1825–1827; *Histoire des Sciences Naturelles au Moyen Age*, &c., Paris, 1845, 8vo.

BLAIR, DR HUGH, a distinguished clergyman of the Church of Scotland, was born at Edinburgh, April 7. 1718. His father, John Blair, was a merchant in that city, and grandson of the famous Mr Robert Blair, minister of St Andrews, chaplain to King Charles I., and one of the most distinguished clergymen of the period in which he lived.

Blair. After the usual grammatical course at school, Blair entered the humanity class in the university of Edinburgh in October 1730, and spent eleven years at that celebrated seminary, assiduously employed in the literary and scientific studies prescribed by the Church of Scotland to candidates for the ministry.

At this time he commenced a method of study which contributed much to the accuracy and extent of his knowledge, and which he continued to practise occasionally even after his reputation was fully established. It consisted in making abstracts of the most important works which he had read, and in digesting them according to the train of his own thoughts. History, in particular, he resolved to study in this manner; and, in concert with some of his youthful associates, he constructed a very comprehensive scheme of chronological tables for receiving into its proper place every important fact that should occur. The scheme devised by this young student for his own private use was afterwards improved, filled up, and given to the public, by his learned friend Dr John Blair, prebendary of Westminster, in his valuable work entitled *The Chronology and History of the World.*

In the year 1739 Blair took his degree of A.M. On that occasion he printed and defended a thesis, *De Fundamentis et Obligatione Legis Naturæ*, which contains a short but masterly discussion of this important subject, and exhibits in respectable Latin an outline of the moral principles which were afterwards more fully unfolded and illustrated in his *Sermons.*

On the completion of his academical course, after undergoing the customary trials before the presbytery of Edinburgh, on the 21st Oct. 1741 he was licensed to preach the gospel. His public life now commenced with very favourable prospects. The reputation which he brought from the university was fully justified by his first appearance in the pulpit; and in a few months the fame of his eloquence procured for him a presentation to the parish of Colessie in Fife, where he was ordained Sept. 23. 1742. A vacancy having occurred the following year in the second charge of the Canongate of Edinburgh, the young orator was elected by a great majority in July 1743.

In this station Dr Blair continued for eleven years, discharging with great fidelity and success the various duties of the pastoral office; till, in consequence of a call from the town-council and general session of Edinburgh, he was translated from the Canongate to Lady Yester's, one of the city churches, Oct. 11. 1754; and on the 15th June 1758 he was promoted to the High Church of Edinburgh, the most important ecclesiastical charge in the kingdom.

Hitherto his attention seems to have been devoted almost exclusively to the attainment of professional excellence, and to the regular discharge of his parochial duties. No production of his pen had yet been given to the world by himself, except two sermons; some translations in verse of passages of Scripture; and a few articles in the *Edinburgh Review*, a publication begun in 1755, and conducted for a short time by some of the ablest men in the kingdom. But, standing as he now did at the head of his profession, he began to think seriously on a plan for teaching to others that art which had contributed so much to the establishment of his own fame. With this view he prepared a course of lectures on composition; and having obtained the approbation of the university, he began to read them in the college on the 11th of December 1759. The university of St Andrews, moved chiefly by the merit of his eloquence, had, in June 1757, conferred on him the degree of doctor in divinity, a literary honour which at that time was very rare in Scotland. His first course of lectures was received with great applause; and the patrons of the university agreed in the following summer to institute a rhetorical class, under his direction, as a permanent part of their academical establishment. On the 7th April 1762, the king was pleased "to erect and endow a professorship of rhetoric and belles-lettres in the university of Edinburgh, and to appoint Dr Blair, in consideration of his approved qualifications, regius professor thereof, with a salary of L.70." These lectures he published in 1783, when he retired from the labours of the office. Blair.

About the time when he was occupied in laying the foundations of this useful institution, he had an opportunity of conferring what he considered another important obligation on the literary world, by contributing to rescue from oblivion the poems of Ossian. It was by the joint solicitation of Dr Blair and Mr John Home that Mr Macpherson was induced to publish his *Fragments of Ancient Poetry*; and their patronage was of essential service in procuring the subscription which enabled him to undertake his tour through the Highlands, for collecting the materials out of which he afterwards arranged "Fingal," and the other productions which bear the name of Ossian. Soon after their publication Blair gave an estimate of their merits in a "Dissertation," which was prodigiously overrated at the time when it first appeared, and has since, by a natural enough re-action in public opinion, been treated with unmerited neglect. It was printed in 1763; and being regarded as a masterpiece of critical acuteness, as well as of elegant composition, it spread the reputation of its author throughout all Europe, and, for a time, silenced the sceptical doubts which had been raised as to the honesty of Macpherson and the genuineness of Ossian.

It was in 1777 that Blair published the first volume of those sermons which had so long furnished instruction and delight to his own congregation; and this volume having been well received, three other volumes followed at different intervals. These sermons experienced an unusual degree of success, and were circulated rapidly and widely; they were soon translated into almost all the languages of Europe; and His Majesty George III. was graciously pleased, July 1780, to confer a pension of L.200 a-year upon their author.

The sermons contained in the fifth volume were composed at very different periods; but they were in many parts recomposed during the course of the summer 1800, after the writer had completed his eighty-second year. They were delivered to the publishers about six weeks before his death, in the form and order in which they now appear.

The reputation which Dr Blair acquired in the discharge of his public duties was well sustained by the great respectability of his private character. Deriving from family associations a strong sense of clerical decorum, feeling in his heart deep impressions of religious and moral obligation, he was eminently distinguished through life by the prudence, purity, and dignified propriety of his conduct.

In 1748, he married his cousin Catherine Bannatyne, daughter of the Rev. James Bannatyne, one of the ministers of Edinburgh; and by her he had a son who died in infancy, and a daughter who lived to her twenty-first year.

Though liable to occasional attacks from some of the sharpest and most painful diseases that afflict the human frame, he enjoyed a general state of good health; and, through habitual cheerfulness, temperance, and care, survived the usual term of human life. After a brief illness, and retaining to the last moment the full possession of his mental faculties, he expired on the 27th of December 1800, with the composure and hope which became a Christian pastor.

Blair, *James*, an eminent divine, born in Scotland, where he was ordained and beneficed in the Episcopal church. Going to England about the end of the reign of Charles II., he was sent by Dr Compton as a missionary to Virginia, and afterwards by the same bishop made commissary, which was the highest ecclesiastical office in that colony. He formed a design of erecting and endowing a college at Williamsburg, in Virginia; and, in 1693, came to England to solicit

Blair. assistance; when Queen Mary espoused the noble design, and with the concurrence of King William, a patent was passed for erecting and endowing a college by the name of the *William and Mary College*, of which Blair was appointed president, an office which he enjoyed for nearly fifty years. He was also rector of Williamsburg, and president of the council in that colony. He died in 1743, leaving four volumes of discourses on our Saviour's Sermon on the Mount. London, 1742.

BLAIR, *John*, a Scottish author, the contemporary and companion, some say the chaplain, of Sir William Wallace. He attended that illustrious hero in almost all his exploits; and, after his death, wrote Memoirs of the Scottish Champion, in Latin. But time has destroyed this work, which might have thrown great light on the history of a very troubled and remarkable period. An inaccurate fragment of it only has descended to us. It was published, with a commentary, in 1705, by Sir Robert Sibbald; and it is translated in Hume's *History of the Douglases*.

BLAIR, *John*, an eminent Scottish chronologer, was born and educated at Edinburgh, and afterwards went to London, where he became usher at a school. In 1754 he presented to the world his valuable work, *The Chronology and History of the World, from the Creation to the year of Christ* 1753. This volume was published by subscription, and dedicated to Lord Chancellor Hardwicke. In 1755 he was elected a fellow of the Royal Society, and in 1761 of the Society of Antiquaries. In 1756 he published a second edition of his Chronological Tables; and in the following year he was appointed chaplain to the princess dowager of Wales, and mathematical tutor to the Duke of York. His services were rewarded with a prebend's stall in Westminster, and other preferments. In 1763 he attended his royal pupil on a Continental tour, when he visited Lisbon, Gibraltar, Minorca, Italy, and France; and on his return he published an improved edition of his Chronology, which he dedicated to the Princess of Wales. The fate of his brother Captain Blair, who fell in the memorable sea-fight in which Admiral Rodney defeated and took prisoner the French commander Count de Grasse, on the 12th April 1782, is believed to have accelerated his own death, which took place on the 24th of June in the same year.

BLAIR, *Robert*, author of the well-known poem entitled *The Grave*, was the eldest son of the Rev. Robert Blair, one of the ministers of Edinburgh, and the grandson of that Robert Blair who was so conspicuous among the Scottish clergy in the civil wars. He was probably born at Edinburgh about the year 1700, and at the university of that city received the elements of a classical education. He afterwards spent some time on the Continent. Upon his return he took orders, and in 1731 was ordained minister of Athelstaneford, in East Lothian, where he spent the remainder of his life. He died of a fever, Feb. 4. 1746; and was succeeded in his living by John Home, the author of *Douglas*. Blair had five sons and one daughter; the late Robert Blair of Avontoun, Lord President of the Court of Session, being his fourth son.

Blair wrote several other pieces besides *The Grave;* but that poem alone constitutes his title to rank as a poet. It consists of a succession of descriptions and reflections, which have no other connection except what they may derive from their relation to a common subject; but these are interspersed with striking allusions, picturesque imagery, touches of a rude though effective pathos, and a vein of sentiment at once natural and just. The rhythm is often harsh, and the versification frequently devoid of correctness, harmony, and grace; but it has nevertheless a masculine vigour and freshness about it, which more than atone for the defects in the finishing; while, in certain moods of the mind, the air of deep and almost misanthropical melancholy diffused over the whole, proves highly touching and impressive. Campbell, in the *Pleasures of Hope*, has borrowed, with a slight variation, a line from this poem:—

Blair-Athole || Blake.

> ——— its visits,
> Like those of angels, short and far between.

The vigorous, though occasionally rather forced, poetic conceptions of the author of *The Grave*, were finely illustrated, in Cromek's edition published in 1808, by the grandly wild designs of William Blake, engraved by the delicate burin of Schiavonetti. *The Grave* was first printed at London in 1743.

BLAIR-ATHOLE, or BLAIR IN ATHOLE, a village and parish in the county of Perth and district of Athole, 18 miles from Dunkeld, 33 from Perth, and 76 from Edinburgh. Pop. in 1851, 2084. The village has almost completely decayed; but the parish is nevertheless remarkable for its interesting localities, striking scenery, and mineral products, particularly marble, which is found in considerable abundance and of almost every variety of colour, though somewhat coarsely grained, in the valley of the Tilt. One of the most conspicuous objects to the eye of the tourist is Blair Castle, a seat belonging to the Duke of Atholl, and formerly a baronial fortress, though now despoiled of its battlements and other castellated honours. It was occupied by the Marquis of Montrose in 1644; stormed by a party under the command of one of Cromwell's officers in 1653; and gallantly defended by Sir Andrew Agnew, in 1746, when besieged by a portion of the Highland army, until he was relieved by the Hessians under the Earl of Crawford. The falls of Bruar, celebrated by Burns, are two miles to the westward; and the pass of Killiekrankie, famous for the battle which was there fought in 1689, between the Highlanders under Viscount Dundee, and King William's troops under General Mackay, is about an equal distance to the eastward of Blair Castle. The old church of Blair, now in ruins, is said to contain the ashes of Dundee, who fell early in the action.

BLAISE, a military order instituted by the kings of Armenia, in honour of St Blaise the martyr, anciently bishop of Sebasta, and the patron saint of Armenia. Justinian calls them knights of St Blaise and St Mary, and places them not only in Armenia, but in Palestine. They made a vow to defend the religion of the church of Rome, and followed the rule of St Basil. This institution appears to have commenced about the same time with the knights-templars and hospitallers.

BLAKE, ROBERT, a famous English admiral, born in August 1589, at Bridgewater, in Somersetshire, where he was educated at the grammar-school. In 1615 he was entered at St Alban's Hall, Oxford, and subsequently removed to Wadham College. On the 10th of February 1617, he proceeded B.A. In 1623 he wrote a copy of verses on the death of Camden, and soon after left the university. He was early tinctured with republican principles, and disliking that severity with which Laud, then bishop of Bath and Wells, pressed uniformity in his diocese, he embraced puritanism. His natural bluntness causing his principles to be well known, the puritan party returned him member for Bridgewater in 1640. He served in the parliamentary army with great courage during the civil war; but when the king was brought to trial, he highly disapproved the measure, and declared that "he would as freely venture his life to save the king as ever he did to serve the parliament." After the death of the king, however, he fell in wholly with the republican party, and, next to Cromwell, was the ablest officer of whom the parliament could boast.

In 1648–49, Colonel Blake, in conjunction with two officers of the same rank, Dean and Popham, was appointed to command the fleet; and soon after he blockaded Prince Maurice and Prince Rupert in Kinsale harbour. But the latter getting out, Blake followed them from port to port, and at last attacked them in that of Malaga, where he burned and destroyed their whole fleet excepting two ships—the *Refor-*

Blake. *mation*, in which Prince Rupert himself was, and the *Swallow*, commanded by his brother Prince Maurice. In 1652 he was constituted sole admiral, and defeated the Dutch fleet commanded by Van Tromp, Ruyter, and De Witt, in three several engagements, in which the Dutch lost eleven men of war, thirty merchant ships, and, according to their own account, 15,000 men. Soon after, Blake and his colleagues, with a fleet of a hundred sail, stood over to the Dutch coast, and forced the enemy's fleet to fly for shelter into the Texel, where they were blockaded for some time by Monk and Dean, while Blake sailed northward. At last, however, Van Tromp got out, and drew together a fleet of 120 men of war. On the 3d of June the generals Dean and Monk came to an engagement with the enemy off the North Foreland, with indifferent success; but the next day, Blake coming to their assistance with eighteen ships, gained so complete a victory, that if the Dutch had not saved themselves on Calais sands, their whole fleet would have been taken or destroyed.

In April 1653 Cromwell turned the long parliament out of doors, and shortly afterwards assumed the supreme power. Blake observed to his officers on the occasion, "It is not for us to mind state affairs, but to keep foreigners from fooling us." In November 1654, Cromwell sent him with a strong fleet into the Mediterranean, to obtain satisfaction for certain injuries which had been done to our merchants. In the beginning of December Blake entered the roads of Cadiz, where he was treated with all imaginable respect; the Dutch admiral durst not hoist his flag while he was there; and his name had now become so formidable, that the admiral of a French squadron which had stopped one of his tenders when separated in a storm, as soon as he knew to whom it belonged, sent for the captain on board, and drank Blake's health with great ceremony, under a discharge of five guns, and then dismissed him. Blake, on the 10th of March, appeared before Algiers, and demanded satisfaction for the piracies committed on the English, and the release of all English captives. The dey, in his answer, alleged that the ships and captives belonged to private persons, and therefore he could not restore them without offending all his subjects, but that the English admiral might easily redeem them; and if he thought it proper, they would conclude a peace with him, and for the future commit no acts of hostility against the English. This answer was accompanied with a large present of fresh provisions; on receiving which Blake left Algiers, and sailed on the same errand to Tunis. The dey of the latter place, however, not only refused to comply with his request, but denied him the liberty of taking in fresh water. "Here," said he, "are our castles of Goletto and Porto Ferino; do your worst." On hearing this, Blake began, as his custom was when highly excited, to twirl his whiskers; and, after a short consultation with his officers, resolved to bear into the bay of Porto Ferino with his great ships and their seconds. On coming within musket-shot of the castle and the line, he fired on both so warmly that in two hours the castle was rendered defenceless, and the guns on the works along the shore were dismounted, although sixty of them played at once on the English. Observing nine ships in the road, Blake ordered every captain to man his long boat with choice men, to enter the harbour and fire the Tunisians; a service which they effected with the loss of only 25 men killed and 48 wounded, while the admiral covered the operation by playing continually on the castle with his great guns. This daring action spread the terror of his name throughout Africa. From Tunis he sailed to Tripoli; caused the English captives to be set at liberty; and concluded a peace with that government. He then returned to Tunis, upon which the Tunisians begged for peace, which he granted on terms highly advantageous to England. He next sailed to Malta, and obliged the knights to restore the effects taken by their privateers from the English. By these and other great exploits, he raised the glory of the English name to such a pitch, that most of the princes and states in Italy thought fit to pay their compliments to the Protector, by sending solemn embassies to him. Blake.

Blake passed the next winter either lying before Cadiz or cruising up and down the straits. He was at his old station, at the mouth of the harbour, when he received information that the Spanish plate fleet had put into the bay of Santa Cruz, in the island of Teneriffe. Upon this he weighed anchor, with twenty-five men of war, on the 13th of April 1657; and on the 20th came to anchor with his ships off the bay of Santa Cruz, where he saw sixteen Spanish ships moored in the form of a half-moon. Near the mouth of the harbour stood a castle furnished with heavy ordnance; besides which there were seven forts round the bay, with six, four, and three guns on each, and connected by a line of communication manned with musketeers. To make all safe, the commander of the Spanish fleet caused all the smaller ships to be moored close in shore; while the six large galleons stood farther out at anchor, with their broadsides towards the sea. Blake having prepared for the fight, a squadron of ships was drawn out to make the first onset, commanded by Captain Stayner in the *Speaker* frigate; who, on receiving orders, sailed into the bay and fell upon the Spanish fleet, without the least regard to the forts, which kept up a heavy cannonade. As soon as these had entered the bay, Blake followed, and stationed several ships to pour their broadsides into the castle and forts; and these kept up so heavy and well-directed a fire, that, after some time, the Spaniards found their forts too hot to hold them. In the meanwhile Blake joined Stayner, and bravely fought the Spanish ships, out of which the crews were beaten by two o'clock in the afternoon; when Blake, finding it impossible to carry them away, ordered his men to set them on fire; and this was done so effectually, that they were all reduced to ashes except two, which sunk downright, nothing remaining above the water but part of the masts. The English having now obtained a complete victory, were reduced to another difficulty by the wind, which blew so strong into the bay that they despaired of getting out, and for a time lay under the fire of the castle and of all the forts, which must soon have torn them to pieces. But the wind suddenly shifting, they were enabled to work out of the bay, and left the Spaniards in astonishment at the fortunate temerity of their assailants. This action does honour to Blake; and although fortune favoured him in the opportune shifting of the wind, and his situation was, upon the whole, less trying than that of the gallant men under Lord Nelson, who made an attempt on this place, his conduct throughout appears to have been distinguished for the most adventurous daring, and consummate nautical skill. "It was so miraculous," says the Earl of Clarendon, "that all men who knew the place wondered that any sober man, with what courage soever endowed, would ever have undertaken it; and they could hardly persuade themselves to believe what they had done; whilst the Spaniards comforted themselves with the belief that they were devils, and not men, who had destroyed them in such a manner."

This was the last and greatest action of the gallant Blake. Consuming with dropsy and scurvy, he was hastening homewards, but just as he came within sight of land he expired. Disinterested, generous, liberal, and ambitious of nothing but true glory, Blake was one of the prominent characters of an age fertile in great men, and remained untainted with those errors and violences which were then so predominant. Lord Clarendon observes, "that he was the first man who brought ships to contemn castles on shore, which had ever been thought very formidable, and were discovered by him to make a noise only, and to fright those who could be rarely hurt by them. He was the first that infused that degree of courage into seamen, by making them see by experience

Blake || Blane.

what mighty things they could do if they were resolved; and the first that taught them to fight in fire as well as in water."

BLAKE, *William*, an engraver of high but wild genius, was born in Ireland, Nov. 18. 1757. He early evinced a decided predilection for drawing, and his father, a hosier, allowed him to follow his natural bias, and devote himself to the fine arts. He was accordingly sent to London, where he served his apprenticeship with Bazire, at that time one of the most noted engravers of the metropolis. He received instructions in drawing from Flaxman and Fuseli; and though much of his time was engrossed in professional pursuits, he found means to compose many odes, sonnets, and ballads, which gained him a temporary reputation in the world of letters. He was subject to extraordinary hallucinations from time to time, during which he believed that he saw and conversed with the heroes of ancient and modern history. These visions he reproduced with pen and pencil. His conceptions have much grandeur, yet too frequently they bear the impress of the morbid condition of his mind, especially in the latter years of his life. His best works are his illustrations of Young's *Night Thoughts*, and of Blair's *Grave*.

BLANC, MONT, a mountain in Savoy. See ALPS.

BLANCH-Holding, in *Law*, is a tenure by which the tenant is only bound to pay an elusory yearly duty to his superior as an acknowledgment of his right.

BLANCHARD, JACQUES, sometimes called the French Titian, was born at Paris, A.D. 1600. After residing two years at Rome he went to Venice, where he studied assiduously the works of Titian, Tintoret, and Paul Veronese. He imitated the style of these masters with much success, and produced numerous pictures; but his masterpiece is the "Descent of the Holy Ghost," in the church of Nôtre Dame. He died at Paris in 1638.

BLANCHE-FERME, or *Blank farm*, in ancient leases, a farm the rent of which was paid in silver, not in cattle.

BLANCHING, in coinage, the operation performed on the planchets, or pieces of silver, to give them the requisite lustre. See COINAGE.

BLANCO, the name of a cape on the western coast of Africa, in a barren and dreary region, near the southern termination of the Great Desert. It forms the boundary of the Bay of Arguin; and, with the exception of Cape Verd, it is the most westerly point of the continent. The Portuguese discovered it in 1441. The approach to it is not unattended with danger. Lat. 20. 47. N. Long. 16. 59. N. There are several other headlands of this name in Africa, America, &c.

BLANDFORD-FORUM, a market and borough town in the hundred of Coombs-ditch, and county of Dorset, 103 miles from London. It is one of the most handsome towns in the west of England, and is situated on a bend of the river Stour, which flows on its south and west sides. The church and town-hall are elegant buildings. This town has frequently been destroyed by fire, but has always risen with increased beauty. The inhabitants are principally employed in making shirt-buttons, a manufacture that has long formed the staple commodity of the place, and been the source of its prosperity. Market-day, Saturday. Pop. (1851) 3948.

BLANE, SIR GILBERT, *Bart.*, *M.D.*, an eminent physician, born in Ayrshire, August 29. 1749. He studied and graduated at Edinburgh, and was introduced by Dr Cullen to Dr William Hunter, through whom he was appointed private physician to Lord Holdernesse, and was introduced to Lord Rodney. He accompanied the admiral as private physician to the West Indies in 1780. Blane was slightly wounded in the memorable action with De Grasse, and through the influence of Lord Rodney was made physician to the fleet, without having gone through the subordinate grades. He remained in the West Indian fleet until 1783, during which time he became acquainted with the Duke of Clarence, afterwards William IV., who was then a midshipman under Rodney. These distinguished persons, and his own merits, soon introduced him to extensive practice in London: he became a physician to St Thomas's Hospital; a Member of the Royal Society in 1786; and was appointed by that body to deliver the Croonian Lecture in 1788, for which he choose "Muscular Motion" as the subject. His practice and his reputation rose high. In 1790 he resigned his office in the hospital, but was placed at the head of the medical department of the navy in 1795, which he long filled with honour to himself and advantage to the service. He was created a baronet in 1812. In 1819 he published his *Elements of Medical Logic*, a work that has gone through several editions, and which, with his valuable *Suggestions on the use of Lemon Juice as a Preventive of Sea Scurvy*, and his other contributions to medical science, procured him the honour of being elected a member of the French National Institute in 1826. His last publication was a pamphlet entitled *Warning to the British Public against the alarming approach of the Indian Cholera*, in 1831. His latter years were spent in retirement from professional duties; and he occupied this leisure in preparing for the press his *Select Dissertations*, which appeared in 1822, and again in 1834. Sir Gilbert Blane died June 26. 1834, in the eighty-fifth year of his age. (T. S.T.)

Blanes || Blankof.

BLANES, a city of the province of Gerona in Spain, at the mouth of the river Tordera, defended by a castle. Pop. 4397, employed in the fisheries and navigation. Long. 2. 51. E. Lat. 41. 42. N.

BLANK (French *Blanc*), literally signifies white. *Blancus*, or *Blanca*, was a kind of white or silver money, of base alloy, coined by Henry V. in those parts of France which were then subject to England. It was valued at 8d. sterling.

BLANK also denotes a small copper coin, formerly current in France, at the rate of five deniers Tournois.

BLANK-*Verse*, in modern poetry, is a species of verse usually composed of ten syllables, and possessing rhythm, but without rhyme.

BLANKENBURG, a principality forming part of the duchy of Brunswick. Area 170 square miles, comprehending a part of the Hartz Forest; pop. 22,000. The chief city, of the same name, is at the foot of the Blankenstein mountain, on the summit of which, 1130 feet above the city, is situated the summer palace of Louisenburg, with its pavilions and preserves for game, from which is an enchanting prospect over a most romantic district. Pop. 3500. Long. 10. 52. E. Lat. 51. 47. N.

BLANKET, a warm woollen stuff, chiefly used in bedding.

Tossing in a BLANKET, in Latin, *sagatio*, a ludicrous kind of punishment, which Martial describes graphically enough: *Ibis ab excusso, missus ad astra, sago.* Suetonius relates that it was a juvenile diversion of the Emperor Otho to stroll out in the dark, and when he met with a helpless drunken person, to give him the discipline of the blanket. Every body recollects Sancho Panza's misfortune in this way, and the sorrowful sport it proved to the worthy squire of the knight of La Mancha.

BLANKOF, JAN TEUNISZ, an eminent landscape-painter, born at Alkmaer in 1628. His first instructions were received from two obscure artists; but he soon became the pupil of Cæsar Van Everdingen, by whose advice he went to Rome, where he occupied himself in copying the works of the best masters, and was admitted into the society of Flemish painters called Bentvogels, who gave him the name of Jan Maat (*i. e.* comrade), by which he is generally known. His subjects were chiefly river scenes, sea-shores, havens, or ports, which are finely coloured, and executed with a light and free pencil. He died in 1670.

Blaps ‖ Blasphemy

BLAPS. See ENTOMOLOGY.

BLARNEY, a small village of Ireland, in the parish of Garrycloyne, county of Cork, and 3½ miles N.W. of the town of that name. It is pleasantly situated on a small rivulet of the same name, and is chiefly celebrated as giving name to that peculiar kind of eloquence supposed to be so characteristic of the natives of Ireland. The "Blarney Stone," the kissing of which is said to confer this faculty, is pointed out at the top of the castle; but the *real* stone, with the founder's name upon it, is said to be on the northern angle of the castle, about twenty feet from the top.

BLASPHEMY (βλασφημία, from βλάπτω, *I hurt*, and φημί, *I speak*) means literally defamation or evil speaking. In the middle ages it was used to denote simply the blaming or condemning of a person or thing.

Blasphemy is more peculiarly restricted to an indignity offered to the Deity by words or writing. Hence Augustin says, *Jam vulgo blasphemia non accipitur nisi mala verba de Deo dicere.* According to Angelus Clavasius, it is threefold:—1. When something is ascribed to God which is not suitable to his nature; and this is, as the divines call it, a sin *contra misericordiam:* 2. when some attribute which is essential to his Godhead is denied, which is a sin *contra justitiam:* 3. when that which is only proper to the divine Creator of all things is attributed to the creature; and this is termed a sin *contra majestatem Dei.* Lindwood defines blasphemy to be an injury offered to God, by denying that which is due and belongs to him, or by attributing to him what is not agreeable to his nature.

Under the Mosaic law blasphemy was punished with death; and the same punishment was also awarded by the civil law. By the canon law blasphemy was only visited by a solemn penance, and introduced the commutation of corporal punishment into a pecuniary fine. According to Blackstone, the offence of "*blasphemy* against the Almighty, by denying his being or providence, or by contumelious reproaches of our Saviour Christ," is "punishable at common law by fine and imprisonment, or other infamous corporal punishment; for Christianity is part of the laws of England." In like manner, the offence of composing, printing, or publishing a *blasphemous* libel is left to the common law, but on a second conviction the punishment is such as may by law be inflicted in cases of high misdemeanours (60th Geo. III., and 1st Geo. IV., cap. 5, § 4). The power to inflict the sentence of banishment also conferred having been repealed by the 11th Geo. IV., and 1st Will. IV., cap. 73, § 1, and by the 9th and 10th Will. III., cap. 32, § 1, any person, having been educated in, or at any time having made profession of, the Christian religion within this realm, who shall deny one of the persons in the Trinity, or assert that there are more than one God, or deny Christianity to be true, or the holy Scriptures of the Old and New Testament to be of divine authority, is for the first offence rendered incapable of any office, and for the second is adjudged incapable of suing, being executor or guardian, receiving any gift or legacy, and ordered to be imprisoned for three years. These provisions, however, so far as relate to denying the holy Trinity, were repealed by the 53d Geo. III., cap. 160, § 2.

By the law of Scotland, as it originally stood, the punishment of blasphemy was death. By an act passed in the first parliament of Charles II., whoever, "not being distracted in his wits," should curse God or any person of the blessed Trinity was punishable with death; and by a statute of King William's reign (1695, cap. 11), any person reasoning against the being of God, or any person of the Trinity, or the authority of the holy Scriptures, or the providence of God in the government of the world, was to be imprisoned for the first offence until he should give public satisfaction in sackcloth to the congregation; to be punished more severely for the second offence; and for the third doomed to death. The capital punishment was in the year 1696 executed against a young student of divinity named Thomas Aikenhead, whose chief offence was the folly of embarking in speculations beyond his capacity. An account of his trial and condemnation, which excited the indignation of Locke, will be found in the fifteenth volume of the State Trials. Both the Scottish statutes were repealed by the 53d Geo. III., cap. 160, § 3.

Blasphemy ‖ Blasting.

BLASPHEMY against the Holy Ghost. Divines are not agreed with respect to the nature of the crime thus denominated, and the grounds of the extreme guilt ascribed to it. Dr Tillotson maintains that it consists in maliciously attributing to the devil the miraculous operations which Christ performed by the power of the Holy Ghost. But Dr Whitby refers it to the dispensation of the Holy Ghost which commenced after our Lord's resurrection and ascension; and contends that those were guilty of the crime who persisted in their unbelief, and blasphemed the Holy Ghost, representing him as an evil spirit. This crime implied a wilful opposition to the last and most powerful evidence which God had vouchsafed to mankind, and precluded the possibility of a return to faith and repentance.

BLASTING, a term used by the engineer and miner to denote the application of the explosive force of gunpowder in opening or rending rocks, indurated clay, consolidated earth, and the walls of buildings. In quarrying sandstone, consisting of regular layers, the work is performed chiefly by means of the *pick*, the *wedge*, the *hammer*, and the *pinch* or *lever;* but for many kinds of limestone, and for greenstone and basalt, blasting is always resorted to. Most of the primary and transition rocks, and nearly all of the trap or igneous rocks, such as basalt, greenstone, porphyry, amygdaloid, &c., called *primitive*, could scarcely be torn asunder by any other means.

At what period blasting with gunpowder was first resorted to as a *power in mechanics*, is uncertain. Gunpowder was applied to military engines in 1312, but there is reason to believe that its application to the peaceful arts is of a much later date. It may seem strange at this day to propose the *expansive or explosive force* of gunpowder as a new *mechanical power;* but when the lever and the wedge become ineffectual for the purposes of the artificer, he must naturally attach a high value, and be disposed to apply an elevated term, to that instrument or means by which he is enabled, in a very simple manner, to effect his purpose, and overcome the greatest obstructions to his operations.

This agent is no less simple in its application than it is powerful in its effects. It is considered as the result of the sudden extrication of a *permanently elastic fluid* by the ignition of the gunpowder, the extricated gas occupying about 472 times more space than the grains of the powder. Some authors are of opinion that the powder contains only atmospheric air in a state of great condensation, and that, when this fluid is set at liberty, being at the same time highly rarefied by the heat, from the inflammation of the powder, it produces the wonderful effects already mentioned. By others, it is supposed that the air contained in the nitre of the gunpowder is about 236 times denser than atmospheric air, and that, when exploded, it produces an effect proportioned to its condensation; the elastic fluid expanding with a velocity which has been calculated at the rate of about 10,000 feet per second; and its pressure or force, when thus expanding, having been estimated as equal to a *thousand atmospheres*, or as a thousand times greater than the atmospheric pressure upon a base of the same extent. If we apply this product to the pressure of the atmosphere, or at the rate of 14¾ pounds to the square inch, we shall find that the elastic fluid of gunpowder, at the moment of explosion, exerts a force equivalent to 6½ tons upon the square inch of surface exposed to its force. Count Rumford, indeed, estimated this force at 10,000 atmospheres; but we have rather followed the calculations of Hutton, whose opportunities of

Blasting.

experiment, connected with the military college of Woolwich, were unquestionably great.

In Europe, the art of mining was long chiefly confined to Sweden and Germany; but since the disappearance of our thickly wooded forests, and the universal introduction of pit-coal for fuel, and of cast-iron in the arts, Great Britain has made rapid strides towards perfection in the art of mining, and now rivals her Continental neighbours. Here we may allude to the coalworks of Northumberland and Durham, of Cumberland, and the western counties of England and Wales. We may also notice the great extent of similar works in the south-eastern and south-western districts of Scotland. Much of this kind of work is done with the pick and shovel; but without the aid of the expansive force of gunpowder these operations must have been of very limited extent. Other works of no less magnitude than those of coal-mines have been executed in Great Britain, almost wholly by the force of gunpowder. To illustrate more fully the use of gunpowder in mining operations, we may mention the extensive works in tunnelling for railways, and for preserving the level of canals, instead of forming locks, or following a circuitous line of navigation. The bold attempt of blasting rocks under such circumstances was, in this country, reserved for Brindley, the engineer upon the Duke of Bridgewater's canals, who in 1776 completed the first navigable tunnel, at Harecastle in Staffordshire, upwards of a mile in length. Since that period the art of blasting has been extensively practised in a great variety of works, and carried to a wonderful degree of perfection.

Method of blasting rocks.

When a perforation is to be made in a rock for the purpose of blasting with gunpowder, the nature of the rock, and the inclination or dip of the strata, determine the calibre, and the depth and direction of the bore or recipient for the gunpowder. According to circumstances, the diameter of the hole varies from half an inch to two and a half inches, the depth from a few inches to many feet; and the direction varies to all angles from the perpendicular to the horizontal. The implements for the performance of this operation are extremely simple; and the whole operation of boring and blasting rocks is so easily performed, that, in the space of a few weeks, an intelligent labourer may become an expert quarrier. The chisel, or *jumper* as it is technically called, varies in its length and other dimensions according to the work to be performed, and its edge is more or less pointed to suit the hardness or tenacity of the rock to be bored. If the cylindrical hole to be drilled is of small diameter and of no great depth, as often happens, the operation of boring is performed by a single person: with one hand he manages the chisel or jumper, which he keeps continually turning, and with the other he strikes the jumper with a hammer of six or eight pounds weight. But when the hole is of larger dimensions, and of a depth exceeding a foot, it generally becomes the business of one man, in a sitting posture, to hold and direct the jumper, to keep it constantly turning, to supply the hole with water, and occasionally to clean it out, while two, and even three men, with hammers of ten or twelve pounds weight, strike successive blows upon the jumper, until the rock is perforated to the desired depth. To prevent annoyance to the quarriers from the squirting up of the water, a small rope of straw or hemp is simply twisted round the jumper, and kept resting on the orifice of the hole. When the perforation is to be made to a greater depth than about thirty inches, a chisel or jumper is used, varying in length from six to eight feet, pointed at both ends, and having a bulbous part in the middle for the convenience of holding it. It thus beomes a kind of double jumper, and is used without a hammer, with either end put into the hole at pleasure. When a bore of considerable depth is to be made, after the hole has been perforated a few inches with the common jumper, the quarriers lay it aside, and, collecting round the *long jumper*, lay hold of it by the bulbous part, lifting and letting it drop into the hole by its own gravity. In this manner, a hole to the depth of five feet and upwards is perforated by the workmen with ease and with great expedition. A very ingenious and expeditious method, borrowed from the Chinese, is by means of a jumper of very considerable length and weight, suspended and worked by a rope passed over a wheel; and which thus acquires, by the twisting and untwisting of the rope, the requisite rotatory motion. The jumper is hollow, and is so contrived as to receive and retain the *debris*, by means of valves opening inwards. When the boring is completed, the *debris* and moisture are carefully cleaned out, and the charge of powder is put into the hole. In practice, there was formerly no very precise rule for the quantity of the charge, this being regulated at the discretion of the quarrier, according to the tenacity and mass of the rock to be removed; and these circumstances having been previously considered in the dimensions of the bore, it is customary to fill the hole in the proportion of about one-half with gunpowder.

Blasting.

Of late the experiments and observations of Sir John Burgoyne and others, which were conducted more exactly than those of former years, seem to have fully established the propriety of proportioning the charges to the cubes of the *lines of least resistance*, which is the law that theory would assign for rocks of uniform consistence and cohesion. The line of least resistance is the distance between the bore and the open side of the rock, measured in the direction in which the resistance to the explosion is least. In the chalk excavations on the South-Eastern railway, where the blasts were on the largest scale of any work hitherto executed, *the charge in pounds for that kind of work was found in practice to be in the proportion of $\frac{1}{32}$d of the cube of the line of least resistance in feet.* To assist in calculating the charges, it may be useful to remark that 1 lb. of loosely poured powder occupies about 30 cubic inches, so that a cubic foot will weigh about 57½ lb.

After the charge has been introduced, which should be done by means of a copper tube extending down to the bottom of the bore, a long iron, called the *pricker*, is inserted amongst the powder, to be afterwards withdrawn when the priming powder is introduced. While this rod remains, the process of *ramming* or *stemming* the hole is performed by forcing burnt clay, fragments of pounded brick, stone, or any other substance less liable than another to produce sparks of fire on being struck with iron. After a stratum of such matter has been pressed down upon the powder, the hole is filled up with pounded stone or earthy matters of any kind, forced down with an iron punch or rammer of such dimensions that it nearly fills the hole, but having a groove in it to receive the pricker. The rammer being flat at the end which enters the hole, the fragments of stone are pounded by it round the pricker, which must be occasionally turned to prevent it from becoming too firmly fixed to be withdrawn. This wadding or matter laid immediately over the powder is forced down gently at first, lest it should explode prematurely; but as the hole is more and more filled up, the quarrier strikes down the stemmer with more violence, and consolidates the wadding as much as possible, with a view to produce a greater effect by the shot. In this operation consists the chief danger attending the process of blasting; for it must be obvious, that unless the utmost care be taken in forcing down the first portions of the wadding above the powder, there is great danger of such a collision taking place between the stemmer and the pricker, or between either of these and the rock or sides of the hole, as may elicit a spark of fire, and produce an explosion. From this cause, indeed, the most dreadful accidents have sometimes happened to quarriers. It is necessary, as before noticed, frequently to turn the pricker during the process of stemming the shot; and it has been known that, by the friction produced in the mere act of turning it unguardedly, the shot has been fired

Blasting. off. To prevent accident in this way, copper prickers, or, to save expense, prickers composed partly of copper and partly of iron, have been introduced. The copper pricker is certainly much less hazardous; but notwithstanding that this fact is self-evident, and has been clearly established in quarries where copper and iron prickers have been used at the same time, yet, from the greater expense of the copper, and its being more liable to twist and break, it is not yet in universal use.

The hole being now fully charged with the powder and wadding, the pricker is drawn out; and the small tubular space which it leaves is sometimes wholly filled with powder. But with a view to save that expensive article, it is common to insert wheaten or oaten straws filled with powder. These straw tubes may be joined so as to reach any necessary depth, the lower straw always terminating in the root part, where a natural obstruction occurs, or it is artificially stopped with clay. The lower part of the priming straw is pared very thin, so as to insure the inflammation of the charge of powder in the hole. A *slow match*, consisting generally of soft paper, prepared by dipping it into a solution of saltpetre, is then carefully applied to the priming powder. When this match is touched with fire, the quarriers give the alarm to all around to retire to a sufficient distance, so as to avoid accident from the expected explosion. This commonly takes place in about a minute. The priming first explodes, attended only with flame; then the rock opens with a sharp report, and fragments of stone are shot into the air in all directions, from amidst a cloud of smoke. When blasting is carried on in confined situations, where the workmen cannot get speedily out of the reach of the shot, or where adjoining houses, &c., may be in danger of being injured, it is common to load or cover up the rock to be blasted with a quantity of furze or brushwood, loaded with stones or chains to prevent the fragments being driven to a distance.

Tamping. It was long supposed that the more firmly the shot was rammed home, by means of a punch or hammer, the more powerful would be the effect of the explosion. This, we know, was long the conviction of military engineers, and was also a principle invariably adopted by miners, to the great personal hazard of the artificer. It has however been, we think, sufficiently established that a wadding or tamping of loose sand, or of any earthy matter in a dry state, answers all the purposes of the firmest ramming or wadding. Now, as it is in the operation of ramming that accidents most commonly befall the quarrier,—accidents which the use of the copper-pricker cannot altogether prevent,—it is surprising that the use of sand is not universal.

It may be noticed, that in several works this method is adopted, particularly at Lord Elgin's extensive mining operations at Charlestown in Fifeshire, where much attention is paid to the security and comfort of the artificer, as well as to everything interesting to science. The practice of using loose sand instead of pounded stone rammed with force, has been in use at these works for many years,—it is believed since about 1810. The writer of this article has also had considerable opportunities of trying the accuracy of these statements, *as to the efficiency* of sand, at the extensive quarrying operations which became necessary in cutting down a part of the Caltonhill, to form the new approach to the city of Edinburgh, where upwards of 100,000 cubic yards of rocky matter were removed, and gunpowder to the value of nearly L.1000 sterling was expended, chiefly in blasting rock, consisting of whinstone or greenstone, much traversed by calcareous spar. The holes at this work were bored of various dimensions, both as to calibre and depth, and also at all the angles of inclination, from the perpendicular to the horizontal. Trials were here made with holes from three to seven or eight feet in depth, and from an inch to two and a half inches in diameter; and it was invariably found, that when the powder was tamped with sand, the effect in tearing or blasting the rock was as great as when the more common method of ramming with pounded stone was adopted. In the judgment of the contractors, the fragments of rock had a greater tendency to fly to a distance when sand only was employed; but there was as great a bulk of the rock raised by the shot wadded with sand as by that which was rammed in the usual way; and in practice it was found that the shots with sand were not more liable to fail, or *blow* without doing execution, than those which were rammed. It is a fact perhaps as curious and interesting as any connected with the subject, that in both ways the shots fail, and at times blow out, without producing any effect, or being occasioned by any apparent cause. Blasting.

When sand is used immediately above the powder, both the pricker and the rammer are wholly unnecessary: the *primed straw* being inserted into the powder, the sand is poured into the hole, and the shot is ready for the match. But a difficulty occurs in the use of sand, which, though easily surmounted, it may be proper to notice. When the perforation happens to be horizontal, or at more than an angle of 45° from the perpendicular, the priming straw is apt to be injured in filling the hole with sand, an evil to which the pricker is not liable; but this is easily got over by inserting the priming straw into a small cylindrical tube of sheet-iron or copper, while the sand is gently pressed into the hole; and the small tube, which is open at both ends, is afterwards withdrawn. By this means the operation of the horizontal shot is rendered not less sure, and is attended with no greater expense, and little more trouble, than when the bore is perpendicular.

It is proper to observe, however, that although hard stemming of broken stones with punches or hammers is generally disapproved of, there is still some diversity of opinion among writers on the subject as to the use of sand tamping. General Pasley and some other experimenters contend for the superiority of clay over sand in every case, and especially for short bores.

Inflammation of the powder. It has been supposed by some that a more complete inflammation of the powder would take place if it were ignited at the bottom of the hole; but it has been found, from experiment, that gunpowder is even more fully inflamed by applying the fire near the top; for, in firing ordnance, considerable quantities of the uninflamed grains of the powder have been collected, by placing a piece of cloth at a distance from the gun, and allowing the shot to pass through it.

Use of quick-lime. Quick-lime, suddenly slacked, has been suggested as a mode of rending rocks; but this process would in practice be found very defective. In some situations where the explosive effects of gunpowder could not be applied with safety, as in the interior of a building, or for such like purposes, this mode may be resorted to with good effect.

Blasting under water. Blasting with gunpowder under water is necessarily performed in various operations of the engineer, particularly in the excavation of the foundations of piers, and in deepening the entrances of harbours. This used to be done by inserting the charge of powder into the perforated rock by means of a case or cartridge made of tin-plate. The lower part is made to fit the bore in the rock as nearly as may be; and from this a small pipe of the same metal, with the priming powder, is carried to the surface of the water. Here wadding is unnecessary, the pressure of the water upon the tin case superseding the necessity of any; and the explosive effects are generally greater, in proportion to the charge, than those in the open air. The use of tin tubes in submarine blasting has now been wholly abandoned, since the introduction of Beckford's patent fusè, which may with strict propriety be called one of the greatest modern improvements in blasting. The fusè is alike applicable to the removal of rock thirty feet under water, as to all situations where the rock is spongy or full of springs. The charge is contained in water-proof bags, and the fusè, which may be described

Bleaching.

as a perforated water-tight *rope* or *hose*, is attached to the shot-bag; and the inflammable composition in the fusè is thus kept in contact with the charge. The fusè itself is of length sufficient to reach the inside of the diving-bell, or, where that is not used, it must be of length to come above the water. It burns at the rate of from two to three feet per minute. When the fusè is used above water in damp quarries, the shot-bags may, for economy, be made of strong brown paper twice oiled, instead of tarred canvas. It may here be observed, that explosions under water have in some instances been proposed as a mode of attack in marine warfare; and it is presumed that explosions at considerable depths might occasion such an impression on the water, and so disturb the equilibrium of the atmospheric pressure, as to be capable of sinking large ships or floating batteries.

Firing by a voltaic battery.

The mode of firing the charge by galvanism is a modern improvement of very great importance, and has the advantage of being equally applicable to submarine and to ordinary blasting. All that is necessary is to make a small interruption in the conducting wire in contact with the charge. In passing the electric current, a spark is produced at the interruption sufficient to fire the charge. It is instantaneous, and enables the operator to fire simultaneously any number of charges, according to the effect desired to be produced. The application of galvanic firing to submarine charges was first put into practice by General Pasley, in 1839, on the wreck of the Royal George at Spithead. It was also used in the same year, at the Skerryvore rock, by Mr Alan Stevenson. The simultaneous firing of several charges was extensively employed by Mr William Cubitt in the blasting near Dover in 1843. Three charges of 18,000 lb. of gunpowder were *simultaneously* fired by this means. Round-Down Cliff, about 400 feet high, was thrown down, with comparatively little explosion, and covered the beach with 400,000 cubic yards of chalk rock; producing a saving of L.7000 to the South-Eastern Railway Company in this part of their works. This method of blasting is now extensively employed in various parts of the country.

Use of gun-cotton.

Gun-cotton has also been employed in blasting, especially on the Manchester and Huddersfield railway in Standedge tunnel, and on the works in the Stour Valley near Birmingham. It has been stated that gun-cotton produces a much greater effect, weight for weight, than gunpowder, in the proportion of 5 to 1. This seems an exaggeration; but the disruptive effect really seems to be greater from gun-cotton; and as it gives no smoke, in confined situations the workmen are enabled sooner to resume their work.

Blasting screw.

It may also be mentioned, that an instrument called the *Blasting Screw* has been applied with considerable success to the rending or splitting of large trees and logs of timber. It consists of a screw which is wrought into an auger-hole, bored in the centre of the timber; here the charge of powder is inserted, and the orifice of the hole in the log is then shut up or closed with the screw, when a match or piece of cord prepared with saltpetre is introduced into a small hole left in the screw for this purpose, by which the powder is ignited. The application of this screw to the purposes of blasting is not very obviously necessary, because, from what we have seen, it would appear that the auger-hole, being charged with powder and sand, would answer every purpose. One great objection to the process of blasting applied to the rending of timber is, the irregular and uncertain direction of the fracture, by which great waste is sometimes occasioned. It may, however, be necessary to resort to this mode of breaking up large trees, when cut down and left in inaccessible situations, where a great force of men and of implements cannot easily be procured or applied.

Blatta ‖ Bleaching.

See *Treatise of Artillery*, by John Muller; Hutton's *Mathematical Dictionary;* Robins's *New Principles of Gunnery*, by Dr Hutton; Nicholson's *Journal*, vols. xii. and xiii.; *Papers of Corps of Roy. Eng.*, vols. iv. and vi.; *Rudimentary Treatise on Blasting and Quarrying Stone*, by Sir J. Burgoyne, Lond. 1849; Stevenson's *Skerryvore Lighthouse*, Edin. 1848; Pasley's *Memoranda on Blasting; London Electric. Soc. Trans.*, 1839. The reader is also referred to Voltaic Electricity for later methods of Blasting. (R. S.) (T. S.)

BLATTA, a genus of coleopterous insects, belonging to the division of *Orthoptera*, and family *Blattidæ*. The best known in this country are the cockroach, *B. orientalis*, that infests our houses, *B. germanica*, *B. pallens*, *B. americana*. See Entomology.

BLAYE, a fortified seaport town of France, capital of an arrondissement of the same name, in the department of Gironde, on the right bank of the river of that name, and 20 miles N.N.W. of Bordeaux. The river is here about $2\frac{1}{2}$ miles broad, and is defended by Forts Pâté and Medoc; and all vessels inward-bound to Bordeaux, &c., are required to anchor at Blaye, and to exhibit manifests of their cargoes; and vessels outwards generally call here to take in stores or complete their cargoes. It has also a considerable export trade in wine, brandy, corn, oil, soap, and fruits. The town has a strong modern citadel, a handsome public fountain, theatre, hospital, tribunals of primary instance and commerce, agricultural society, &c. Pop. (1851) 4350; of arrondissement, 59,469.

BLAZONRY, the art of deciphering coats of arms; and also that of expressing or describing a coat of arms in appropriate language. The term is said to be derived from the German *blasen, to blow;* it having been customary at jousts and tournaments for the herald to sound a trumpet when he proclaimed the arms of a knight on ushering him into the lists.

BLEACHING

Is the art of depriving cotton, linen, silk, wool, wax, &c., of their colouring matter, and rendering them as white as possible. The word is probably derived from the French term *blanchiment*, which signifies the process of *rendering white.*

History.

1. The ancients, especially in Egypt, where white linen or cotton was a common article of clothing, must at an early period have been acquainted with the method of bleaching that substance; but none of their writers have left us any details on the subject. We know, however, from Pliny, that different plants, and likewise the ashes of plants, which no doubt contained alkali, were employed as detergents. Pliny mentions particularly the *Struthium* as much used for bleaching in Greece. This plant has been considered by some as the *Gypsophila Struthium.* But as it does not appear from Sibthorp's *Flora Græca*, published by Sir James Smith, that this species is a native of Greece, Dr Sibthorp's conjecture that the *Struthium* of the ancients was the *Saponaria officinalis*, a plant common in Greece, is certainly more probable. Mr Parkes, in his *Essay on Bleaching* (*Chemical Essays*, vol. iv. p. 7), says, that Theophrastus states that lime was used by the ancients in bleaching; and that a ship, partly loaded with linen, and partly with lime for bleaching it, was destroyed by the water having accidentally found access to the lime. We endeavoured, with some pains, to verify this quotation; and, accordingly, turned over all the writings of Theophrastus with which we are acquainted, but without being able to find anything bearing the least allusion to it.

Till the middle of the 18th century, the art of bleaching was scarcely known in Great Britain. It was customary to send all the brown linen manufactured in Scotland to Holland to

Bleaching. be bleached. It was sent away in the month of March, and not returned till the end of October, being thus out of the hands of the merchant more than half a year. The principal Dutch bleaching-grounds were in the neighbourhood of Haerlem; and the great success of their bleaching was ascribed to the superior efficacy of their water, which, according to the fashionable theory of the time, was sea-water filtered and rendered sweet by passing through their sand-downs. Indeed, it was long a prejudice on the Continent, that no water was efficacious for bleaching but sea-water.

The Dutch mode of bleaching was to steep the linen for about a week in a potash ley poured over it boiling hot. The cloth being taken out of this ley, and washed, was next put into wooden vessels containing butter-milk, in which it lay under a pressure for five or six days. After this it was spread upon the grass, and kept wet for several months, exposed to the sunshine of summer.

In the year 1749, as we are informed by Mr Parkes (*Chemical Essays*, vol. iv. p. 26), an Irishman, who had learned something of the art of bleaching, settled in the north of Scotland, and established a bleaching manufactory. On applying to the principal Scotch makers of linen, they readily furnished him with a quantity of goods; but after keeping them a whole year, he failed in all his endeavours to bleach them, and the proprietors were obliged to send them to Holland to get the process completed. Next summer his efforts were not more successful; the linen was considerably injured, and even rendered tender by his management, but it was not whitened. Nevertheless, this man by perseverance became in a few years an excellent practical bleacher. He had the merit of introducing the art into Great Britain, and his descendants at this day figure among the higher ranks in the metropolis.

The bleaching process, as at that time performed, was very tedious, occupying a complete summer. It consisted in steeping the cloth in alkaline leys for several days, washing it clean, and spreading it upon the grass for some weeks. The steeping in alkaline leys, called *bucking*, and the bleaching on the grass, called *crofting*, were repeated alternately for five or six times. The cloth was then steeped for some days in sour milk, washed clean, and crofted. These processes were repeated, diminishing every time the strength of the alkaline ley, till the linen had acquired the requisite whiteness.

For the first improvement in this tedious process, which was faithfully copied from the Dutch bleachfields, manufacturers were indebted to Dr Francis Home of Edinburgh, who proposed to substitute water acidulated with sulphuric acid, for the sour milk previously employed. This suggestion was in consequence of the new mode of making sulphuric acid, contrived some time before by Dr Roebuck, which reduced the price of that acid to less than one third of what it had formerly been. It is curious, that when this change was first adopted by the bleachers, there was the same outcry against its corrosive effects as we have seen some years ago, when chlorine was substituted for crofting. No allegation, however, could be worse founded, and it was completely destroyed by the publication of Dr Home (*Essay on Bleaching*), who demonstrated the perfect innocence and the superior efficacy and cheapness of sulphuric acid, when properly applied, as compared with sour milk. Another advantage resulted from the use of sulphuric acid, which was of the greatest importance to the merchant. A souring with sulphuric acid required at the longest only twenty-four hours, and often not more than twelve; whereas, when sour milk was employed, six weeks, or even two months, were requisite, according to the state of the weather. In consequence of this improvement, the process of bleaching was shortened from eight months to four, which enabled the merchant to dispose of his goods so much the sooner, and consequently to trade with less capital. Bleaching.

The bleaching art remained in this state, or nearly so, till the year 1787, when a most important change began to take place in it, in consequence of a discovery which originated in Sweden about thirteen years before. In the year 1774 there appeared in the *Memoirs of the Royal Academy of Stockholm* a paper on manganese, by Mr Scheele. Among other experiments to which he subjected this mineral, he mixed it with muriatic acid, put the mixture in a retort, and applied heat. He perceived a smell similar to that of aqua regia. This induced him to collect what came over in a receiver, and he found it to be muriatic acid, altered in a remarkable manner by the action of the manganese on it. Its smell was greatly heightened, it was become less soluble in water, and it possessed the property of destroying those vegetable colours on which it was allowed to act. M. Berthollet repeated the experiments of Scheele on this new acid in 1785, and added considerably to the facts already known. He showed that this new substance (called by Scheele *dephlogisticated muriatic acid*) is a gas soluble in water, to which it gives a yellowish green colour, an astringent taste, and the peculiar smell by which the body is distinguished. When water impregnated with this gas is exposed to sunshine, it gradually loses its colour, while at the same time a quantity of oxygen gas is disengaged from the water. If the liquid be now examined, it will be found to contain, not the new acid, but common muriatic acid. This experiment Berthollet considered as exhibiting an analysis of the new acid, and as demonstrating that it is a compound of muriatic acid and oxygen. On that account he gave it the name of *oxygenated muriatic acid*, which was afterwards shortened into *oxymuriatic acid*, an appellation by which it was long known among bleachers.

The property which this gas possesses of destroying vegetable colours led Berthollet to suspect that it might be introduced with advantage into the art of bleaching, and that it would enable practical bleachers greatly to shorten their processes. At what time these ideas first struck his mind we do not exactly know; but at the end of a paper on dephlogisticated muriatic acid, read before the Academy of Sciences at Paris in April 1785, and published in the *Journal de Physique* for May of the same year (vol. xxvi. p. 325), he mentions that he had tried the effect of the gas in bleaching cloth, and found that it answered perfectly. This idea is still further developed in a paper on the same substance, published in the *Journal de Physique* for 1786. In 1786 he exhibited the experiment to Mr Watt, who, immediately upon his return to England, commenced a practical examination of the subject, and was accordingly the person who first introduced the new method of bleaching into Great Britain.

Mr Parkes, in his *Chemical Essays*, published in 1815, has mentioned some facts upon this subject, which it will be proper to state. In the early part of the year 1787, Professor Copland of Aberdeen accompanied the Duke of Gordon to Geneva, and was there shown the discolouring property of chlorine gas by M. de Saussure. Mr Copland was much struck with the importance of the experiment; and on his return to Aberdeen in July 1787, he mentioned the circumstance, and repeated the experiment before some eminent bleachers in his own neighbourhood. These gentlemen were Messrs Milnes of the house of Gordon, Barron, and Company, Aberdeen. They immediately began the application of the process to the bleaching of linen on a great scale; and Mr Parkes assures us that they were the first persons who applied the new process to practical bleaching in Great Britain.

New process introduced into Britain by Mr Watt.

But this statement, though it may appear plausible at first sight, is quite incorrect. The writer of this article took the liberty of applying to Mr Watt himself for information on the subject. Mr Watt has preserved copies of all his letters since the year 1782, taken by means of his copying machine; and he allowed the writer of this article to peruse such of them as bore any reference to this subject. Now, two letters were found which entirely set the matter at rest. The first of these is to his father-in-law, Mr Macgregor, dated Birmingham, 19th March, 1787. In this letter he gives a particular detail of the new bleaching process, states its advantages, and says that he had sent Mr Macgregor a quantity of the whitening liquor. The second letter is to Berthollet, and is dated Birmingham, May 9, 1787. The following is a part of that letter, which we have transcribed verbatim: "Je ne sais pas si j'ai encore fait la liqueur acide si fort que vous avez fait, mais je vous donnerois les moyens de juger. Je trouve que 4 onces de mon acide mêlé avec la quantité nécessaire d'alkali de pearl-ash peut blanchir un gros de toile brune, telle comme j'ai vu chez vous. Il est vrai qu'il ne la fait tout-à-fait blanc; mais il le fait aussi blanc, que je puis le faire, même en ajoutant une second dose d'acide. Je bouille la toile par avance dans une solution d'alkali faible; et, à mi blanc, je la bouille une second fois. Je trouve que le savon est meilleur que l'alkali pur pour la second bouillon. J'ai blanchi tout-à-fait le coton, mais je ne suis encore parvenu à blanchir *parfaitement* la toile de lin." The reader will observe that the date of both of these letters is some months before Mr Copland's return from the Continent. M. Berthollet had published his process in 1785, and as Watt had brought it to England in the end of 1786, and had put it in practice, and introduced it into Mr Macgregor's bleachfield, near Glasgow, in the month of March 1787, it is clear that Saussure has no claim to the original discovery, nor Mr Copland to the first introduction of the new process into Great Britain.[1]

Dr Henry quotes a letter of Mr Watt, dated February 23, 1788, in which he says, "I have *for more than a twelvemonth* been in possession *and practice* of a method of preparing a liquor from common salt, which possesses bleaching qualities in an eminent degree; but not being the inventor, I have not attempted to get a patent or exclusive privilege for it." (*Annals of Philosophy*, vi. 423.) This letter alone is sufficient to show that Mr Watt's experiments were of an earlier date than those of Messrs Milnes. He says further, that "at that very time 1500 yards of linen were bleaching by the new process, under his directions." This great experiment was conducted in the bleachfield of his father-in-law, Mr Macgregor, near Glasgow; where, as he wrote to M. Berthollet, soon after, 500 pieces were bleached by the new method, and Mr Macgregor was so satisfied of the importance of the new process, that he had resolved to continue it. Mr Watt made several improvements in the method of M. Berthollet. Instead of employing muriatic acid and manganese, as had been done by Scheele and Berthollet, he had recourse to the cheaper mode of a mixture of common salt, black oxide of manganese, and sulphuric acid. He made use of wooden vessels to hold the water which was to be impregnated with the chlorine, coating them within with a mixture of wax and pitch, which rendered them air-tight, and prevented the gas from acting on the wood. Mr Watt likewise contrived a test to indicate the strength of the water impregnated with chlorine, as far as its bleaching effects were concerned. He took a determinate quantity of the infusion of cochineal, and ascertained how much of the bleaching liquor was necessary to destroy the colour. The strength of the bleaching liquor was obviously inversely as the quantity necessary to destroy the colour. But M. Welter hit upon another method about the same time, which has been considered as preferable, and has in consequence come into general use. He employed a solution of indigo in sulphuric acid, instead of the infusion of cochineal. In other respects the two methods were the same.

Mr Thomas Henry of Manchester began his experiments on bleaching by means of chlorine nearly as early as Mr Watt, and without any previous knowledge of what he had done. He was very assiduous, and very successful in his trials. At a meeting of the bleachers held at Manchester early in 1788, he exhibited half a yard of calico, bleached by the new method, which was considered as superior in whiteness to half a piece of calico bleached by the same process by Messrs Cooper, Baker, and Charles Taylor. In consequence of this exhibition he was applied to by Mr Ridgway of Horwich, to be instructed in the new process: and the instructions which the latter accordingly received were the first step of a series of improvements carried on by Mr Ridgway and his son, with an ability and spirit of enterprise which have raised their establishment to its present extent and importance. (See *Annals of Philosophy*, vi. 423.) These two gentlemen, Messrs Watt and Henry, had the chief merit of introducing the new mode of bleaching into Lancashire, and the neighbourhood of Glasgow.

In the year 1789 M. Berthollet published a memoir on the subject, in the second volume of the *Annales de Chimie*, p. 151. In this memoir, which constituted the first publication on the mode of bleaching by means of chlorine, Berthollet gives a detail of the progress of his experiments, and states the attempts that had been made to introduce the new mode of bleaching into France. M. Bonjour, who had assisted him in his experiments, associated himself with M. Constant, a manufacturer of cloth at Valenciennes, to form a bleaching establishment in that city upon the new plan. But their project was prevented by the prejudices of the inhabitants and by the jealousy of the bleachers, who were afraid of being injured by the introduction of any new improvements. M. le Comte de Bellaing, however, who approved of the project, granted a piece of ground possessed of all the requisite conveniences, but at rather too great a distance from Valenciennes. Mr Bonjour applied to the board of commerce for the exclusive privilege of bleaching for some years, according to the new method in Valenciennes and Cambray, and for two leagues around these places, offering at the same time to explain the new process in all its details to those who wished to make themselves acquainted with it. But the request was refused.

It does not appear from Berthollet's account that the new mode of bleaching had been successfully established in any manufactory in France before the publication of his Memoir. One of the great difficulties in the way of applying chlorine to bleaching, was the very disagreeable and noxious odour which characterized it, and which rendered it not only very offensive, but highly injurious to the health of the workmen. Berthollet describes, at consider-

[1] The late Prof. T. Thomson, when he drew up the preceding historical detail for the Supplement to the Sixth Edition of the Encyclopædia Britannica in the year 1816, thought it right to write to Professor Copland, stating the facts given in the text, and requesting him to say whether they were accurate. Mr Copland returned no answer to the letter. This silence may be considered, we think, as an admission of the accuracy of the statements.

Bleaching

able length, a vessel contrived for impregnating water with it, by M. Welter, and likewise the mode of preparing the gas from common salt, black oxide of manganese, and sulphuric acid. But his improvements, though considerable, were far from obviating the inconveniences complained of. Some method was wanted which should deprive water impregnated with this gas of its smell, without depriving it of its bleaching qualities. The first attempt to accomplish this object originated with M. Berthollet himself.

When he first began to bleach by means of water impregnated with chlorine, he employed that liquid as concentrated as possible; but he found that the texture of the cloth steeped in it was considerably injured. To prevent this effect, he at first added a little alkali to the liquid, in order to saturate a portion of the acid. But he found afterwards that it was better to dilute the liquid with water. Before this last method occurred to him, however, he was requested to go to Javelle, to show the bleachers there the method of preparing the chlorine and making the bleaching liquor. He went twice in consequence, prepared the liquor before the bleachers, and added some potash to prevent the acid from injuring the texture of the cloth. Some time afterwards the manufacturers of Javelle announced in the different journals that they had discovered a peculiar liquid which they called *Lessive de Javelle*, and which possessed the property of bleaching cloth immersed in it for a few hours. This liquid they prepared by dissolving potash in the water which they were going to impregnate with chlorine. The consequence was, that the liquid absorbed a much greater quantity of gas, and might be diluted with a considerable proportion of water, without losing its bleaching quality.

Being disappointed in their attempts to introduce this liquor among the French bleachers, they came over to England, and applied to parliament for the exclusive privilege of supplying the British bleachers with this liquid. The patent was to be given to MM. Bourbollon de Bonneuil and Company. In consequence of this application, a meeting of the bleachers of Lancashire was advertised in the beginning of the year 1788. It was at this meeting that Mr Henry exhibited the half yard of calico bleached according to the new method. Mr Watt had written a letter to Dr Percival on the subject, which was communicated to the meeting. He stated in it that he had been in possession of a new method of bleaching, by means of chlorine, for above a year; that he had learned it from Berthollet, and that he had every reason to believe that the liquor of MM. Bourbollon de Bonnueil and Company consisted of chlorine, or of some preparation of it. In consequence of this meeting, the county members of parliament were requested to oppose the intended monopoly. Mr Watt also exerted all his influence; and Mr Parkes informs us likewise, that one of the Messrs Milnes of Aberdeen, who had been informed of the use of chlorine by Mr Copland, happened to be in the gallery of the House of Commons when the application in favour of the French gentlemen was made. He took immediate measures to inform the principal members that this was not a new process; that he himself had long ago prepared an article equally advantageous; and that he was ready to substantiate the truth of his statement when required. (Parkes's *Chemical Essays*, iv. 62.) In consequence of the united exertions of all these different gentlemen, the bill was thrown out, and the monopoly prevented.

It seems to have been partly in consequence of this application of the French gentlemen that Mr Henry of Manchester was induced to attempt bleaching upon a large scale with chlorine. His attention had been first drawn to the subject by the papers of Berthollet, published in the *Journal de Physique*, during the years 1785 and 1786. He was at that time engaged in a course of lectures on dyeing, printing, and bleaching. An acquaintance with the properties of chlorine, which he had repeatedly had occasion to exhibit in his course of lectures, and the general hints previously thrown out by Berthollet, led him to conclude that the liquor of Bourbollon and Company could be nothing else than chlorine, or some compound of it. His first operations on the large scale consisted in exposing the goods, in a moist state, in air-tight chambers, to the action of chlorine gas. He likewise began to prepare for sale a bleaching liquor, in which the gas was condensed in a very weak solution of potash; which, as we learn from Berthollet, was the very same with the *Lessive de Javelle*. This liquid possessed two advantages over water simply impregnated with chlorine gas. Its smell was less noxious, and it might be employed to whiten printed calicoes without destroying the colours which had been dyed upon the cloth. But these advantages were much more than counterbalanced by equivalent disadvantages. It was found not to go nearly so far as water impregnated with chlorine gas, and when kept for some time it lost its bleaching properties altogether. The reason of this last alteration is now sufficiently understood: the chlorine in the liquid was gradually converted into common muriatic acid and chloric acid; the water containing merely common muriate of potash and chlorate of potash. In consequence of these disadvantages, the addition of potash to the bleaching liquid was soon laid aside. The next attempt to destroy the noxious smell of the liquid, without destroying its bleaching property, was the addition of lime to the liquid. Mr Henry of Manchester was one of the first persons who thought of this addition. On the floor of his air-tight chambers rested a stratum of thin cream of lime, through which the goods were passed by means of a wince; and were afterwards exposed, on quitting the liquor, to chlorine acid gas. Hence the chloride of lime was formed upon the cloth. But this method was objectionable in the case of some coloured goods, the colours of which were injured or destroyed by that earth. It admitted, therefore, of only a partial application.

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Other persons made similar attempts, none of which appear to have been attended with success. But Mr Tennant of Glasgow, after a great deal of most laborious and acute investigation, hit upon a method of making a saturated liquid of chloride of lime, which was found to answer perfectly all the purposes of the bleacher. This was certainly a most important improvement. Without it, the prodigious extent of business carried on by some of our bleachers could not possibly have been transacted. To give some idea of the rapidity with which bleaching is conducted according to the new process, we may mention the following fact, which we state on what we consider as very good authority. A bleacher in Lancashire received 1400 pieces of gray muslin on a Tuesday, which on the Thursday immediately following were returned bleached to the manufacturers, at the distance of sixteen miles, and they were packed up and sent off on that very day to a foreign market. The quick return of capital which is thus made is a benefit entirely to be ascribed to the new mode of bleaching.

In the year 1798 Mr Tennant took out a patent for his new invention, and offered the use of it to practical bleachers, for a fair and reasonable portion of the savings made by its substitution for potash, then in general use. Many of the bleachers, however, used it without paying him, and a combination was formed to resist the right of the patentees. In December 1802, Mr Tennant and Company brought an action for damages against Messrs Slater and Varley, nominally the defendants, but who, in fact, were

Bleaching. backed and supported by a combination of almost all the bleachers in Lancashire. In consequence of this action, the patent right was set aside by the verdict of a jury and the decision of Lord Ellenborough, who used very strong language against the patentees. The grounds of this decision were, that the patent included a mode of *bucking* with quicklime and water, which was not a new invention. It was decided that, because one part of the patent was not new, therefore the whole must be set aside. Had the writer of this article constituted the jury, the verdict would have been very different. Lime was indeed used previous to the patent of Mr Tennant; but it was employed in a quite different manner from his, and he would have allowed all of them to continue their peculiar method without any objection, because it would have been productive of no injury to his emolument. If the very same process as that of Mr Tennant was employed before he took out his patent, there could be no doubt that the process originated with him, and that those who used it had been induced to do so from the information which they derived from him. In the opinion of the writer of this article, Mr Tennant was hardly used, and the words employed by Lord Ellenborough were quite inapplicable to him. But when a very powerful combination is formed against any individual, the sentiments with which they are actuated propagate themselves with rapidity; and it is difficult for the most upright jury to avoid being swayed by prejudices, which are the more formidable, that their existence is not perceived.

In consequence of this decision, the use of liquid chloride of lime in bleaching was thrown open to all, and appears now to be universally employed by the bleachers in Britain. Mr Tennant, thus deprived of the fruits of several years of anxious and laborious investigation, advanced a step farther, to what may be considered as the completion of the new method. This consisted in impregnating quicklime in a dry state with chlorine.[1] He had taken out a patent for this on the 13th of April 1799, and his right fortunately was not contested. He began his manufactory of solid chloride of lime at first upon a small scale, which has been ever since gradually extending, and his manufactory is now the largest of the kind in Great Britain. During the whole period of the duration of his patent he laboured under great disadvantages. The chlorine gas with which the lime was impregnated was obtained from common salt. Now, his patent did not extend to Ireland, in consequence of which manufactures of dry chloride of lime were established in that kingdom. In Ireland the manufacturer obtained his salt duty free, while Mr Tennant was obliged to pay a duty of 7s. 6d. per bushel. Such, however, was the superiority of the methods employed by Mr Tennant, that he was able to compete with the Irish manufacturers in their own country.

In the year 1815, in consequence of the joint application of the bleachers, the duty on common salt, formerly charged upon all bleachers and others who employed that article in the preparation of a bleaching liquid, was taken off, and they were henceforth allowed to use it duty free. But this act, while it affords great advantages to bleachers on a large scale, precludes those who only work on a small scale from making their own chloride of lime; the consumption of the powder, therefore, is likely to increase very much among the little bleachers and calico printers. Its use is also considerable in partially discharging the colour of Turkey red cloth. The method was originally a French invention; but a patent was granted to Mr Thomson, a Lancashire calico-printer, for the process, which, we believe, he imported from Jouy. The method is this: An acid paste, consisting of tartaric acid, or any other acid thickened with gum, is first printed on the Turkey red cloth, which is then passed through liquid chloride of lime. It becomes white only where the acid was applied. On this bleached part any other colour may be applied, and the combinations produced are exceedingly beautiful and striking. Bleaching.

Such, as far as we are acquainted with the subject, is the history of the progress of the new method of bleaching in Great Britain. We have said nothing of the Irish bleachers, because we are not particularly acquainted with the progress of the new method in that country, though we believe that chlorine was tried by the Irish bleachers almost as early as it was in Great Britain. Mr Parkes supposes that Mr Kirwan might have proposed the trial of the new re-agent, in consequence of some suggestion from Scheele or Saussure. (Parkes's *Chemical Essay*, iv. 43.) But we have no evidence that this was the case. Indeed, it would be quite unreasonable to attempt, by such vague suspicions, to detract from the merit due to Berthollet for his original suggestion of the application of chlorine to bleaching, a merit which he has enjoyed without a competitor for thirty years. Scheele was dead before any one attempted to introduce the new gas into bleaching, either in Great Britain or Ireland; and there is every reason for believing that Saussure's knowledge of the bleaching qualities of chlorine originated from Berthollet's publications on the subject in 1785 and 1786.

The *bleaching powder*, or *chloride of lime* as it is usually called, is made by exposing slacked lime to an atmosphere of chlorine gas till it refuse to absorb any more. Unslacked lime is incapable of absorbing this gas; but slacked lime, or hydrate of lime, absorbs it readily. Mr Tennant of Glasgow, the original inventor of the process, whose firm is still by far the greatest in this manufacture in Britain, prepared it by covering the floor of a stone chamber with a layer of slacked lime to the height of a few inches. The stone of which the chamber is built is the Glasgow coal sandstone, which is rendered impervious to the chlorine by being coated externally with a layer of cement, made by melting together wax and rosin in the requisite proportions to make a stiff but very ductile cement. The wooden door of the apartment is then closed and made air-tight. There is an aperture above, which can be occasionally opened; the use of which seems to be to allow the common air of the chamber to make its escape. A mixture of native black oxide of manganese, ground to a fine powder, of common salt, and of sulphuric acid diluted with water, is put into a large leaden vessel, nearly spherical, and furnished at the top with a lid, which fits so as to be air-tight. From this lid a leaden tube passes into the lime chamber, to convey the chlorine gas as it is formed. This leaden vessel is cased on the outside with an iron vessel, between which and the leaden vessel there is an interval. At first the chlorine gas is extricated without any heat being applied; but after the process has continued for some time, a current of steam is made to pass into the inside of the iron case, which heats the leaden still sufficiently high to continue the process till the whole common salt is decomposed, and of course the disengagement of chlorine gas is at an end.

The black oxide of manganese (supposing it pure) is a compound of

1 atom manganese	= 3·5	5·5
2 atoms oxygen....	= 2·0	

[1] The idea of saturating slacked lime with chlorine was first suggested by Charles M'Intosh, Esq. of Cross-Basket, who was at that time a partner of Messrs Tennant and Knox.

Bleaching. By the mutual action of the sulphuric acid and the acid of the common salt it is converted into protoxide of manganese, composed of

1 atom manganese = 3·5
1 atom oxygen..... = 1·0 } 4·5

It therefore loses an atom of oxygen. This atom unites with the hydrogen of the muriatic acid evolved, forming water, and thus converting the muriatic acid into chlorine. It is obvious from this, that if the black oxide of manganese were pure, every 5·5 parts of it would be sufficient to generate 4·5 parts of chlorine, which is the quantity contained in 7·5 parts of common salt. Hence the proportions of black oxide and common salt which ought to be used are 5½ of the former to 7½ of the latter. But the black oxide of manganese employed in this country is never pure. It is always contaminated with a quantity of peroxide of iron, seldom less than one-fourth of the weight of the ore, and often amounting to one-third of that weight. It contains also not unfrequently barytes or lime, which seem to be in chemical combination with a portion of the oxide. On this account it is always necessary to use more than 5½ of manganese for every 7½ of salt. We believe that the quantity of black oxide for every 7½ parts of common salt ought not to be less than 8 parts, to make sure of obtaining the whole chlorine from the common salt.

The black oxide of manganese having a specific gravity of 4·97, and being insoluble in water, speedily falls to the bottom of the leaden still, and would soon cease to convert the muriatic acid into chlorine. To prevent this, there is an agitator in every leaden vessel, which is very frequently moved by the workmen whose province it is to take charge of these stills. By this means the manganese, which is in very fine powder, is mixed with the whole liquid, and thus brought into contact with the nascent muriatic acid, which it deprives of its hydrogen, and thus converts into chlorine.

To decompose 7½ parts of common salt completely, 12¼ parts of sulphuric acid of the specific gravity of 1·843 are requisite. This acid should be previously diluted with at least its own bulk of water; or it is better (when the manufacturer of bleaching powder makes his own acid, which is generally the case) to employ the sulphuric acid in the state in which it comes from the leaden chambers, without any artificial concentrations. This, if the acid maker conducts his process properly, may be as high as 1·75. Mr Tennant finds it better to employ a still greater quantity of acid than 12¼ for every 7½ of salt; because the decomposition goes on with the application of less heat, and the leaden stills are much less corroded, than when a smaller quantity of acid and a stronger heat are employed. What remains in the still after the evolution of the chlorine gas is at an end, is a mixture of sulphate of manganese, bisulphate of soda, and free sulphuric acid. It would not do to lose the free sulphuric acid. The residue is therefore mixed with as much common salt as the sulphuric acid is able to decompose, and the whole is gradually fused in a furnace. By this fusion the sulphate of manganese is decomposed as well as the common salt, and there remains sulphate of soda mixed with oxide of manganese and peroxide of iron. Lixiviation gets rid of these two oxides, and leaves a solution of sulphate of soda, which is evaporated to dryness, mixed with pounded coal, and ignited in a reverberatory furnace. By this simple process the Glauber salt is converted into sulphuret of sodium, from which carbonate of soda is extricated by simple and well-known processes.

The bleaching powder, when first prepared, was a bichloride of lime, or a compound of one atom of chlorine and two atoms of lime. But of late years Mr Tennant has improved his process so much, that it is now a chloride of lime, or a compound of one atom chlorine and one atom lime; that is to say, it contains twice the quantity of chlorine which it originally did, and goes twice as far when employed in bleaching; and other manufacturers have been obliged to follow his example. Hence the value of the bleaching powder all over Great Britain is about doubled, while its price is reduced to less than one-half of what it was originally; being sold at present at the rate of threepence per pound, containing nearly half its weight of chlorine. Bleaching.

With respect to the nature of bleaching powder, no experiments have been made sufficiently decisive to remove all doubts. The most commonly received opinion is, that it is a compound of chlorine and lime, or a *chloride of lime*. The objection to this opinion is what happens when carbonate of soda is saturated with chlorine to form the disinfecting liquor used by Labaracque. If the solution be evaporated, a peculiar salt is obtained, which possesses bleaching properties. No chlorine gas is given off during the evaporation. The same phenomena take place when carbonate of potash is saturated with chlorine. From this it has been conjectured, that when chlorine acts upon slacked lime, a certain portion of the lime is converted into calcium, while a portion of the chlorine is converted into *chlorous acid*, or a compound of one atom of chlorine and three atoms of oxygen. On this supposition it is evident that three-fourths of the lime are converted into calcium. The three atoms of oxygen thus evolved convert one atom of chlorine into chlorous acid. This chlorous acid unites with the one-fourth of lime remaining, and converts it into chlorite of lime; while the three atoms of calcium evolved, uniting each with an atom of chlorine, constitute chloride of calcium. According to this view of the subject, the strongest bleaching powder will be a mixture of

3 atoms chloride of calcium = 21
1 atom chlorite of lime..... = 11 } 32

So that about one-third of the weight is chlorite of lime, to which alone the bleaching powers of the substance is owing.

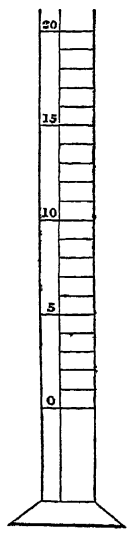
It is rather inconsistent with this opinion, that bleaching powder does not attract moisture from the atmosphere with nearly so much rapidity as might be expected from a mixture containing two-thirds of its weight of so deliquescent a salt as chloride of calcium; unless, indeed, this be prevented by the chloride and chlorite being united into a double salt. When sulphuric acid or muriatic acid, however diluted, are poured into a solution of bleaching powder, chlorine gas is given out in abundance. This seems rather inconsistent with the notion of its being a mixture of chloride of calcium and chlorite of lime; at least no such evolution takes place when these acids are mixed with solutions of chloride of calcium or chlorate of potash.

The bleaching powder, in order to be applied to the cloth, must be dissolved in water; and the quantity employed for the first process consists of a solution of 24 lb. of bleaching powder in 60 gallons of water.

In general, a solution of one pound of bleaching powder in one gallon of water has a specific gravity of 1·05. But the specific gravity of the bleaching powder solution into which the cloth is put is only 1·02. The quantity of liquor of this specific gravity necessary for 700 lb. of cloth is 971 gallons. Hence it is obvious that the quantity of bleaching powder required for 700 lb. of cloth will be 388½ lb.

But the specific gravity of the solution is not sufficient to determine its qualities as a whitening substance. The longer bleaching powder is kept, especially if it be not well shut up from the action of the atmosphere, the less bleaching power does it possess. We have purchased it from apothecaries in London a great many years ago almost totally inert; yet this inactive substance was soluble in water, and was capable of augmenting the specific gravity of the liquid as much or nearly as much as the best bleaching powder whatever; but the liquid was merely a solution

Bleaching. of chloride of calcium. Some other method, accordingly, of judging of the goodness of bleaching powder is necessary for the bleachers. The method commonly employed by the bleachers is the indigo test, first brought into use by M. Welter.



The mode of applying the indigo test followed in this country is by means of the graduated glass tube, figured in the margin, which is known by the name of the *Test-tube*. The method is as follows: One part of the best indigo is dissolved in nine parts of strong sulphuric acid, and the solution is mixed with 990 parts of water, making a solution, $\frac{1}{1000}$th part of which is indigo. Of this liquid a quantity is to be poured into the test-tube, so as to fill it up to 0, or the commencement of the scale. The bleaching liquor whose power is to be tried is then to be dropt gradually in, and mixed with the blue liquor by shaking the tube from time to time till the blue is changed into a clear brown. As soon as this takes place, the degree of the scale to which the mixture reaches is observed, and the figure marked at that degree indicates the strength of the steep-liquor. The lowest on the scale is, of course, the strongest in bleaching power, being capable of destroying most colour. The liquor whose strength is thus ascertained is denominated steep-liquor, of 1, 2, 3, 4, 5, and 6 degrees, the last of which is the weakest ever used for any kind of goods. By adding stock-liquor when the steep-liquor is too weak, and water when too strong, this liquor may be obtained of any strength which is required.

This mode of testing is obviously defective, because we have no good method of determining the goodness of the indigo itself employed as the test; and yet it is well known that different indigoes vary considerably in the quantity of colouring matter which they contain. Various attempts have been made to improve it; but at best it can only be considered as enabling us to compare the relative values of the different varieties of bleaching powder. It can never give us the absolute quantity of oxygen which the bleaching powder is capable of disengaging, upon which its bleaching powers must entirely depend.

Mr Dalton, however, in his paper On Oxymuriate of Lime, in the *Annals of Philosophy*, vol. i. p. 15, has pointed out a process, which, when a little modified, as it has been by Mr Walter Crum, one of the most extensive bleachers in the neighbourhood of Glasgow, answers exceedingly well, and enables us to determine the true quantity of oxygen which the solution of the bleaching powder is capable of yielding to the cloth. Mr Crum's method is this. He dissolves four ounces of green sulphate of iron in hot water, and then adds solution of bleaching powder by small quantities at a time till the smell of chlorine begins to be perceptible. This is a proof that the whole of the protoxide of iron in the four ounces of green vitriol has been converted into peroxide. The strength of the bleaching powder liquid employed by Mr Crum, when the object is to test its value as a bleaching ingredient, is one pound of bleaching powder dissolved in one gallon of water. Of this he adds quantities by $\frac{1}{64}$th of a gallon at a time to the solutions of green vitriol, till the smell begins to become sensible. Six of these measures may be added at once without any risk of evolving any smell; but on the addition of the seventh measure it is necessary to proceed with caution, adding only a little at a time, lest the point of saturation be exceeded. Let us suppose that $7\frac{1}{2}$ measures were necessary to evolve the smell of chlorine; as 64 measures contain one pound of bleaching powder, it is obvious that $7\frac{1}{2}$ measures will contain 820·3 grains. We learn from the experiment, that in the case in question 820·3 grains of bleaching powder, when placed in contact with protoxide of iron, are capable of converting all the protoxide of iron contained in four ounces of green vitriol into peroxide. Now, crystallized sulphate of iron is composed of

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1 atom sulphuric acid	5	17·375
1 atom protoxide of iron	4·5	
7 atoms water	7·875	

Consequently four ounces of the salt must contain 396·2 grains of protoxide of iron, to convert which into peroxide will require 44 grains of oxygen. This, of course, is the quantity of oxygen contained in 820·3 grains of the bleaching powder tried. If six measures had been sufficient instead of $7\frac{1}{2}$, then $656\frac{1}{4}$ grains of bleaching powder would yield 44 grains of oxygen. In general, the bleaching powder employed by the bleachers is of about this strength.

Sulphate of manganese might be substituted for sulphate of iron. The result would be the same, excepting that the protoxide of manganese is converted into the native black oxide, by uniting with an additional atom of oxygen. And as crystallized sulphate of manganese is composed of

1 atom sulphuric acid	5·0	14
1 atom protoxide of manganese	4·5	
4 atoms water	4·5	

it is obvious that 14 of sulphate of manganese will go twice as far, as a test of bleaching powder, as 17·375 of sulphate of iron. Thence $1\frac{3}{4}$ oz. of crystals of sulphate of manganese will just go as far, as a test for bleaching powder, as 4 oz. of sulphate of iron. The manganese is thrown down in the state of native black oxide; not, however, pure, but every six atoms of it are combined with one atom of lime, constituting a compound which may be called sex-manganite of lime, composed thus:

6 atoms black oxide	33·0	36·5
1 atom lime	3·5	

Prussian blue might also be employed as a test for bleaching powder. A solution of bleaching powder dissolves prussiate of iron, and the solution, when just neutral, is *green*; when there is an excess of bleaching powder the liquid becomes brownish yellow. But prussiate of iron can only be employed as a comparative test in the same way as indigo; although it is preferable to indigo, because it can always be obtained of the same relative strength or purity.

1. *Bleaching of Cotton.*

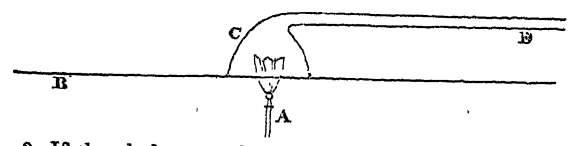
Cotton is a kind of down which fills the seed-pods of various species of plants, particularly the *Gossypium herbaceum*, *hirsutum*, and *arboreum*, from all of which it is extracted in considerable quantity for the purposes of manufacturers. This substance was known to the ancients, and made by them into thread and cloth. Cotton cloth appears to have been generally worn in Egypt and the neighbouring countries at a very early period; and no doubt the plant was cultivated in India and China for similar purposes before the time at which the history of these nations, as far as we are acquainted with it, commences. Pliny gives a short description of the *gossypium* which grew in Upper Egypt, which is sufficient to show us that it was the same with our cotton plant. "Superior pars Ægypti in Arabiam vergens gignit fruticem, quem aliqui *gossipion* vocant, plures *xylon*, et ideo lina inde facta *xylina*. Parvus est, similemque barbatæ nucis defert fructum, cujus ex interiore bombyce lanugo netur. Nec ulla sunt eis in candore mollitiave præferenda." (Plinii *Natur. Hist.* lib. xix. c. 2.) The *byssus* mentioned in the same chapter was probably likewise a species of cotton; though the account of it given by Pliny is not sufficiently precise to enable us to make out the point with certainty.

Since the discovery and colonization of America and the West Indies, and our great connection with the East, cotton has become a very common article of clothing in

Bleaching. Europe. The manufacture of cotton cloth in consequence has increased prodigiously, and in Great Britain constitutes one of the great branches of manufacturing industry. The quantity of colouring matter in cotton is much less than in linen, and it is more easily removed. Hence the bleaching of cotton is much easier, and occupies less time, than that of linen. On that account it will be best to give the reader a clear idea of the processes at present followed by the most skilful cotton bleachers in Great Britain. The bleaching of cotton is practised chiefly in Lancashire and the neighbourhood of Glasgow, to which districts the cotton manufacture is almost confined. We shall describe the processes as they are followed in the most extensive bleaching-houses, where they have been brought to the state of greatest perfection. The processes are numerous, though each is sufficiently simple. Let us follow the cotton cloth, from the time that it comes into the hands of the bleacher till it is returned to the merchant fully bleached and ready for sale.

1. The first process is to stamp the proprietor's name upon the end of every piece of goods, that there may be no mistake from the mixture of the cloth belonging to different persons, so that every individual may have his own goods returned to him again without the least risk of error. The substance used for the purpose is *coal-tar*, which distils when pit-coal is heated in iron retorts for the purpose of obtaining coal-gas. It consists of a mixture, or rather solution, of black bituminous matter in naphtha. A quantity of coal-tar is spread over a woollen sieve with a brush. A wooden stamp containing the name of the proprietor of the cloth is pressed against the cloth. It takes up the requisite quantity of coal-tar, and when pressed against the end of the piece makes a black and very distinct impression of the name, which withstands all the subsequent processes to which the cloth is to be subjected without being obliterated; but which might be removed were the stamped part of the cloth to be well washed with soap, and rubbed hard between the hands of the washer. Damask table-cloths, &c., are generally marked with Turkey-red thread, linen goods with nitrate of silver.

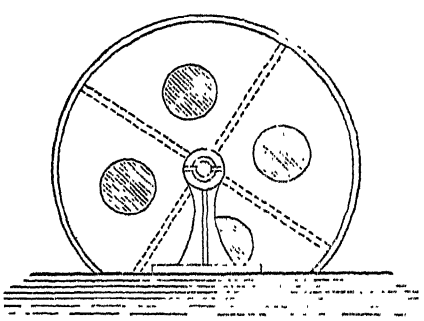
2. The cloth thus marked is in the next place singed, in order to remove the numerous hairs or flocks of cotton, which would have the effect of injuring the look of the cloth. This is usually done by passing the pieces with a uniform velocity over an iron heated red hot. The heat is sufficient to burn off the hairs; but the cloth passes too rapidly to be injured by the hot iron. Some years ago Mr Hall of Nottingham contrived a very ingenious apparatus, by means of which the cloth is singed by coal-gas. Some idea may be formed of the nature of the process by the following imperfect description. A represents the gas flame issuing from a pipe, and B the cloth drawn uniformly along, with the requisite velocity to prevent it from catching fire from the flame; C represents the section of a kind of vessel terminating in a tube D, which is connected with an air-pump kept working during the whole process. The consequence is, that the cloth presses rather forcibly against the bottom of C, and the flame is cut off by the cloth without passing through it, singeing only one side of it.



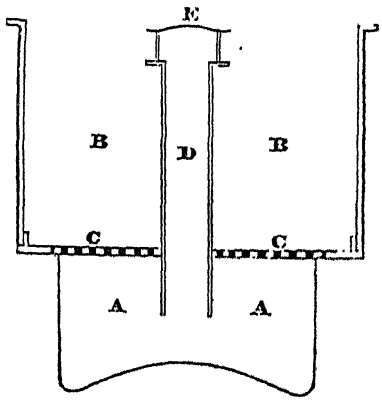
3. If the cloth were thrown into a vessel of water, regularly folded into a number of plies, the water would not be able to penetrate through it, but the central folds would remain dry. To prevent this, each piece of cloth is pulled into a band, by drawing it between the hands so as to give it a slight resemblance to a rope. This band is folded loosely, and tied up by one of its ends into a kind of irregular bundle. These bundles are thrown one after another into a large square cistern or vessel, filled with cold water, and left in that situation till they are completely soaked. In many bleaching establishments, instead of merely soaking the goods, it is customary to steep them in water of a temperature varying from 150° to 170° Fahr., or to boil them for a certain time, to remove the flour or paste dressing which had been applied by the weaver. Muslin goods, however, and in certain bleaching establishments all calicoes, are first thoroughly wetted, and then covered either with pure water, or, better still, with a weak spent alkaline lye of a temperature from 100° to 150°, when they are allowed to ferment for a period of 36 hours. As the dressing consists of sour paste, it is the acetous fermentation which occurs, but it must not be continued longer than 36 hours, otherwise it is apt to run into the stage of putrefaction, which injures the fabric of the cloth. This plan cannot be followed with advantage if the cloth contains many grease stains, or the weaver has applied tallow or oil to his warp during its manufacture. Experience has shown that acids render these fats or oils nearly insoluble in alkaline lye, and should the cloth afterwards be dyed these grease spots attract the colouring matter and cause the cloth to assume a mottled appearance. Bleaching.

The cloth, when removed from the steep vat, or fermenting vat, as the case may be, is either taken to the *wash-stocks* where it is well washed for half an hour, or is put into the *dash-wheel* which effects the washing in from eight to ten minutes.

The dash-wheel is a cylindrical box revolving on its axis. It has four divisions, as shown by the dotted lines, and an opening into each division. Two pieces are put into each, abundance of water is admitted behind, and the knocking of the pieces as they alternately dash from one side of the division to the other during the revolution of the wheel effects the washing. The process lasts from four to six minutes. The object is to remove as much of the weaver's dressing as possible from the cloth before the regular bleaching processes commence.

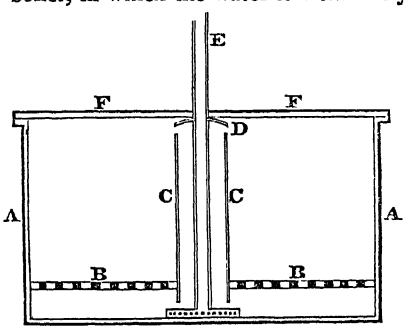


4. The next process to which the cloth is subjected is boiling with lime. This is done in a large circular *boiler*, or *kier* as it is termed, of which a section is given in the margin. It has two parts; the pan of wrought iron A, set in brick-work, on which the fire acts; and the upper part B, which is of cast iron, and which contains the goods to be boiled. These parts are separated by a cast iron false bottom C, perforated with small square apertures. D is an iron pipe placed in the centre of the kier, and resting upon the false bottom. The liquid in the pan A, from the pressure upon it, does not boil till it is heated considerably above the boiling point. At last it begins to boil in a part of the pipe D, where the pressure is less than in the pan. A mix-

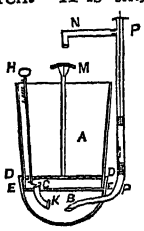


Bleaching. ture of steam and water is formed there, producing a column of lower specific gravity than before. This rushes up the pipe, and is thrown back by the cap E into the boiler, over the cloth, making room for another portion of highly heated liquid, which rising also in the pipe, boils in its turn, making room for a third portion, and so on till the pan is emptied of all its liquid above the bottom of the pipe. The liquid then filters gradually through the goods in the vessel B into the pan, where in a few minutes it is again heated to the requisite degree, and again rushes up the pipe as before. This process lasts about eight hours after boiling commences. The pipe D is often not carried lower than the grating C, to which it is firmly screwed. This operation is usually called "bucking."

Another kind of boiler, in which the water is heated by steam from a separate boiler, is now in very general use. It consists of a cylindrical vessel AA, 9 feet wide, of wood or iron, having a false bottom BB, on which the goods are placed, about six inches from the real one. A small pipe E, in the centre of a wider one CC, conveys the steam from the steam-boiler. When the liquid boils at the bottom, where the steam issues, the steam forces its way up the pipe CC, carrying with it a quantity of the lye, which is thrown back by the small cover D, spreads itself over the surface of the goods, and filters through them into the space below the false bottom, where it is again heated by the steam, re-ascends the pipe CC, and so on in constant succession, till the alkali is exhausted. FF is a wooden cover which prevents the cooling of the materials below a boiling heat.



For some goods these vomiting boiling vats are objectionable, as it is found that exposing the goods at the bottom of the vat to the contact of steam to a certain extent injures their fabric. To get rid of this difficulty some bleachers employ a simple boiler, with a false perforated bottom, set some five inches above the true bottom; or they use a movable rack frame, which they let down with the cloth into the boiler. The most improved boiler, however, consists of a modification of the above described vomiting boilers, of which the accompanying is a sketch. A is the wooden kier or vat, containing the cloth, with false perforated bottom DD. B is the cast iron boiler, with a water-tight top EE. P is the pump, with a movable copper tube N. C K is the pipe of communication between the kier and the boiler, with a valve at each end, that at C acted on by a handle H; that at K opening inwards, so as to allow free egress to the water flowing down from the vat, but shutting by the pressure of the steam in the boiler B, so as to allow no steam to escape through it. The pump is only used till the water in the boiler boils, and is kept constantly at work till the water heats, in order to heat the cloth slowly. As soon as the water boils, and the pressure of the steam which collects in the upper space of the boiler B is sufficient to force the water through the pipe PPN; the piston of the pump is removed, and the boiling fluid forced up is vomited out on the broad plate M, which spreads it equally over the cloth. The fluid as it soaks through the cloth, finds its way into the vacant space between the top of the iron boiler and the false bottom of the vat, and the workman, acting on the handle H, opens the valve C, and allows the liquid to escape into the boiler, where it is heated, and the same process is kept going on so long as is thought necessary.



Bleaching

The quantity of lime used in this process is 1 lb. of lime for every 35 lb. of the cloth. This lime, previously slacked, is mixed with water in a separate vessel, till it has acquired the consistency of cream. A layer of pieces of cloth is deposited in the boiler, and over it is spread equally a portion of this cream of lime. Then another layer of goods is introduced over the former, which is covered with cream of lime as before. In this way the goods and cream of lime are introduced in alternate layers, till the whole has been put into the boiler; then the requisite quantity of water is introduced, and the process of boiling begun.

The colouring matter of the cotton, which it is the object of bleaching to remove, is also acted upon by the lime, but certainly not removed; for the colour of the cloth after it has undergone the lime-boiling is darker than it was before it was wetted at all. Yet it cannot be doubted that this colouring matter has been acted on by the lime, and that it is rendered more easily removable by the future processes to which the goods are subjected.

Some bleachers, in order to shorten the number of processes, instead of boiling with lime alone, boil with lime and soda, in the proportion of from 55 to 65 lb. of each to the ton of cloth. This mixture has the effect of rendering the lye a solution of caustic soda, the lime being rendered inert by combining with the carbonic acid of the soda. This plan is said to answer fully as well as boiling the cloth in the same quantity of lime separately, washing it, and afterwards boiling it separately in the soda lye. In this case the vomiting boiler is not used, but a simple boiler with a false bottom set five inches above the bottom of the iron, and the cloth is kept carefully covered with the lye during the whole process of boiling.

After the lime-boiling, the cloth is carefully washed in the dash-wheel, in order to remove the lime, loaded as it is with impurities, as completely as possible from the cloth. It is then drained, or passed through the squeezers, to expel as much of the water as possible.

5. The cloth, now thrown into loose folds, is next subjected to the action of the bleaching powder or chloride of lime, the solution of which is usually of the strength of 1 on the indigo test-tube, or nearly in the proportion of one pound of chloride of lime to every six gallons of water. The cloth is left in this cold solution about six hours.

It is then taken out and washed with water. It has now assumed a kind of light gray colour. It is not yet white, but much whiter than when it came into the hands of the bleacher.

6. The next process to which it is subjected is called *souring*. Eight gallons of the sulphuric acid of commerce are mixed with 200 gallons of water. This constitutes a liquid having a decidedly sour taste, but too dilute to be in the least corrosive. Some bleachers use their "sour" much more dilute, viz., only $1\frac{1}{4}$ gallon to 300 gallons of water. In this liquid it remains for about four hours. It is then taken out and carefully washed in cold water, to remove the acid as completely as possible. By the *souring* the cloth is rendered much whiter than it was before. The sulphuric acid dissolves and removes the oxide of iron with which the cloth is always more or less contaminated. It removes also the lime which the cloth had imbibed partly from the lime-boiling and partly from the bleaching liquor in which it was so long immersed. The colouring matter of the cloth would seem to combine with the sulphuric acid, and to form a compound much whiter than the uncombined colouring matter itself. That it is not removed is obvious from this, that if the cloth be steeped in an alkaline solution, the dark colour is again in some measure restored.

7. The cloth, after being well washed in cold water, is

Bleaching. immersed in an alkaline lye, in which it is boiled for eight hours, precisely in the same way as was described when giving an account of the lime-boiling. Sixty pounds of soda made caustic by quicklime are used for every 2100 pounds of the unbleached cloth, or for every boiler of a ton's capacity. Some prefer using the soda in its carbonated state, but continue the boiling a little longer.

After this boiling the cloth is again carefully washed in cold water.

8. A solution of bleaching powder is now prepared, two-thirds of the strength of the first bleaching powder liquid, in which the cloth is immersed, and left for five or six hours; but by this exposure the bleaching powers of the liquid are not exhausted, so that by an additional supply of strong liquor it may be rendered fit for another process.

If the cloth to be bleached has red ends, which is sometimes the case, it is carefully washed after this exposure to the action of the bleaching liquor before it is subjected to souring; but if there be no red ends this washing is dispensed with.

9. The next process is a *souring*. The mixture of sulphuric acid and water is nearly of the same strength as before, and the cloth is left immersed in it about four hours, or sometimes not so long. By this process the bleaching of the cloth is completed, for it comes out of the acid steep quite white.

It is a very material thing to remove all trace of the sulphuric acid from the cloth as completely as possible; because any portion of it remaining would corrode and destroy the cloth, especially when it was exposed to the action of heat. To accomplish this necessary result, the cloth is subjected to very careful washing; and this washing process is repeated two several times.

10. Such are the processes of bleaching cotton cloth when of the best quality, and carried to the greatest extent. In many cases several of the processes are omitted; but we have thought it right to detail them all as they are applied to cotton shirting, and to the better cotton fabrics that are to undergo the subsequent processes of calico-printing. But after the bleaching is finished, the cloth is put through a variety of subsequent processes by the bleacher, in order that it may please the eye of the purchaser, and be in the best possible state for commanding a ready sale. Of the most important of these processes it will be requisite to give a short account.

The cloth is *squeezed* after washing, in order to remove a considerable portion of the water which it had imbibed in the washing. This is done by making it pass between two rollers, which by their pressure force out the water. There is something ingenious in this process, simple as it is, that deserves to be noticed. The pieces of cloth, as they come out of the washing wheel, are crumpled together, and frequently entangled in irregular knots. If these knots were allowed to enter between the rollers, they would, from their too great size, be apt to derange them, and might even stop the motion of the machinery altogether. To prevent this from happening, a water cistern, the top of which is on a level with the floor of the room, and which is constantly kept full of water, is placed immediately before the rollers. Over this water the cloth is made to pass on its way to the rollers. By the force necessary to drag it through this water, the piece is stretched, and any wrinkles or knots into which it may have been cast are effectually removed. Thus the cistern of water is made to answer the purpose of one or rather of two workmen. For as two pieces of cloth pass through the rollers at once, were it not for the water, two persons would be required to unfold the cloth, one to each piece.

Plate CVI. fig 1, exhibits a view of the machine called *squeezers*, employed to press as much water as possible from the piece after being bleached. It consists of a cast-iron framing, with two wooden rollers, which are pressed together by a double lever, and made to revolve by means of wheels connected with a shaft from a steam-engine or water-wheel. The wet piece is laid down at one side of the machine, and after passing between the rollers, is folded by a workman stationed at the opposite side. Bleaching.

11. The cloth after the squeezing process is still wet, and is crumpled together like a rope. The next process is to pull out each piece to its breadth. This is done by women, a number of whom are constantly employed in this simple but necessary process. But the edges of the piece still continue folded in. To make them straight, a workman knocks them against a smooth beating stock, first one edge and then the other. By this process the pieces are spread out to their full breadth, and all the folds and wrinkles removed as before the bleaching processes commenced. The pieces are then stitched end to end by women with a sailor's needle, to prepare them for the mangle.

12. The next step is mangling the cloth while still wet, by passing it successively between cylinders, forced towards each other by levers, to which a considerable weight is attached. These cylinders require all to be turned quite true, so as to be perfectly round. One of them is of brass, and two are of wood. By this mangling process the water is equalized throughout the whole piece, the threads are flattened, and the cloth stretched, smoothed, and wound upon a roller, and thus rendered fit for receiving the *starch*

13. Starching is the next process; and though it be well understood, yet it may not be superfluous to give a short sketch of the processes which the bleacher follows, the great object being to unite economy with exactness. Wheat starch would be too expensive; the bleacher therefore satisfies himself with flour. But the gluten of wheat flour renders it unfit for starching. The first step, therefore, is to get rid of that ingredient. Flour is mixed with water in the proportion of one pound of flour to the gallon of water, and allowed to remain for twenty-four hours. A brisk fermentation takes place, an acid, *lactic*, is generated, the texture of the gluten is destroyed, and the water acquires a specific gravity of 1·015. After twenty-four hours, the whole liquid is passed through a sieve. The starch passes along with the liquid, but the bran is retained upon the sieve. The starch is then boiled, a little indigo being added, and water also, so as to proportion the thickness of the liquid to the degree of stiffness which the goods are to acquire.

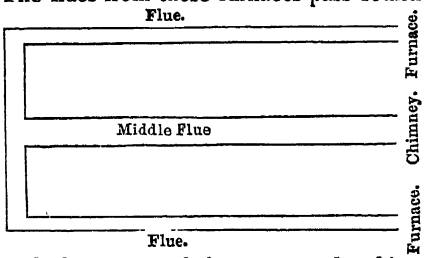
In many cases the starch is mixed with porcelain clay, about equal bulks of flour and porcelain clay being most commonly employed; though the proportion varies according to circumstances. The starch is applied in the state of a pretty thick paste, while the goods are passed between a pair of rollers.

In other cases equal quantities of porcelain clay and calcined sulphate of lime are mixed with the starch. These substances are applied only on one side; but by the rollers they are forced into the cloth, intermix themselves with its internal structure, and add greatly to its apparent strength and thickness. This method of thickening was undoubtedly intended at first as a fraudulent method of making the purchaser believe that the cloth was much stouter and thicker than it really was. But it has been so long practised, and is now so universally known, that all purchasers must be aware of it, and of course not in any danger of being deceived. But it certainly serves the purpose of making the goods appear much more beautiful, and of a stouter fabric to the eye; and as long as they continue unwashed, they are really stronger than they would be without this artificial dressing. So far it is beneficial; and as it does not enhance the price, the purchasers have no reason to complain of imposition.

Plate CVI. fig. 2, represents the starching machine or stiffening mangle; the middle roller being of brass and the

Bleaching. other two of wood. They are pressed together by means of levers, which are loaded less or more, so as to leave the requisite quantity of starch in the cloth that passes through the rollers. A is the roll of pieces as they come from the water mangle, B a box containing the starch. It is furnished with a roller fixed near the bottom. The piece, in passing under this roller, gets filled with starch, the superfluous part of which is pressed out again by the rollers of the mangle. The piece is then rolled up as before at the back of the machine.

14. The next process is to dry the goods after starching. This is done by hanging them on rails in an apartment heated by a flue passing round the room and down the centre, where it passes into the chimney. There are usually two furnaces, one at each corner of one of the sides of the apartment. The flues from these furnaces pass round the apartment in the way represented in the margin, and uniting in the centre of the side of the room farthest from the furnaces, pass down in one common flue through the centre of the room to the chimney, which is situated midway between the two furnaces. The side flues are usually covered by thin brickwork, but the middle common flue is covered with plates of cast iron. When the cloth is hung up in this apartment the temperature is at first low, but it gradually rises as the goods get dry. The workmen, while employed in hanging up the goods on the rails, &c., which occupies a considerable time, find themselves obliged to throw off part of their clothes, and even sometimes to work naked, with the exception of a pair of drawers or a cloth wrapt round their loins.



15. Nothing now remains but the process of calendering, which gives the goods their final gloss and texture. For this purpose they require in the first place to be damped. This is done by passing them leisurely over a machine, which scatters upon them, as they pass, an infinity of exceedingly small drops. When these drops are first applied, if we hold up the cloth between the eye and the light, we see a great number of small round wet spots, while the greatest part of the cloth is dry. But when the pieces are left for some time standing together in a heap, these spots gradually disappear, and the cloth acquires a uniform dampness, which fits it for assuming the gloss which it acquires by the calendering.

Plate CV. fig. 3, represents the damping machine. A is a box containing a circular brush B, which is made to revolve rapidly, its points just touching a surface of water which is kept of a uniform height. The goods, dry from the stove, are laid down at C; they are pulled in single folds over the surface of the box A, by the pair of rollers D, which are turned round by machinery. A shower of minute drops of water is thus thrown up upon the cloth as it moves over the surface of the box, and the piece, folded up by a workman, is left in a heap till the drops have all disappeared, and the cloth acquired a uniform degree of dampness.

Calendering is making the cloth to pass between a pair of rollers forced against each other by the application of a considerable pressure. During this process the texture of the cloth is made to vary at pleasure. When the goods pass simply between the smooth rollers, the threads are flattened, and the whole piece assumes a soft and silky lustre. When two folds of the cloth are made to pass together through the rollers, the threads make an impression on each other, and assume a wiry appearance, with an intermediate hollow between each. Various degrees of this wiry appearance may be given at pleasure. Bleaching.

Plate CV. fig. 4, represents the *calender*. It consists essentially of a framework, arranged so as to retain a number of rollers parallel, one above another, with levers and pulleys to press them together, and wheels and shafts to make them revolve. Two of these rollers are of cast iron, nicely turned and polished, and three (the largest) of wood with iron centres. The piece of cloth, after being damped, is laid down in front of the calender, and made to pass in various ways between these rollers, after which it is rolled round a cylinder behind, and taken away to be folded.

The goods, after being thus calendered, are folded, and various devices are stamped in red or in blue upon the end of the piece, according to the different markets in which they are to be exposed; for different stamps are requisite for different markets, South America, the West Indies, India, North America, the Mediterranean, &c., requiring each its own device; and, what is very curious, the sale of the goods in a great measure depends upon these stamps; so that if they were absent, the goods, however well prepared, and however excellent in every other respect, would not meet with a ready sale. Everywhere appearances are more attended to than realities. Man is essentially a gullible animal, and quackery is a most important principle in human affairs in general. After the goods have been regularly folded, they are placed piece by piece into a Bramah's press, with a sheet of pasteboard between each; and after a certain interval an iron plate is substituted for the pasteboard, to prevent any inequality in the pile. After sufficient pressure in this machine, they are packed up between boards, to prevent any injury during the carriage, and sent to the merchant or manufacturer to whom they belong.

Such is a sketch of the processes at present followed in the most extensive bleaching establishments in Great Britain for bleaching cotton. The processes altogether amount to about twenty-five, and the whole expense of bleaching and finishing a piece of twenty-four yards in length is tenpence, which is somewhat less than one halfpenny per yard.

When the goods are bleached previous to being printed or dyed, no starching or calendering processes are gone through; but the cloth after receiving its last washing is passed through the squeezers to remove its surplus water. Each piece is then folded separately into a flat square mass, which is knocked by men against the edge of the smooth beating stone, for the purpose of removing all creases from the cloth. It is then hung up on wooden bars in the drying room, and when dry is folded and tied up in parcels of ten pieces each, preparatory to being handed over to the dyers or printers.

The finer muslin goods are not now boiled in lime, as it is proved to injure their fabric, and it is found that the purest whites may be obtained without its aid. A caustic soda lye is used instead, made by boiling for one hour soda with an equal weight of caustic lime. In finishing muslin goods, they are run through water containing some fine starch, and a little fine smalts, which give them a clear shade. They are then pressed nearly dry, and are thorough-dried on a tin cylinder heated by steam.

Book muslins again, after being dried, are passed through starch coloured with smalts; after being wrung out of which they are dried in a heated room, three or four persons stretching each piece from its selvages to keep the piece to its breadth. Sewed dresses, trimmings, &c., are starched in the same way, and kept stretched till they are dry.

The loss of weight sustained during the bleaching of fine cotton cloth in the bleaching houses round Glasgow amounts very nearly to ten per cent. Of this one-half may be considered as weaver's dressing; so that the real loss sustained during the bleaching is not more than five per cent. But when some coarse cotton goods are bleached, we are in-

Bleaching. formed, by a gentleman who tried the experiment, that the loss of weight, independently of the weaver's dressing, amounts to ten per cent.

2. *Bleaching of Linen.*

From the experiments of Mr Lee, who took out a patent about the year 1810, it appears that the colouring matter of flax is not chemically combined with the fibrous threads constituting the bulk of the stalk; but that a chemical combination takes place while the plant is steeped in water. The object of this steeping is to rot the plant, and enable the fibres to separate readily from the stalk. The putrefaction goes on to a considerable extent, and generates so much noxious matter as to destroy any fish which may be in the water where the flax is steeped. This fermentation weakens very considerably the strength of the flax fibres, and even destroys many of them. Mr Lee's process, therefore, if it be practicable on a large scale, would be a prodigious improvement. It would render the flax fibres much stronger, it would increase their quantity, and it would save the expense of the materials employed in bleaching the linen. The late Dr Thomas Thomson was informed that Mr Lee's process had uniformly failed of success when tried in Ireland. If this account were true, it is extremely difficult to explain it. Dr Thomson saw it performed by workmen under his own direction at Old Bow, near London, with the most complete success; not merely upon handfuls of flax, but upon whole fields of it. Indeed the whole is so extremely simple, that we cannot well see how it should fail, if properly conducted. We cannot, therefore, help suspecting that the prejudices of the Irish, with which it would have to contend, have been too powerful for it; but that, as soon as it shall meet with fair play, it will be found just as practicable, and certainly much cheaper and better than the methods at present in use.

That Mr Lee's process has hitherto failed, and that it has been abandoned by the patentee himself, is an undoubted fact; but we cannot avoid suspecting that this was in some measure the fault of the patentee himself. If, instead of attempting the process at Old Bow, at a distance from the linen manufactory, and where no person qualified to appreciate its importance was likely to be near, he had tried it in a place where the linen manufactory existed,—Dundee, for example, or Belfast,—and had he associated with himself some person who was conversant with machinery, and who could have applied a mechanical process more convenient and expeditious than the method of Mr Lee, which was simply beating off the woody fibre by means of wooden mallets,—we cannot but think that the process would have been attended with success. The object of Mr Lee was to save the expense of bleaching linen. For when the flax is separated from the plant without the putrefactive process induced by steeping it in water, nothing more is necessary in order to make it white than simply to wash it in water.

A few years ago Mr Claussen renewed the attempt to prepare flax without steeping, by breaking it by means of machinery, separating the refuse part of the stalk from it, and then by a chemical process splitting the hollow fibres, so as to reduce them to a soft cottony state fit for spinning by means of the cotton-spinning machinery. The fibre was proposed to be split by steeping the prepared flax in a solution of carbonate of soda, and then plunging it into dilute sulphuric acid. The sudden evolution of carbonic acid gas within the hollow tube of the flax was said to have the effect of splitting up the fibre and reducing it to fine flat threads possessing the felting properties of cotton. Sir Robert Kane was commissioned to report on these processes, and his report was printed by the House of Commons, May 20. 1852. It reports that the whole process failed. The machinery for the beating and cleansing of the flax failed to separate it sufficiently from the refuse part of the stalk; and the chemical process for the splitting of the hollow tube only broke up small portions of the exposed ends, leaving the greater portion untouched. Bleaching.

As steeping is uniformly practised, the colouring matter becomes chemically combined with the fibres of the flax, and the process of bleaching must be had recourse to in order to render it white.

Formerly it was the custom to boil linen in lyes of pearl ashes or of soda, wash it, and expose it for several days on the grass, and repeat these several processes five or six times before it was steeped in the "sour" (acid solution), or was exposed to the action of the chloride of lime. Mr Grimshaw, calico-printer, near Belfast, however, recommended an early souring in dilute sulphuric acid, and the process of bleaching has been thereby greatly hastened. Still the bleaching of linen as commonly followed is a very tedious process, according to the plan adopted, requiring from eight to eighteen separate steepings, boilings, and sourings, with as many separate washings, besides exposure to the sun's light on the grass from thirty to sixty days. If the linen is not exposed on the grass to the sun it requires more frequent and longer immersion in the chloride of lime solution to bleach it properly. It cannot be doubted that many of the processes at present followed even in large bleachfields are very faulty, and might be greatly shortened. This will be apparent from casting a glance over the three following plans, each of which produces linen of a pure white. In the first the bleaching is left entirely to the action of the chloride of lime, and is the most scientific. The last is evidently a very faulty plan, and in it, as well as the second, the bleaching is trusted a good deal to the action of the sun's rays. As the processes followed are the same as for the bleaching of cotton, we shall merely give the different plans in the form of a list of the succession of the different operations. The goods bleached are 360 pieces of linen, each 35 yards long.

1st PLAN.—No Exposure on the Grass.

1. Steeped in weak alkaline lye and fermented 36 hours; washed.
2. Boiled in lye of 60 lb. caustic soda 6 hours; washed.
3. Steeped in solution of chloride of lime 15 hours; washed.
4. Soured in sulphuric acid solution 6 hours; washed.
5. Boiled in lye of 60 lb. caustic soda 4 hours; washed.
6. Steeped in solution of chloride of lime 14 hours; washed.
7. Soured in sulphuric acid solution 10 hours; washed.
8. Washed with brown soap on rubbing board; washed.

2d PLAN.—Exposed on Grass.

1. Steeped in weak alkaline lye and fermented 36 hours; washed.
2. Boiled with 60 lb. pearl ashes; washed. Exposed on grass 3 or 4 days.
3. Do. 80 do. do.
4. Do. 90 potashes do. do.
5. Do. 80 do. do.
6. Do. 60 pearl ashes do. do.
7. Soured in dilute sulphuric acid; washed.
8. Boiled with 60 lb. pearl ashes; washed. Exposed on grass.
9. Steeped in chloride of lime solution; washed.
10. Soured in dilute sulphuric acid; washed. Exposed on grass.
11. Boiled with 30 lb. pearl ashes; do. do.
12. Do. 20 do. do.
13. Soured in dilute sulphuric acid; washed.
14. Washed with brown soap on rubbing board; washed.

3d PLAN.—Exposed on Grass.

1. Steeped in weak alkaline lye and fermented 36 hours; washed.
2. Boiled with 60 lb. lime; washed.
3. Do. 50 do.
4. Soured in sulphuric acid, 1¼ gallon to 300 gallons.
5. Boiled with 60 lb. soda; washed. Exposed on grass 3 or 4 days.
6. 7. 8. 9. 10. Do. do. do.
11. Soured in sulphuric acid 1 gallon to 300 gallons; washed.
12. Boiled with 50 lb. soda; washed.
13. Steeped in chloride of lime solution, of strength 1½ by indigo test-tube; washed.
14. Boiled with 50 lb. soda; washed. Exposed on grass.
15. Do. do. do.
16. Steeped in chloride of lime solution, 2 degrees strength by indigo test-tube; washed.

Bleaching.

17. Boiled with 50 lb. of soda; washed.
18. Steeped in chloride of lime solution, 6 degrees by indigo test-tube; washed.
19. Soured in sulphuric acid, 1 gallon to 300 gallons; washed.
20. Scoured with brown soap; washed in pure water.

The loss of weight which linen sustains during bleaching amounts to about one-third of the whole weight of the goods. By the first of the above plans the loss was about 31 per cent., by the second 33 per cent.; but we have not learned the loss by the third plan. Charles Tennant, Esq. of St Rollox, made some experiments in 1831 to determine by which parts of the process the chief loss was sustained during bleaching. The result was that in 1000 parts by weight, linen yarn lost in the fermenting alkaline steep 57 parts

In 4 boils with caustic soda,	70
In 4 steeps with chloride of lime,	170
In 4 steeps in the sour,	18
Total,	315 parts in 1000.

3. *Bleaching of Wool.*

Wool consists of fine filaments or tubes, the external surface of which, instead of being smooth like the tubes of hair, is thrown into transverse corrugations or wrinkles, very similar in appearance to those of the ram's horn. These transverse wrinkles, under a powerful microscope, are seen to be covered with a line of circular apertures or pores, which communicate with the internal part of the filament. Wool is covered with a peculiar varnish or greasy matter which impairs its qualities, and which it is the object of the bleacher to remove. To this varnish the name of "yolk" is given. It is a fatty unctuous matter, chiefly derived from the cutaneous perspiration, but no doubt also secreted by the pores of the wool itself; and it imparts that peculiar heavy odour to sheep with which all must be familiar. From the researches of Vauquelin it would appear that this unctuous varnish consists chiefly of a kind of soap, together with a small quantity of waxy matter, a peculiar odorous animal substance, acetate, carbonate, and muriate of potash, and a little lime. This varnish, in consequence of its soapy nature, is soluble in water, so that washing in pure water would remove the greater portion of it; but it is found more advantageous to remove it by the process termed "scouring."

Scouring is performed by means of an ammoniacal lye, which is thus prepared. Five parts of river or other soft water are to be mixed with one part of stale purified urine, which is found to contain a large quantity of ammonia.[1] This mixture is to be boiled for a short time; and into this, at about the heat of fifty-six degrees, or so that the hand of the workman can be easily held in it for a considerable time, the wool is to be thrown. Four or five pailfuls will generally be sufficient for twenty pounds of wool. After steeping for a short time, the wool is to be stirred about in the mixture continually for about a quarter of an hour or twenty minutes, according to the quantity of greasy matter. It is then to be taken out and drained into a basket, so that the drainings may drop into the vessel in which it was steeped, that nothing may be lost. It must now be completely rinsed by exposing it in baskets to a continued stream of clear water, while a workman is perpetually employed in stirring it with a pole, till the water passes off perfectly clear. The wool is then removed, and a fresh quantity put into the basket, which is to be treated in the same manner. The steeping and rinsing are to be repeated till the wool has attained as great a degree of whiteness as it is capable of receiving from this operation.

In order to conduct this process to the greatest advantage, it is necessary that the workman should attend to the following circumstances:—1*st*, A quantity of fresh lye must be from time to time added to the bath, as the immersion of the wool is found to weaken its power; but it is better not entirely to renew the bath, as the grease abstracted from the wool during its immersion forms with the ammonia of the urine a kind of soap, which much increases the cleansing quality of the bath. 2*d*, Increasing the temperature of the bath will augment its detergent powers, and may sometimes supply the want of an addition of stale urine; but both these circumstances require caution, as too great a degree of heat hardens the greasy matter, and renders it more difficult of solution; and again, too much urine makes the wool harsh. 3*d*, After being much used the bath becomes too foul, and must be entirely renewed. Bleaching.

It is known that the wool is properly scoured by its filaments being smooth, long, slender, white, and perfectly free from foreign substances, and not having lost their natural tenacity.

If this scouring be properly done there is no need of further washings in soaps, or otherwise, till it is subjected to the process called "sulphuring;" and in point of fact it is very rarely passed through any other process. Some, however, recommend that for the finer wools, where a very delicate white is wished, it should be passed through one, two, or more baths of soft soap. No caustic alkaline lyes can be employed, as they destroy the wool altogether, dissolving it, and forming with it a kind of soap.

Scouring, however, is seldom sufficient to bring the wool to that brilliant whiteness which is desirable for some manufactures. This is imparted by means of the vapour of sulphur, or by steeping it in water impregnated with sulphurous acid gas, which is called by the manufacturers *sulphuring*.

The usual method of sulphuring woollen goods is to expose them in a close apartment to the vapour of burning sulphur. The goods are hung on poles so disposed that the vapour can readily pass between the pieces, and when the chamber is filled, a quantity of sulphur placed in very flat and broad dishes is set fire to, and allowed to burn away gradually in the chamber, while every aperture by which the vapour could escape is carefully closed. The acid vapour generated by the combination of the sulphur with the oxygen of the air of the chamber penetrates to every part of the cloth to which it can get access, destroys the colouring matter, and thus completes the bleaching. Everything is allowed to remain quiet till it is supposed that the effect of the sulphurous vapour has fully taken place, which requires from 6 to 24 hours.

After sulphuring the wool has a harsh crispy feel, which is removed by passing it through a weak soap bath. Soft (potash) soap is preferred for this purpose, after being washed with which it is wrung out by the aid of hooks, fixed at each end of the wash-tub, on which the wool is fastened, and twisted round by means of a handle fixed to one of the hooks. It is then hung up and dried.

4. *Bleaching of Silk.*

Silk is the fine glossy filament or thread which the caterpillar of the silk-moth (Phalæna bombyx) spins around it in the form of a cocoon or hollow ball before it assumes the form of a chrysalis. These cocoons are thrown into hot water, and being agitated there the ends of the threads are caught hold of, and several being wound off together into one thread, thus form what is termed "raw silk."

Silk is covered with a kind of varnish, the nature of which was only recently examined by M. Roard. He showed that this varnish, instead of being a gum, as was usually believed, resembled a mixture of bee's wax and oil, with a resinous colouring matter, and in raw silk constituted 23 or 24 per cent. of the weight. The varnish is soluble in water, and affords a solution which forms a lather like soap. The yel-

[1] The detergent property of urine has been long known, and it is frequently employed in washing to save soap. At sea, where fresh water cannot be spared for the purpose of washing, the sailors are accustomed to scour their foul linens in stale urine, which so far cleanses them that a subsequent rinsing in salt water renders them tolerably pure and sweet.

Bleaching. low varnish is of a resinous nature, is insoluble in water, but is soluble in alcohol. The colour is easily discharged either by the sun or by chlorine. Bees' wax also exists in all silks, but the whiter the silk the less wax does it contain.

This varnish, or "gum" as it is technically called, gives the silk a stiffness and elasticity which, for many of the purposes to which silk is applied, it is desirable to remove. This is called "ungumming" by the bleachers of silk. Though many different processes have been suggested for this purpose, none seems to answer so well as the old process of scouring in a weak solution of soap. Mr Roard, however, has shown that if the silk be kept in the soap too long after the varnish is removed, it begins to lose body, and has its qualities impaired, becoming dull, stiff, and discoloured, in consequence of being partly dissolved. He states that white or yellow silks may be completely scoured in one hour in the soap bath, using about 15 lb. of water for each pound of silk, and a suitable quantity of the finest soap. The soap and silk should be put into the water half an hour before it is brought to the boiling point, and then be boiled one hour. They are then removed, wrung out, washed in pure water, and either exposed to the vapour of sulphur or passed through a solution of sulphurous acid gas in water.

The following, however, is the process usually followed by the scourers of silks.

A quantity of water is put into a boiler over a fire, and for every hundred pounds of silk to be scoured, thirty pounds of very fine soap are dissolved. The solution is generally boiled; but before the silk is put into it, the heat must be lowered to about 90 degrees of Fahrenheit, and at this temperature it must be kept during the process. The silks are to be hung in the liquor on rods or frames, and left till the gum is sufficiently destroyed; care being taken to alter their position now and then, so that every part may be exposed to the action of the bath. When perfectly ungummed, they are flexible and of a dull whiteness; in this state they are to be wrung with the pin to clear them of the soapy water, then well shaken, and put into coarse linen bags, in parcels of from twenty to thirty pounds each.

These bags are now to be steeped in a fresh bath, or, as the workmen say, are to be baked. The bath is prepared in a manner and proportion much as before, except that the quantity of soap may be somewhat diminished as the heat is to be increased; for the silk is now to be boiled for an hour and a half, taking care to keep the bags from sticking to the bottom of the boiler, by frequently stirring them with a stick.

For silk that is intended to be dyed, the former steeping in the lukewarm soap bath is unnecessary, and the boiling only is employed, using a greater quantity of soap in proportion to the fineness of the colour. Thus for the ordinary colours, the proportion above laid down, or even less, will suffice; but for the saffron and the poppy and cherry red colours, even 50 pounds are sometimes employed to the 100 pounds of silk.

After boiling, the silk is wrung as before, and then washed thoroughly in a stream of water; they are then examined, and if it appears they are not sufficiently or not uniformly scoured, they must be submitted to a fresh bath.

The white silk usually sold has a bluish shade. This is given it by a bath impregnated with litmus or indigo. This is prepared by dissolving a pound and a half of fine soap in about ninety gallons of water, in which a small quantity of litmus or indigo has been diffused. The bath is heated to about 90 degrees, and the silk is passed through it over rods or reels till it has acquired the requisite shade. Being taken out, it is wrung and dried.

This process gives to the silk the tints known by the names of "silver white," "azure white," and "thread white," according to the depth of shade which has been imparted. The "China white" tint is given by adding annotto to the bath instead of indigo.

From these processes the silk acquires a tolerably clear white, but the highest degree is given to it by the action of the sulphurous acid, either in the state of vapour, as is usually practised, or by immersing it in the liquid acid, according to the method of Mr O'Reilly. Bleaching.

At Lyons no soap is used in the tinting process; but, after being boiled, the silk is washed, wrung dry, sulphured, and then passed through water properly blued.

Silk intended for blonds and laces is not deprived of its natural varnish, as it is essential that such silk should preserve its natural stiffness. The whitest raw silks are therefore selected for this purpose; they are steeped, then rinsed in water containing a very little soap, wrung dry, exposed to the vapours of sulphur, and then tinted by being passed through water properly blued.

Dr Ure mentions that the Abbé Collomb in 1785 scoured silks by boiling them for eight hours in pure water. The silks were stronger than after the usual process, but were not so white. It may be mentioned that a patent has lately been taken out in England for bleaching silks by means of steam.

5. *Bleaching of Rags for the Papermaker.*

The rags to be whitened should be well washed in the engine, and when reduced to what is called half-stuff, the water should be run off, leaving just enough to allow them to be easily turned. While the rags are thus preparing, a solution of the bleaching powder is to be got ready, by putting the powder into a pitcher or other convenient vessel, and pouring upon it two or three gallons of water, stirring and bruising it well, till everything soluble is taken up. After it has stood some time to allow the insoluble sediment to fall down, it is fit for use, and the pure solution should be poured into the engine. The sediment may be repeatedly washed with fresh portions of water to exhaust any remains of soluble matter, which alone is useful in the whitening process. After the bleaching liquor is put in, the stuff is allowed to turn in the engine for ten or fifteen minutes. It is then emptied into a chest or puncheon where it should lie from six to twelve hours, by which time the required degree of whiteness is attained. It is then thoroughly washed to free it from all remains of the chloride. The quantity of powder usually allowed is from two pounds to four pounds for every hundredweight of rags, in proportion to the whiteness required and the difficulty of whitening the stuff.

Rags containing dyed colours to be discharged, should be well washed, and reduced to half-stuff. They are then removed from the engine and put into a puncheon made water-tight, but having a sufficient opening in the side to admit with ease the putting in and taking out of the stuff, and capable of being shut up so as to retain the water. Having put the stuff into this puncheon, take for every hundredweight of the rags a solution containing from five to eight pounds of bleaching powder, according to the strength and fixedness of the colours to be discharged. Pour the solution into the puncheon among the stuff, allowing liquid enough to let the stuff float easily, and for each pound of powder used add half a pound of sulphuric acid. Then shut up and secure the opening so as to make the puncheon air-tight; then turn the puncheon round upon its axis, by means of a crank fixed at one end of it. Moving it in this manner gives facility and uniformity to the discharging process.

6. *Bleaching of Straw.*

The fine wheat-straw used in Tuscany, and elsewhere, for straw-plaiting, after being cut, dried, and tied up in bundles, is stacked for a month. It is then spread out in a meadow, and exposed to the action of the sun and air, being frequently turned during that period. The lower joint of the straw is then pulled off, leaving only the upper joint with

Bleaching || Bled-el-Jereede.

the ear attached; this being the only part of the straw used. It is then steamed, and after that exposed to the vapours of sulphur, which complete the bleaching. It is then tied up in bundles, in which state it is ready for the market. In this country straw is usually bleached by the vapours of sulphur alone; but Dr Ure mentions that a solution of the chloride of lime may be advantageously substituted.

7. Bleaching of Yellow Wax.

Before the discovery of chlorine and its application to bleaching, this was effected by exposing the yellow wax, formed into thin cakes, to the free action of the air, sun, and dew. The chlorine, however, as being far more expeditious, is to be preferred.

In the bleaching of wax it is proper to employ the simple gas, and its action would be the most effectual if used in the gaseous form. For this purpose a pneumatic tub, with a cover secured in the manner recommended by Rupp, is the most proper. This should be filled with water, and the wax, shred very fine, must be introduced, and the gas made to pass through the water, while the agitator is kept in constant motion. In the course of an hour or two the wax will be bleached, may be separated from the water, melted, and formed into cakes.

8. Of Whitening and Cleaning Prints, Maps, Books, and other Articles of Paper.

The chlorine was first applied to this purpose by Chaptal, and the method has been employed with the greatest success by Vialard and Heudier.

Gas might be used for this purpose, but it is safer and equally efficacious to employ it in the liquid form.

Simple immersion in chlorine, letting the article remain in it a longer or shorter space of time, according to the strength of the liquid, will be sufficient to whiten an engraving. If it be required to whiten the paper of a bound book, as it is necessary that all the leaves should be moistened by the liquid, care must be taken to open the book well, and to make the boards rest on the edge of the vessel, in such a manner that the paper alone be dipped in the liquid; the leaves must be separated from each other, in order that they be equally moistened on both sides.

The liquor assumes a yellow tint, and the paper becomes white in the same proportion. At the end of two or three hours the book may be taken from the acid liquor and plunged into pure water, with the same care and precaution as recommended in regard to the acid liquor, that the water may exactly touch the two surfaces of each leaf. The water must be renewed every hour, to extract the acid remaining in the paper, and to dissipate the disagreeable smell.

By following this process there is some danger that the pages will not be all equally whitened, either because the leaves have not been sufficiently separated, or because the liquid has had more action on the front margins than on those near the binding. On this account the practice followed by book-binders, when they wish to whiten printed paper, is to be preferred. They destroy the binding entirely, that they may give to each leaf an equal and perfect immersion; and this is the second process recommended by M. Chaptal.

Bleaching || Bled-el-Jereede.

"They begin," says he, "by unsewing the book and separating it into leaves, which they place in cases formed in a leaden tub, with very thin slips of wood or glass, so that the leaves, when laid flat are separated from each other by intervals scarcely sensible. The acid is then poured in, making it fall on the sides of the tub, in order that the leaves may not be deranged by its motion. When the workman judges, by the whiteness of the paper, that it has been sufficiently acted upon by the acid, it is drawn off by a cock at the bottom of the tub, and its place is supplied by clear fresh water, which weakens and carries off the remains of the acid, as well as its strong smell. The leaves are then to be dried, and, after being pressed, may be again bound up.

"The leaves may be placed also vertically in the tub; and this position seems to possess some advantage, as they will then be less liable to be torn. With this view I constructed a wooden frame, which I adjusted to the proper height, according to the size of the leaves which I wished to whiten. This frame supported very thin slips of wood, leaving only the space of half a line between them. I placed two leaves in each of these intervals, and kept them fixed in their place by two small wooden wedges, which I pushed in between the slips. When the paper was whitened, I lifted up the frame with the leaves, and plunged them into cold water, to remove the remains of the acid, as well as the smell. This process I prefer to the other.

"By this operation books are not only cleaned, but the paper acquires a degree of whiteness superior to what it possessed when first made. The use of this acid is attended also with the valuable advantage of destroying ink spots. This liquor has no action upon spots of oil, or animal grease; but it has been long known, that a weak solution of potash will effectually remove stains of that kind.

"When I had to repair prints so torn that they exhibited only scraps pasted upon other paper, I was afraid of losing these fragments in the liquid, because the paste became dissolved. In such cases I inclosed the prints in a cylindrical glass vessel, which I inverted on the water in which I had put the mixture proper for extricating the oxygenated muriatic acid gas. This vapour, by filling the whole inside of the jar, acted upon the print, extracted the grease as well as ink spots, and the fragments remained pasted to the paper."

Vialard and Heudier by this process restored several of the most valuable books of the French national library, and we believe they were the first who carried Chaptal's process into actual execution. (T. T.) (J. S—K.)

BLED (or BELED) EL-JEREEDE, an extensive territory in Africa, immediately to the south of the kingdoms of Algiers and Tunis, from which it is separated by the range of the Atlas. On the southern side it passes gradually into the great desert of the Sahara, the character of which it in some degree partakes. The northern districts indeed are tolerably watered by streams descending from the Atlas, some of which spread even into considerable rivers, that never reach any receptacle, but are either absorbed by the sands or diffused into shallow and extensive lakes. Some of the districts thus irrigated possess a considerable share of fertility; but the greater number labour under severe drought, which always increases till the country assumes the arid character of the desert. It is only in a few spots that the grains and fruits which are carried to such perfection in Barbary can be raised with advantage. The date, peculiarly adapted to dry soil, is almost the exclusive product, and forests of the tree producing it cover a great extent of the territory. It forms the food of the people, and their chief article of export, by which they obtain the few foreign luxuries in which they indulge. They likewise rear sheep and goats, and employ themselves in the chace of the ostrich for the sake of its valuable feathers, which form another article of trade. The name of the country is commonly supposed to be derived from *jerid*, a date; but Dr Shaw conceives that *jeriddé*, dry, is the true etymology.

The people of this district, exposed to the direct rays of a burning sun, are lean and swarthy, with a shrivelled ap-

Bleeding ‖ Blind.

pearance, and their eyes are frequently subject to inflammation, in consequence of the reflection of the rays from a naked arid soil; yet the plague, which commits such havoc in the cities of Barbary, never attacks the Bled-el-Jereede, notwithstanding the constant intercourse between the two places. The inhabitants in general reach a good old age, of which they often exhibit the appearance without any decay in the faculties of body or mind. They are composed of a mixture of Arabs and native Africans, partly living in rude villages, partly wandering in tents. In some places, where rain scarcely ever falls, the people construct their dwellings of the salt with which the territory abounds; but a casual shower often melts these frail habitations. Another characteristic feature is the occurrence of water, which is almost uniformly found on digging to a certain depth beneath the arid surface, and to which the natives give the appellation of the sea under ground. When the soil is dug into, it rushes forth, sometimes in such quantities as to drown the workmen employed. By bringing up this subterranean store, fertility is communicated to the most barren soils; but the labour of the operation is such that it can be practised only to a limited extent.

Bleeding of a Corpse, a pretended phenomenon once superstitiously believed to be exhibited by the bodies of persons murdered, which, on the touch or even the approach of the murderer, appeared to bleed. This circumstance was formerly admitted in England and elsewhere as a detection of the criminal, and proof of the fact.

BLEIBERG, a town in the circle of Villach in Illyria, remarkable for the lead mines whence it derives its name. The produce of the lead mines is about 2000 tons annually; besides which there are valuable copper mines in the adjacent mountains. The town contains 3700 inhabitants.

BLEMYES, or Blemmyes, a nomad tribe of Ethiopia, fabled to have had no heads, their eyes and mouths being placed in their breasts. (See Augustin, *De Civ. Dei*, xvi. 8.)

BLENDE, in *Mineralogy*, a sulphuret of zinc, and by much the most common ore of that metal. In its crystalline form, its colour, and appearance, this mineral varies extremely. The most common varieties, certainly, are brown or black, but a fine oil-green transparent species occurs at Schemnitz in Hungary; another of a rich hyacinth-red colour is met with at Klapruck in Transylvania; and a third in botroidal concretions, having a white fibrous structure, is found near Fowey in Cornwall. The fibrous blende of Przibam in Bohemia possesses, after a fresh fracture, a lustre almost metallic, and is peculiar, from the portion of cadmium with which it is associated. The crystalline form of blende is tessullar, and often presents the faces of the dodecahedron, to which figure the larger cleavable varieties are easily reducible by mechanical division. The surfaces of the crystals are extremely resplendent, and have at times a strong adamantine lustre. They yield to the knife, are rather brittle, and possess a specific gravity equal to 4·07. Blende, according to Thomson and Berthier, is composed of

Zinc	59·09	70·4
Iron	12·05	4·0
Sulphur	28·86	35·6

When strongly heated in the oxidating flame of the blowpipe, it gives off vapours of zinc, which form a coating on the charcoal; but it does not melt. It is soluble in nitric acid, during which process sulphuretted hydrogen is disengaged. Some varieties are phosphorescent in the dark when rubbed, and present that phenomenon even although the experiment be repeated under water. The sulphuret of zinc occurs both in primitive and secondary rocks, and is an almost constant accompaniment in the veins of lead, iron, and copper, associated with quartz, calcareous spar, or barytes. Great quantities of blende are found in Derbyshire and Cornwall, at Alston Moor and Lead Hills, at Klapruck in Transylvania, and Freyberg in Saxony; in Hungary, Bohemia, Silesia, and the Hartz. It is used in some places for obtaining the zinc in combination with it, but is otherwise an unimportant ore.

Blenheim ‖ Blind.

BLENHEIM (German *Blindheim*), a village of Germany, in the kingdom of Bavaria, and circle of Suabia, remarkable as the scene of the defeat of the French and Bavarians on the 13th of August 1704, by the English and their confederates under the Duke of Marlborough and Prince Eugene. See Britain.

Blenheim House, a princely mansion erected for the Duke of Marlborough at Woodstock, near Oxford, as a testimony of national gratitude, and, with the manor of Woodstock, settled on the duke and his heirs, in consideration of the eminent services performed by him, and more especially of his decisive victory at Blenheim over the French forces under Marshal Tallard. The sum of L.500,000 was voted by parliament for the purchase of the manor of Woodstock, and the erection of this edifice. Blenheim, notwithstanding the malicious strictures of Swift, and the unjust criticisms of Evans and Walpole, is a magnificent pile, built by Sir John Vanbrugh, in a massive Italo-Corinthian style. Walpole's taste in architecture may well be distrusted, when it produced the crudities of Strawberry-hill. The front of Blenheim from wing to wing extends to 348 feet; and the great hall is a lofty noble apartment, in good proportions. In the house are a considerable number of fine pictures,—the most noted of which are, "The Young St Augustine and Pope Gregory," by Titian; "Europa," "Esther," and "The Massacre of the Innocents," by P. Veronese; "St Jerome," by Tintoretto; "Magdalen," by C. Dolce; many historical subjects, by Rubens; portraits by him and Vandyk; "The Woman taken in Adultery," "Isaac blessing Jacob," by Rembrandt," &c.

BLENNORRHŒA (βλέννα and ῥέω), an inordinate secretion or discharge of mucus; more particularly applied to that of the urethra and vagina.

BLENNY. See Ichthyology, *Index*.

BLEPHARIS, a genus of acanthopterygious fishes, of the family of Scomberoides. See Ichthyology. The same name has been applied to a genus of orthopterous insects. See Entomology.

BLETONISM, a supposed faculty of perceiving and indicating subterraneous springs and currents by sensation; so called from one Bleton, a Frenchman, who was reputed to possess such power.

BLIGHT, a disease incident to plants, and affecting them variously, the whole plant sometimes perishing by it, and sometimes only the leaves and blossoms, which are scorched and shrivelled up, whilst the rest remains green and flourishing.

BLIND,

General observations.

An epithet applied to a person deprived of the use of sight; or to one from whom light, colours, and all the variety of the visible creation, are intercepted by some natural deprivation or accidental disease.

There is no external sense or faculty which affords such an endless variety of perceptions as that of vision; nor of all losses that can be sustained is there one productive of so many disadvantages and evils as the want of that faculty. By no avenue of perception is knowledge so accessible, by none, in fact, does it flow so abundantly, as through the channel of this sense, which not only reveals external things in all their beauty, in all their changes, and in all their varie-

Blind. ties, but supplies those materials out of which the imagination creates new forms still more glorious; whilst the understanding traces the varied relations existing among the ideas thus received, and gives birth to a secondary and reflex class still more subtile and refined. To the blind man, however, the visible universe is totally annihilated; he is perfectly conscious of no space excepting that in which he stands, or to which his extremities can reach. Sound, indeed, gives him some ideas of distant objects; but these ideas are often obscure and indistinct; and although by them the notion of distance in general, or even of some particular distances, may be obtained, yet they never fill the mind with those vast and exalting conceptions of extension which are inspired by ocular perception. For although a clap of thunder or an explosion of ordnance may be distinctly heard after they have traversed an immense region of space, yet when the distance is uncommonly great it ceases to be indicated by sound; and hence the ideas of extension acquired by hearing are extremely confused and inadequate. But the living and comprehensive eye darts its instantaneous glance over expanded valleys, lofty mountains, sweeping rivers, and vast tracts of land or of ocean. It measures in an instant of time the mighty space from earth to heaven, or from one star to another. By the assistance of telescopes its horizon is almost indefinitely extended, its objects are greatly multiplied, and the sphere of its observation is prodigiously enlarged. By these means the imagination, habituated to vast impressions of distance, can not only recall them in their utmost extent with as much rapidity as they were at first imbibed, but can multiply them, and add one to another, till all boundaries, distances, and measures, are swallowed up in immensity. By profusely irradiating the face of things, and clothing objects in a robe of diversified splendour, nature at once invites the understanding to expatiate on that extensive and gorgeous theatre which she thus opens up, and gratifies the imagination with every possible exhibition of the sublime and the beautiful. The man of sight enjoys these unspeakable advantages, and beholds from afar the objects of his attention and curiosity. Taught by experience, he measures their relative distances; distinguishes their qualities; determines their situations, positions, and attitudes; traverses in security the space which divides them from him; stops at the point where they are placed; and either obtains them with ease, or immediately perceives the means by which the obstacles that intercept his passage to them may be surmounted. The blind, on the contrary, not only may be, but in reality are, during a considerable period, apprehensive of danger from every motion they make towards any object or place, because their contracted power of perception can give them no certain intelligence of the obstacles or hazards which may intervene.

Nor is this the worst of their case. All the various modes of delicate proportion, all the beautiful varieties of light and colours, whether exhibited in the works of nature or of art, are to them irretrievably lost. Dependent for every thing on the good offices of others, and from every object obnoxious to injury, which they are neither capacitated to perceive nor qualified to resist, they are, during the present state of being, rather to be considered as prisoners at large than citizens of nature. The sedentary life to which they are doomed relaxes the frame, and subjects them to all the disagreeable sensations which arise from dejection of spirits. Hence the most feeble exertions create lassitude and uneasiness, and the natural tone of the nervous system, destroyed by inactivity, exasperates and embitters every disagreeable impression. But even from their loss, however oppressive and irretrievable, they derive some advantages; not indeed adequate to recompense, but sufficient to alleviate, their misery. The attention of the mind, confined to those avenues of perception which it can command, is neither dissipated nor confounded by the multiplicity or rapid succession of surrounding objects. Its contemplations are more uniformly fixed upon itself and its own operations; and hence its perceptions of such external things as are contiguous and obvious to observation become more lively and exquisite, whilst even the instruments of corporeal sensation are more assiduously cultivated and improved; so that from them are derived notices and presages of approaching pleasure or impending danger, which entirely escape the attention of those who depend for security on the information of sight. A blind man, when walking swiftly, or running, is kindly and effectually checked by nature from rudely encountering such hard and extended objects as might hurt or bruise him. When he approaches bodies of this kind, he feels the atmosphere more sensibly resist his progress; and in proportion as his motion is accelerated, or his distance from the object diminished, the resistance is increased. He distinguishes the approach of his friend from afar by the sound of his steps, by his manner of breathing, and almost by every audible token which he can exhibit. Prepared for the dangers which he may encounter from the surface of the ground upon which he walks, his step is habitually firm and cautious. Hence he not only avoids those falls which might be occasioned by its less formidable inequalities, but from its general bias he collects some ideas how far his safety is immediately concerned; and although these conjectures may sometimes prove fallacious, yet they are generally so true as to preserve him from accidents not incurred by his own temerity. The rapid torrent and the deep cascade not only warn him to keep a proper distance, but inform him of the direction in which he is moving, and form a kind of audible beacons to regulate his course. In places to which he has been accustomed, he as it were recognises his latitude and longitude from every breath of varied fragrance wafted by the breeze, from every ascent or declivity in the road, from every natural or artificial sound that strikes his ear. Regulated by these and other analogous signs, the blind have not only been known to perform long and difficult journeys themselves, but even to conduct others through dark, tortuous, and dangerous paths, with the utmost security and exactness. Blind.

It were endless to recapitulate the various mechanical operations of which they are capable, from the nicety and accuracy of their touch. In some the tactile powers are said to have been so highly improved, as to perceive that texture and disposition of coloured surfaces by which some rays of light are reflected and others absorbed, and in this manner to distinguish colours.[1] But the testimonies to this fact still appear too vague and general to deserve implicit credit. We have known a person who had lost the use of his sight at an early period of infancy, and in the vivacity and delicacy of his sensations was not perhaps inferior to any one: this individual having often heard that others in his situation were capable of distinguishing colours by touch with the utmost exactness and promptitude; and being stimulated partly by curiosity to acquire a new train of ideas, if that acquisition were possible, but still more by incredulity respecting the fact alleged; tried

[1] De comite Mansfeldico cœco refert Keckermanus, solo tactu album a nigro discernere; de equo fusco vel alho, item de columba nigra vel cærulea, judicium ferre potuisse. (*Syst. Physic.* lib. iii. c. 16.)

Blind. repeated experiments, by touching the surfaces of different bodies, and examining whether any such diversities could be detected in them as might enable him to distinguish colours;—but nothing of the kind was he ever able to ascertain. Sometimes, indeed, he imagined that objects which had no colour, or, in other words, were black, had something different and peculiar in their surfaces; but this experiment did not universally hold; and his scepticism therefore still continued to prevail. That the acoustic perceptions of the blind are distinct and accurate, we may fairly conclude from the rapidity with which they ascertain the acuteness or gravity of different tones, as relative one to another, and from their exact discernment of the various kinds and modifications of sound and of sonorous objects, if the sounds themselves be in any degree significant of their causes.

It is owing to this vivacity and accuracy of the other senses, and the assiduous application of a comprehensive and attentive mind, that we are enabled to account for the rapid and astonishing progress which some of them have made, not only in those departments of literature which were most accessible to their understandings, but even in the most abstract, and, if we may be allowed the expression, occult sciences. What, for instance, can apparently be more remote from the conceptions of a blind man than the abstract relations and properties of space and quantity? Yet the attainments of Dr Saunderson in all the branches of mathematics are well known to the literary world since the publication of his works; and we have the testimony of Dr Guillié to the fact that the blind in general have a remarkable aptitude for the study of the exact sciences.[1]

When we reflect on the numberless advantages derived from the use of sight, and the immense importance of the information it conveys, both for the well-being of the body and the improvement of the mind, we are almost tempted to doubt the fidelity of the reports which have been published concerning such persons as, without the assistance of sight, have arrived at high degrees of eminence even in those sciences which would appear absolutely unattainable without the aid of this sense. It has, however, been demonstrated by Dr Reid, that blind men, by proper instruction, are capable of forming almost every idea, and attaining almost every truth, which can be impressed on the mind through the medium of light and colour, except the sensations of light and colour themselves. (*Inquiry into the Human Mind*, chap. vi. § 1, 2.) Yet there is one phenomenon of this kind which seems to have escaped the attention of that great philosopher, and of which no author either of this or any former period has been able to offer any satisfactory explanation, although it seems to merit the attention of philosophers. For, admitting that the blind can understand all the phenomena of light and colours, and that on these subjects they may extend their speculations even beyond the sphere of their instructions, and by the mere force of genius and application investigate the mechanical principles of optics from the data which they had previously obtained; yet it will be difficult to assign any reason why these objects should prove more interesting to a blind man than any other abstract truths whatsoever. By means of a retentive memory, it is possible for a blind man to tell that the sky is azure, that the sun, moon, and stars are bright, that the rose is red, the lily white or yellow, and the tulip variegated; by continually hearing these substantives and adjectives joined, he may be mechanically taught to join them in the same manner; but as he never had any sensation of colour, however accurately he may speak of coloured objects, his language must be like that of a parrot, without meaning and without ideas. Homer and Milton had been long acquainted with the visible world before they were afflicted with the calamity of blindness. They might, therefore, still retain the warm and pleasing impressions of what they had seen; their descriptions might be animated with all the enthusiasm which had originally fired their bosoms when the grand or delightful objects which they delineated were immediately beheld; and that enthusiasm might even be heightened by a bitter sense of their loss, and by the regret which a situation so dismal naturally inspired. But how shall we account for the same energy, the same transport of description, exhibited by those on whose minds visible objects were either never impressed, or must have been entirely obliterated? Blind.

Yet certain it is, however extraordinary the fact may appear, that the latter class of the blind experience such emotions, and depict them with astonishing accuracy and truth; that they seem to have a kind of imaginative feeling of external beauty, and to enter into accounts of natural scenery with a keener relish than those who enjoy the blessing of sight. To them light, and shadow, and colour in all its variegated modifications, are merely *voces et præterea nihil*; yet by the force of imagination, aided by the information supplied by the other senses, and by certain suggestions and relations of language, they are enabled, as it were, to approximate to ideas which it is impossible they should ever fully attain, and to form for themselves a set of notions adjusted in such a wonderful manner as to serve as links in the chain of association, and to guide them to the use of accurate expressions, in speaking or writing of things which to them are as if they were not. But the speculations into which these considerations would lead us are of too refined and subtile a nature to be prosecuted further in such an article as the present. Whoever thinks the subject of sufficient consequence to merit a nicer scrutiny, may consult the preface to *Blacklock's Poems* printed at Edinburgh 1754; or the account of his life and writings by the Rev. Mr Spence, prefixed to a quarto edition of his poems published at London in the year 1756; or the *Essai sur l'Instruction des Aveugles*, by Dr Guillié, a work which, from the opportunities of observation enjoyed by the author, is naturally of high authority on the subject of which it treats.

It has already been hinted that the blind are objects of compassion, because their sphere of action and observation is abridged; and this is certainly true. For what is human existence in its present state, when deprived of action, and to a certain extent of contemplation? Thus limited, all that remains is the information derived from form, or from sensitive and locomotive powers. But for these, unless directed to happier ends by superior faculties, few rational beings would, in our opinion, be grateful. The most important view, therefore, which can be entertained in the

[1] Si la privation de la vue peut, dans quelques circonstances, devenir un avantage, c'est dans l'étude des mathématiques. Les aveugles ont des dispositions naturelles pour cette science, à laquelle ils se livrent avec un goût décidé. Très-jeunes, ils apprennent facilement les opérations les plus compliquées de l'arithmétique, et, sans employer aucun des moyens dont les clair-voyans font usage pour la géométrie, ils ont une idée exacte et précise des figures; ce qui est prouvé par leur succès dans l'algèbre, la trigonométrie, et les autres branches subséquentes des mathématiques. Leur intelligence pour cette étude est tellement développée, que non seulement ils sont en état de suivre parfaitement les démonstrations faites sur le tableau, et de profiter des leçons publiques données par les maîtres les plus distingués (M. Biot, M. Francœur), mais même remporter, dans les Lycées, les premiers prix sur les clair-voyans. (*Essai sur l'Instruct. des Aveugles*, p. 159, 160.)

Blind. education of a person deprived of sight, is to redress as effectually as possible the natural disadvantages under which he lies; or, in other words, to enlarge as far as may be the sphere of his knowledge and activity. But this can only be done by the improvement of his intellectual, imaginative, or mechanical powers; and which of these ought to be most assiduously trained and cultivated, the genius of every individual can alone determine. Were men to judge of things by their intrinsic nature, less would be expected from the blind than from others. But, by some pernicious and unaccountable prejudice, people generally hope to find them either possessed of preternatural talents, or more attentive than others to those which they actually do possess: for it was not Rochester's opinion alone,

> That if one sense should be suppress'd,
> It but retires into the rest.

Hence it unluckily happens that blind men, when they do not gratify the extravagant expectations of the spectators, too frequently sink in the general estimation, and appear to be much less considerable and meritorious than they really are. This general diffidence of their powers at once deprives them both of the opportunity and the spirit to exert themselves; and they descend at last to that degree of insignificance in which the public estimate has fixed them. From the original dawning of reason and spirit, therefore, the parents and tutors of the blind ought to inculcate this maxim,—that it is their indispensable duty to excel, and that it is absolutely in their power to attain a high degree of eminence. To impress this notion on their minds, the first objects presented to their observation, and the first methods of improvement applied to their understanding, ought to be capable of being comprehended without difficulty by those internal powers and external senses which they possess. Not that improvement should be rendered quite easy to them, if such a plan were possible; for all difficulties which are not really or apparently insuperable heighten the charms and enhance the value of those acquisitions which they seem to retard. But care should be taken that these difficulties be not magnified or exaggerated by imagination; since the blind have naturally a painful sense of their own incapacity, and consequently a strong propensity to despondency continually working in their minds.

For this reason, parents and relations ought never to be too ready in offering their assistance to the blind in any office which they can perform, or in any acquisition which they can make for themselves, whether they are prompted by amusement or necessity. Let a blind boy be permitted to walk through the neighbourhood without a guide, not only though he should run some hazard, but even though he should suffer some pain. If he have a mechanical turn, let him not be denied the use of edge-tools; for it is better that he should lose a little blood, or even break a bone, than be perpetually confined to the same place, and thus debilitated in his frame, and depressed in his mind. Such a being can have no employment but that of feeling his own weakness, and becoming his own tormenter; or perhaps transferring to others a portion of the malignity and peevishness engendered by the natural, adventitious, or imaginary evils which he feels. Scars, fractures, and dislocations in his body, are trivial misfortunes compared with imbecility, timidity, or fretfulness of mind. Besides the pernicious effects of inactivity in relaxing the nerves, and consequently in depressing the spirits, nothing can be more productive of discontent, envy, jealousy, and every mean and malignant passion, than a painful impression of dependence on others, and of our insufficiency for our own happiness. This impression, which even in his most improved state will be but too deeply felt by every blind man, is redoubled by that utter incapacity of action superinduced by the officious humanity of those who would anticipate or supply all his wants, prevent all his motions, and do or procure every thing for him without his own interposition. It is the course of nature that blind people, as well as others, should survive their parents; and it may likewise happen to them to survive those who, by the ties of blood and nature, are more immediately interested in their happiness. But when they come to be dependent on the world, such exigencies as they themselves cannot meet will be but coldly and languidly supplied by strangers. If their expectations be high, their disappointments will be the more sensible; their desires will often be resisted, seldom fully gratified; and, even when their requests are granted, the concession will sometimes be so ungraceful as to deprive it of the character of kindness. For these reasons, we repeat, that, in the training of a blind man, it is infinitely better to direct than to supersede his own exertions. From the time he can move and feel, let him be taught to supply his own wants; to dress and to feed himself; to run from place to place, either for exercise or in pursuit of his own amusements or avocations. Blind.

In these excursions, however, it will be proper for the parent or tutor to superintend his motions at a distance, without seeming to watch over him. A vigilance too apparent may defeat its own object, and create, in a mind naturally jealous, a suspicion of its originating in some interested motive. But, on the other hand, when dangers are obvious and great, those who are intrusted with the care of the blind will find it neither necessary nor expedient to make their vigilance a secret. They ought then to acquaint their pupil that they are present with him, and to interpose for his preservation whenever his temerity renders it necessary. But objects of a nature less noxious, which may give him some pain without any permanent injury or mutilation, may with design be thrown in this way, provided, however, that the design be industriously concealed; for his own experience of their bad effects will prove a much more eloquent and sensible caution than the abstract and frigid counsels of any monitor whatever.

When the season of childish amusement has expired, and the impetuosity of animal spirits has abated, the tutor will probably observe, in the whole demeanour of his pupil, a more sensible degree of timidity and precaution, and his activity will then require to be stimulated rather than restrained. In this crisis, exercise will be found requisite to preserve health and facilitate the vital functions, as well as for the mere purpose of recreation; and, of all kinds of exercise, riding on horseback will be found by far the most eligible and advantageous. On such occasions, however, care must be taken that the horses employed be neither capricious nor unmanageable; for on the docility of the animal which he rides, not only the safety, but the confidence, of the blind will entirely depend. In these expeditions, whether long or short, his companion or attendant ought to be constantly with him; and the horse should either be taught to follow its guide, or be conducted by a leading rein. Next to this mode of exercise is walking. If the constitution of the blind boy be tolerably robust, let him be taught to encounter every vicissitude of weather which the human constitution can endure with impunity. And when the cold is so intense, or the elements so tempestuous, as to render air and exercise abroad impracticable, there are methods of exercise within doors, which, though not equally salutary, are still highly eligible. The dumb-bells, the bath-chair or spring board, and the common swing, have been particularly recommended for this purpose; and as each affords an agreeable exercitation, any of them may be had recourse to at pleasure.

Blind.

Education of the blind.

Institutions for the education of the blind have been established in different parts of Britain in the following order:—Liverpool, Edinburgh, Bristol, London, Norwich, Glasgow, York, Manchester, Newcastle-on-Tyne, Exeter, Aberdeen. There are three establishments in which the blind are received in Dublin, and one in Belfast. The oldest of these establishments with us date from about the beginning of this century; the majority of them from a few years only. We shall briefly describe the system practised in the Asylum for the Industrious Blind in Edinburgh,—an institution which, though in some respects inferior to that of Paris, is on the whole well calculated to serve as a model for others of a similar description.

This asylum was for many years the only one of the kind in Scotland; but latterly an institution of the same description has been formed at Glasgow, and is now conducted upon nearly the same plan. It was originally intended for men; and, during a period of twenty-eight years from its formation, no provision whatever was made for the employment or instruction of the blind of the other sex, who, from their greater helplessness, have still stronger claims to the charitable and humane consideration of the public. But about the year 1820 a female asylum was instituted under the care of the same directors, though in a separate house; and both branches of this interesting establishment are now conducted upon the same general plan, and with nearly equal success.

The leading feature of this plan is to combine industry with instruction, and alternately to find occupation for the hands and heads of those who are admitted into the asylum. Accordingly, the men and boys are employed in making baskets of all descriptions; in weaving cloth of cotton, linen, and hair; in rope-making in all its branches; in forming matrasses of straw, sea-grass, and hair, and in stuffing beds; in working door-mats, hearth-rugs, and other articles of this description; and, in general, in any occupation for which they have a taste, or in which they are likely to excel. The females, on the other hand, are employed in sewing, knitting, spinning, and other occupations peculiar or suited to their sex, especially in the different kinds of "plain and white seam," as it is called, which they execute with singular neatness. Stockings, shoes, snow-boots, table-mats, table-covers, shawls of all descriptions and colours, spensers, tippets, dresses for ladies and gentlemen, hair-mits, and such like articles, are also manufactured in the asylum. A great part of the knitted fancy work has, we understand, been invented by the mistress of the house; and such is the perfection to which this elegant branch of industry has been carried, that its products are said to have found their way to all parts of the world.

Blind.

France has done much towards the education of the blind, which indeed has engrossed a large share of attention in that country; but although the methods employed are in some respects superior in point of scientific adaptation, it may, nevertheless, be doubted whether any institution in the neighbouring kingdom be upon a more efficient footing than that in Edinburgh, which owes not only its existence, but the success which has attended its endeavours, to the spontaneous and benevolent zeal of enlightened individuals. Various opinions have been expressed respecting the French method of teaching the blind to read by means of letters in relief,—a very ingenious though by no means a recent invention.[1] It has been said, for example, that angular letters are preferable to circular ones, as being more easily felt; and Mr Gall of Edinburgh has constructed an alphabet of this kind on the French plan, whilst others have been making trial of a variety of shapes and forms with a view to the same object. But no device of this kind has hitherto been patronised by the directors of the Edinburgh institution; nor, as far as we know, has any one yet been proposed which is in all respects calculated to answer the end proposed. From what has been done, however, for enabling the blind to feel a written language, it seems practicable, by some analogous method, to teach them both to read and write; and we are inclined to hope that such a method, combining distinctness with simplicity and cheapness, will in time be discovered.

In the Edinburgh institution the men and women are taught to read and write by means of what is called the "string alphabet." This is formed by so knotting a cord, ribbon, or the like, that the protuberances thus made upon it may, by their shape, size, and situation, denote the elements of language. The letters of this alphabet are distributed into seven classes, which are distinguished by certain knots or marks; and each class comprehends four letters, excepting the last, which includes only two. The first or A class is distinguished by a large round knot; the second or E class, by a knot projecting from the line; the third or I class, by a series of links, vulgarly called the "drummer's plait;" the fourth or M class, by a single noose; the fifth or Q class, by a noose with a line drawn through it; the sixth or U class, by a noose with a net-knot cast on it; the seventh or Y class, by a twisted noose. The first letter of each class is denoted by the simple characteristic of its respective class; the second by the characteristic and a common knot close to it; the third by the characteristic and a common knot half an inch from it;

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[1] The first attempt of this kind appears to have consisted in a modification of the Illyrian or Sclavonian alphabet, which was doubtless preferred on account of the square form of the letters; but on trial it was found to possess no advantage over the common characters, and to have disadvantages peculiar to itself. (Fournier, *Manuel Typographique*, tome ii. p. 226, No. 68, 1766.) Movable letters on small tablets of wood were next tried; but after a time this expedient was also abandoned, as not suited for the instruction of the blind, though singularly well adapted for teaching children who see to read. In fact, it was by means of similar letters that Usher, afterwards archbishop of Armagh, was taught to read by his two aunts, who were both blind. (*Biographia Britannica*, *voce* Usher; London, 1773). In the sixteenth century letters were engraved in wood for the instruction of the blind;—these, however, were not in relief, but cut out in the ordinary way of engraving;—the fingers could with difficulty be employed in ascertaining their configuration;—when used in printing, the letters remained white, whilst the rest of the space was blackened;—and hence they had none of the advantages which belong to letters in relief, and which are essential in the instruction of the blind. (Francesco Lucas, *Arte de Escrivir*, Madrid, 1580, 4to.) This method was reproduced with some modifications in 1575, by Rampazzetto, an Italian; but with no better success. (*Essemplare di più sorti di Lettere* di M. Gio Francesco Cresci, Milanese, Scrittore en Venetia; 1575, 4to.) In 1640 a writing-master of Paris, called Pierre Moreau, caused movable characters to be cast in lead for the use of the blind; but, discouraged by the difficulties he met with, or not choosing to incur the expense to which the prosecution of the scheme would have subjected him, he abandoned it, and applied himself to the formation of matrices for a new variety of letter, which still bears his name in French typography. A simpler and more ingenious method than any of these consisted in forming letters by means of pins stuck into large pincushions, leaving out only the heads, which of course were easily felt, and rendered the shape of the letters quite distinct as well as palpable, while the arrangement could be altered at pleasure, and with extreme facility. By this natural and easy plan the celebrated Mademoiselle Paradis learned to read. Various other modes were also tried; letters in wood were again had recourse to, and again dropped; and no method secured general approbation till 1783, when letters in relief, that is, letters raised, or as it were embossed on paper, were first invented, and, being gradually improved, were afterwards employed in the instruction of the blind in France. Nor has this invention as yet been superseded by any thing that seems better adapted to the purpose.

Blind. and the fourth by the characteristic and a common knot an inch from it. Thus, A is expressed by a large round knot; B by a large round knot, with a common knot close to it; C by a large round knot, and a common knot half an inch from it; and D by a large round knot, and a common knot an inch from it; and so in the case of the other classes. This alphabet was invented by Robert Milne and David Macbeath, both at one time inmates of the asylum, and it is found by experience to answer the purpose for which it was intended, as by means of it the blind can communicate with their friends and with one another.

Robert Milne, one of the persons above named, also improved the arithmetical board. An instrument of this kind had been invented by Dr Saunderson, and afterwards modified by Dr Moyes; but the board used in the asylum is considered as superior to it in several respects, and has lately undergone a further improvement by the substitution of metal for wood; in consequence of which it has been rendered both cheaper and more correct than before. By means of this instrument both men and women are taught figuring, and may be carried to any extent in arithmetical acquirement. Two small square pins with knobs represent the ten digits.[1]

The blind are taught geography, both ancient and modern, by means of globes and boards constructed solely for their use; astronomy, by means of an orrery and celestial maps similarly adapted; and mathematics, on a board of analogous construction. In all these branches of science the progress they make is considerable, and, with reference to their peculiar situation, astonishing. As the plan of the globes and boards is exceedingly simple, a few words on each will suffice. From a plan submitted to him, the present master constructed two globes, one thirty and the other thirty-six inches in diameter. Having described the meridians and parallels of latitude, and drawn the boundary lines of countries, and divisions of all kinds, he glued on twine or cord on such lines as are continuous, employing shorter pieces to indicate rivers, and pins to denote towns: the portions representing land are covered with fine sand; the rivers and seas are left smooth; the meridian circle, which is of iron, is so deeply marked as to render the divisions easily felt; and the equator is indicated by small pins. The globes, thus prepared and adapted, have been found by experience completely to answer the purposes of instruction. With regard to the maps, again, they are pasted on square boards, and have cord glued on the boundary lines, in precisely the same manner as the globes.[2] The orrery has brass hoops or rings to represent the orbits of the planets, which are indicated by balls or spheres of proper relative dimensions, and slide at pleasure along the rings or orbits; the ecliptic, or the outer edge of the circular board, is marked with the degrees of the circle and the days of the month in such a manner as to be felt; and the signs of the zodiac are raised figures, also placed on the edge. The celestial maps consist of square and oblong boards, on which is glued Bristol paper, cut into the figure of the sign or constellation which it is intended to represent, after which steel knobs of different sizes are driven in to indicate the different magnitudes of the stars, while small knobs on the sides of the board denote the degrees. The mathematical board is a square of fourteen inches, full of small holes, with a few pins fitted to them, so as to represent certain letters of the alphabet; while Blind. with fine cord or twine extended from the angular points are formed the lines of the figure or diagram, whatever it may be. The globes and boards for geography, as well as the orrery, celestial maps, and mathematical board, were invented in 1824, and are used in no other institution excepting that of Glasgow, and that of Boston in North America, to each of which a set of these instruments was transmitted by order of the directors of the Edinburgh Asylum. In as far as we are able to judge, these latter instruments seem superior to those employed in the Parisian institution; at all events they are simpler, which is a great advantage; and with regard to the mathematical board, the method of representing the diagrams appears to be by far the best that has yet been employed.

The inmates of this establishment are also taught to play on the violin and piano-forte. They read the music from boards constructed for their use, but by whom invented we have not learned. The game of draughts is a favourite amusement with them. It is played on a board of the common kind, but the alternate squares are covered with sand, and in each there is a small hole fitted to receive a pin, attached to the piece, which is thus retained in the position in which it is placed.

The greater part of the inmates of this institution consists of persons who originally lost their sight by disease or accident; and there are but few who have been blind from their birth. At the same time, it has been remarked that when one child in a family is born blind, those that follow it are also generally born blind. There are two or three instances of this in the asylum; and we know several others without the walls of the institution. This succession of blindness is probably to be referred to the force of imagination; and, in fact, the mother of two blind children being questioned on the subject, stated her belief that the second instance was occasioned by her continually looking on and thinking of her sightless child.

Results. The experience acquired in the institution confirms the general observation which we made at the outset, that the loss of one faculty, especially sight, is almost always accompanied by a compensatory and counterbalancing improvement in the other senses and faculties. This undoubtedly arises, not from any original superiority in the senses or faculties which remain, but from a closer attention to their indications, and above all from incessant application. The sense of touch, in particular, is signally improved, and, as it were, quickened in blind persons, who have no other means of discovering the size and figure of the bodies presented to them. With regard to the statement, however, which has sometimes been made, that they can distinguish colours by touch, we may mention that no instance of such extreme delicacy of touch has occurred in the experience of the Edinburgh institution. Memory, like touch, is also improved by constant use and application; and this holds equally true in all cases, though it is more signally exemplified in the case of the blind, who depend so much on this faculty. It has been thought that the memories of the blind are greatly assisted by the exclusion of external objects, which from their multiplicity tend to distract the attention; but as darkness magnifies dangers, which consequently engross the thoughts and excite continual apprehensions, it may reasonably be doubted whether the attention of the blind is

[1] For an account of the method employed in the Royal Institution of Paris, see Dr Guillié's *Essai sur l'Instruction des Aveugles*, p. 159. In Paris, as in Edinburgh, Saunderson's table has been abandoned as operose and inconvenient.

[2] In the Parisian institution improvement has been carried a step further; fine iron wire covered after the fashion of milliners is used instead of cord for the divisions, as well as the meridians and parallels of latitude; whilst towns and islands are represented by hemispherically-headed nails of different sizes; and over the whole blank paper is pasted, so as in fact to form a skeleton map in relief. (*Guillié*, p. 147, 149.)

Blind. not at times as liable to be disturbed as that of those who possess the blessing of sight, and receive impressions from the external world; and hence it is to application chiefly that the improvement of this faculty in the case of the blind ought to be ascribed.

The same observation holds true in regard to those signs and indications which persons who see neglect because they are not necessary to be attended to, but which are of great importance to the blind, and are consequently carefully attended to by them. Hence they can discover by the voice whether a person be tall or short, agreeable or disagreeable, and also form some judgment of the passions and affections of the mind. They have even in some cases attempted, from such indications, to describe the external form and beauty of a person. They know the steps of their friends and companions even at a distance. Breathing and smell also afford indications. In hearing a sermon they can tell by the sound of the preacher's voice whether he uses notes; and currents of air, or different modifications of atmospherical pressure, enable them to discover when they approach any object or building. Their curiosity is so intense that at any risk it must be gratified; and as they are often not aware of the danger to which they expose themselves, they generally attain their object. It is a remarkable fact, that a person born blind never dreams that he *sees* the object of his dreams.

The blind have been made to communicate with the deaf and dumb by means of the finger alphabet; the former, of course, appealing to the *sight* of the latter, and the latter forming the alphabetical characters *palpably* on the fingers of the former. An attempt was also made by the deaf and dumb to discover what was said by the blind from the varying configuration of their lips in speaking; but it did not succeed to any extent, and was abandoned, more especially as it could be employed by only one of the parties. In France the means of communication between these two classes of unfortunates have been improved by the invention of a set of pantomimic signs, representing not letters, but words or ideas. These are formed by means of the arms, which being extended somewhat in the manner of a telegraph, are made, by each change of position, to represent a word or idea; and when the blind communicate in this way with the deaf and dumb, their arms are placed in contact, and they go through the strange but ingenious pantomime together in a manner equally grotesque and amusing.

Parisian institution. The experience acquired in the Parisian institution is substantially in accordance with what has been stated as the results of continued observation in the Edinburgh asylum. Dr Guillié is decidedly of opinion that the blind have no natural superiority in any sense or faculty over those who possess all their faculties in an ordinary state of perfection. " L'adresse qu'on remarque dans les aveugles pour le toucher," says he, " et l'aptitude des sourds-muets à saisir tous les traits de la physionomie, résultent de la nécessité où ils sont, les uns, de se servir presque continuellement du tact pour suppléer à la vue qui leur manque, et les autres, d'employer la vue pour remplacer l'ouïe et la parole: l'organe n'en est pas moins en tout semblable à celui des clair-voyans; et si l'aveugle-né opéré par Cheselden ne reconnaissait plus par le toucher, après l'extraction de la cataracte, les objets comme il le faisait auparavant, ce n'est pas qu'il eût perdu, en recevant la vue, la faculté de toucher, mais seulement, parce qu'il ne l'employait plus que comme sens auxiliaire et correctif de la vue." P. 32, 33. In this opinion the Abbé Sicard, Dr Guillié's distinguished colleague, completely coincides.

" The memory of the blind is prodigious" This fact has been exemplified in Paris as well as in Edinburgh and everywhere else; how to account for it is another question. In man there is a memory of sensation and a memory of intelligence: the one recalling his merely physical perceptions; and the other his reflections, judgments, reasonings, speculations, and moral sentiments. Now it is principally with the latter description of memory that the blind are eminently provided; and although they are deprived of the means which persons having the use of sight possess for forming an artificial kind of mnemonics, it is probable that they construct an internal scheme for their own use, and of still superior efficacy. Such at least is the opinion of Dr Guillié; and it appears to be well founded. Helvetius has remarked (*De l'Esprit*, chap. iii. disc. 3), that a great memory is a phenomenon of order; that it is almost entirely factitious; and that among men well organised, the great inequality of memory is less the effect of unequal perfection in the organ or faculty which produces it, than of unequal attention in cultivating it. But the blind are in general eminently distinguished for the spirit of order, referred to by the French philosopher as the basis of a great memory; and as the faculty in question depends mainly on association, of which natural arrangement or classification is the very essence, it must of course be greatly strengthened in minds which are animated by the spirit of order, and have a tendency to arrange their ideas in a strictly logical sequence. Blind.

Another peculiarity of the blind is great fecundity of imagination; united in some with a facility in analyzing and recombining their ideas, to which their extraordinary progress in the exact sciences is to be ascribed. Of the former quality, Homer, Milton, Delille, and many others might be cited as examples; of the latter we shall give two instances in the words of Dr Guillié. " Le premier est Paingeon, qui, par l'esprit de l'ordre dont il est doué, a acquis des connaissances transcendantes en mathématiques, et après avoir remporté, en 1806, tous les premiers prix au concours général des quatre Lycées de Paris, fut nommé, par le Grand Maître de l'Université, professeur de mathématiques au Lycée d'Angers: l'autre est J. Delille, aujourd'hui pensionnaire des Quinze-Vingts, qui a porté très-loin la métaphysique de la langage Française; un aplomb parfait, une précision admirable dans ses definitions, caractérisent surtout ce sujet que nous nous énorgueillissons d'avoir formé." Both were educated under Dr Guillié, at the Royal Institution for the instruction of the blind.

On the subject of the moral condition of the blind Dr Guillié has stated many curious and interesting particulars. They are generally deficient in modesty or shame. " La pudeur, qui est une des grâces de la jeunesse, est presque pour eux un être imaginaire, quoiqu'ils aient une sorte de timidité qui tient peut-être plus, il est vrai, de crainte que de la honte, mais qui augmente beaucoup leur embarras dans certaines circonstances." They are, it is said, for the most part without sensibility and without gratitude; irritable, suspicious, vindictive, implacable. Their situation obliges them to be on their guard against all the world; the consciousness of their own deficiency, and the disadvantages under which it places them, render them suspicious as well as selfish; and, by an easy, and we had almost said natural transition, they come to arrange in the same category their benefactors and their enemies. " Commes de toutes les démonstrations extérieures, qui rêveillent en nous la commisération et les idées de la douleur, les aveugles ne sont affectés que par la plainte," says Diderot, " je les soupçonne, en general, d'inhumanité. Quelle différence y a-t-il, pour un aveugle, entre un homme qui urine et un homme qui, sans se plaindre, verse son sang? Nous-mêmes, ne cessons-nous pas de compatir, lorsque la distance, ou la petitesse des objets, produit sur nous le même effet que la privation de la vue chez les aveugles."

Blind. (*Lettres sur les Aveugles.*) This is too strongly stated; but the principle in human nature, on which the striking observation of Diderot is founded, would lead us to anticipate, at least in part, the moral results to which we have alluded. It has been alleged that the blind have a tendency towards atheism; but this is denied by Dr Guillié, who, however, qualifies his contradiction by a very lamentable admission: "Néanmoins, je ne les justifierai pas entièrement du reproche d'impiété qu'on leur a fait avec quelque fondement;" and he adds, "la conscience enfin n'a pas sur leurs actions l'influence qu'elle a sur nous." But as these observations are grounded on a partial experience, we hope they have no application to the blind of this country, amongst whom sounder principles and better feelings will always, we trust, prevail; nor will they ever lose a sense of dependence on that Being, whose existence they have only to stretch forth their hands to discover, and who has opened the eye of humanity to compassionate, and the hand of charity to relieve, their wants.

Remarkable blind persons.

History has preserved sundry particulars of blind persons, who, of themselves, acquired great knowledge before there existed any regular method of instruction applicable to their case. The number of these is considerable; so much so, indeed, that any accurate enumeration would not only be a task of great difficulty in itself, but would also far exceed the limits prescribed to this article. It may not be uninteresting, however, to signalize a few of those who have made the greatest figure in science and in art.

The number of blind appears to have been very considerable in Asia and Italy in the time of the Romans. This is proved by the great number of physicians who at the epoch in question wrote on ocular diseases; but what mode of instruction, or whether any at all, was employed in those times, we have not learned. Diogenes Laertius and Thrasylus relate (Diog. Laert. lib. ix., Vossius, *De Philosophia*) that several philosophers voluntarily deprived themselves of sight in order to pursue their contemplations with less interruption; and, amongst those who inflicted on themselves this deprivation, is cited Democritus of Abdera. But it is scarcely probable that this philosopher, the companion of the gymnosophists of India, a man who laughed at every thing, and whom his countrymen wished Hippocrates to cure of madness, because he believed that all things were as they ought to be, depending on chance and the fortuitous aggregations of atoms, should have put out his eyes in order to scoff philosophically, when he might have indulged his humour to so much better purpose with the use of his sight. Besides, putting out the eyes was next to crucifixion, one of the most ignominious punishments inflicted by the laws of ancient times, and as such was reserved only for great criminals. It may therefore be doubted whether the laughing philosopher of Abdera would, on a mere hypothesis, treat himself like a felon: and the words of Cicero, "Democritus impediri etiam animi aciem aspectu oculorum arbitrabatur (*Tuscul. Disp.* v. 39), which have been often quoted, seem rather to express a general opinion than to state a particular fact, or warrant the inference that the philosopher had deprived himself of sight because he thought that the penetration of the mental was impeded by the vision of the natural eye.

Diodatus, Cicero's master in philosophy, applied himself to study with more assiduity than ever, after he had lost his sight; and, what is still more remarkable, he taught geometry with so much precision, that his disciples found no difficulty in comprehending how to trace the most complicated figures from his instructions. (Cicero, *ubi supra*; Zahn, *Specul. Physico-Math. Hist.* tome iii. c. 6.) Cornelius Aufidius, a Roman citizen, who had lost his sight in his youth, distinguished himself in the study of elegant literature, and wrote a Greek history. (Zahn, *Sens. Ext. Mirab.* § 2.) Eusebius the Asiatic became blind at five years of age. He acquired vast knowledge and profound erudition, and taught with the utmost facility as well as success. (Cassiodorus *De Inst. Div. Litter.* c. 5.) St Jerome has left an account of Dydimus of Alexandria, his master, of whom he speaks with great respect. This blind man, who had lost his sight at the same age with Eusebius, flourished in the fourth century. Ruffinus, Paladus, Isidorus, and several other celebrated men, were his disciples. He acquired great knowledge by having the sacred and profane authors read to him; he was one of the ablest mathematicians of his time; and he applied himself especially to theology, for which he had a decided taste. He composed several works, the principal of which is *A Treatise on the Holy Spirit*, translated into Latin by St Jerome. Dydimus was pious as well as learned: nevertheless, his attachment to the opinions of Origen, on whose books he had commented, caused his works to be condemned after his death by the council of Lateran. St Athanasius and St Antony had the greatest esteem for him. Dydimus died A. D. 398, at the age of eighty-five. (Hieronymus *De Viris Illustr.* c. 109; Socrates, lib. iv. c. 25; Ruffinus, lib. ii. c. 7.)

Nicaise of Malignes flourished in the fifteenth century, and enjoyed great reputation for the extent of his learning. Blind from the age of three years, he nevertheless made great advances in science, and taught publicly, in the university of Cologne, both the civil and canon law, citing from memory long passages which he had never seen, *quos nunquam viderat.* Having been elected doctor of Louvain, the pope granted a dispensation for his admission to priests' orders; after which he employed the rest of his life in preaching, and died at Cologne in 1492. (Urithème et Valère, *Bibliothèque des Ecrivains des Pays-Bas.*) James Shegkius, born at Shorndorf, in the duchy of Wirtemburg, taught philosophy and medicine with great success at Tubingen for about thirteen years. Having early become blind, he was so little sensible of the loss of sight that he refused to allow himself to be couched by an oculist, who offered to restore vision—in order, as he said, not to be obliged to see many things which appeared odious or ridiculous. He died at Tubingen in 1587, leaving several treatises on different points of philosophy, medicine, and controversy. (Zahn, *Visus Im. Dep. et Cæcit. Ex. Mir.* p. 114.) John Fernand, born in Belgium, was the son of a Spaniard, and blind from his birth. His father was very poor; but he surmounted the obstacles both of poverty and blindness, and became a poet, logician, philosopher, and musician. He composed from memory several pieces, which are considered excellent of their kind. (Zahn, *ubi supra.*) Ascanius Pedianus the historian lived several years after the loss of his sight, and wrote treatises on grammar, which exhibit no trace either of his age or infirmity. (*Fulgosus*, lib. viii. c. 7.)

Uldaric Schomberg, born in Germany towards the commencement of the seventeenth century, lost his sight by the small-pox at the age of three; but as he grew up he applied himself to the study of the belles-lettres, which he afterwards professed with credit at Altorf, at Leipsic, and at Hamburg. (C. Harknocks, *Alt und Neu Preussen*, 1684.) Bourchenu de Valbonais, born at Grenoble in 1651, became blind when very young, soon after the naval combat at Solbaye, where he had been present. But this accident did not prevent him from publishing the *History of Dauphiné*, in two volumes folio. He had made profound researches into the history of his province, and, besides the work just mentioned, published a *Nobiliaire* of Dauphiné. (*Feller*, vol. ii.) Of Dr Nicolas Saunderson, Lucasian

Blind. Professor of Mathematics in the University of Cambridge, and one of the most remarkable men of his time, some account will be found under the proper head. He was born in 1682, at a small town in the county of York, and died at Cambridge in 1739, at the age of fifty-six. He invented a table, which has since been greatly improved, for teaching arithmetic palpably to the blind. A notice of Dr Blacklock will be found under the biography of that individual. Dr Henry Moyes professed the Newtonian philosophy, which he taught with considerable success as an itinerant lecturer. He was also a good chemist, a respectable mathematician, and a tolerable musician.

M. Phefel of Colmar, who lost his sight when very young, in consequence of a violent ophthalmia, composed a great deal of poetry (6 vols. 8vo, Colmar, 1791), consisting chiefly of fables, some of which have been translated into French by M. Degerando. He was privy counsellor to the margrave of Baden; and established at Colmar a military school or academy, where children of the best families were sent to be educated. Among the pupils of this learned blind man may be mentioned Prince Schwartzemberg, Prince Eisemburg, and M. Heilman, lately pensionary of the Quinze-Vingts. He died at Colmar in 1809. Weissemburg of Manheim became blind at the age of seven. He wrote perfectly, and read with characters which he had imagined for his own use. He was an excellent geographer, and composed maps and globes, which he employed both in studying and teaching this science. He was the inventor of an arithmetical table, differing but little from that of Saunderson. (*Journal de Paris*, April, 1784.)

The blind man of Puiseaux must be known to all who have read Diderot's celebrated *Lettres sur les Aveugles*. He was the son of a professor of philosophy in the university of Paris, and he had attended with advantage courses of chemistry and botany at the Jardin du Roi. After having dissipated a part of his fortune he retired to Puiseaux, where he established a distillery, the products of which he came regularly once a year to Paris to dispose of. There was originality in every thing that he did. His custom was to sleep during the day, and to rise in the evening; he worked all night, "because," as he himself said, "he was not then disturbed by anybody." His wife, when she rose in the morning, used to find every thing perfectly arranged. He spoke very sensibly of the qualities and defects of the organ in which he was deficient, and answered questions put to him with much justness and discrimination. Being interrogated as to the idea he formed of a mirror, he replied, "C'est une machine qui met les choses en relief loin d'elles-mêmes, si elles se trouvent placées convenablement par rapport à elle. C'est comme ma main qu'il ne faut pas que je pose à côté d'un objet pour le sentir." To Diderot, who visited him at Puiseaux, he put some very singular questions on the transparence of glass, colours, and such like matters. He asked if naturalists were the only persons who saw with the microscope, and if astronomers were the only persons who saw with the telescope; if the machine which magnified objects was greater than that which diminished them; if that which brought them near was shorter than that which removed them to a distance. He believed that astronomers had eyes of different conformation from those of other men, and that a man could not devote himself to the study of a particular science without having eyes specially adapted for the purpose. "The eye," said he, "is an organ upon which the air ought to produce the same effect as my cane does upon my hand." He possessed the memory of sounds to a surprising degree, and recognised by the voice those whom he had only heard speak once. He could tell if he was in a thoroughfare or in a cul-de-sac, in a large or in a small place. He estimated the proximity of fire by the degree of heat; the comparative fulness of vessels by the sound of the liquor in falling; and the neighbourhood of bodies by the action of the air on his face. Being asked on one occasion if he would not be very well pleased to have eyes, he replied, "Si la curiosité ne me dominait pas, j'aimerais bien autant avoir de longs bras: il me semble que mes mains m'instruiraient mieux de ce qui se passe dans la lune que vos yeux ou vos telescopes; et puis les yeux cessent plutôt de voir que les mains de toucher. Il vaudrait donc bien autant qu'on perfectionnât en moi l'organe que j'ai, que de m'accorder celui qui me manque." He employed characters in relief in order to teach his son to read, and the latter never had any other master than his father. Blind.

M. Huber of Geneva, an excellent naturalist, and author of the best treatise extant on bees and ants, was blind from his earliest infancy. In reading the descriptions of these insects, we can scarcely persuade ourselves that they are not the production of a singularly clear-sighted man, well versed in this branch of natural history. In executing his great work, however, M. Huber had no other assistance than what he derived from his domestic, who mentioned to him the colour of the insects; and then he ascertained their form and size by touch, with the same facility as he would have recognised them by their humming when flying in the air. This laborious writer has also published a valuable work on education.

Francis Lesueur, born of very poor parents, at Lyons, on the 5th of August 1766, lost his sight when only six weeks old. He went to Paris in 1778, and was begging at the gate of a church, when M. Haüy, discovering in the young mendicant some inclination to study, received him, and undertook the task of instructing him, at the same time promising him a sum equal to that which he had collected in alms. Lesueur began to study in October 1784. Six months after, he was able to read, to compose with characters in relief, to print; and in less than two years he had learned the French language, geography, and music, which he understood very well. His intelligence and penetration were indeed surprising, and he was among the blind what Massieu has since been among the deaf and dumb. He was successively repeater to his comrades, head of the printing and economy of the institution for the blind, and pensionary of the Quinze-Vingts. It is painful to add, that he proved unthankful to his benefactor and master, to whom he owed every thing; and that by his conduct he merited the reproach of ingratitude, a vice which, with some reason, has been charged against the blind generally.

Avisse, born at Paris, was one of the most distinguished élèves of the institution. His father, who kept furnished lodgings in the Rue Guénégaud, intended him for the sea; and he embarked when very young on board a vessel fitted out for the slave-trade, in the capacity of secretary or clerk to the captain; but he was struck by a *coup de vent* on the coast of Africa, and lost his sight from the violent inflammation which ensued. On his return his parents procured his admission into the institution for the blind, where, in a few years, he became professor of grammar and logic. He produced a comedy in verse, in one act, entitled, *La Ruse d'Aveugle*, which was performed on the 2d Nivose, year 5; a scene, also in verse, entitled *L'Atelier des Aveugles-travailleurs;* and several other pieces, which were all printed in one volume 12mo. in the year 1803. He died before he had completed his thirty-first year, at the very time when the high hopes entertained of him were on the point of being realized.

Nor have the blind been less distinguished in the practice of the arts than in science and literature. Many instances of their eminence in this respect may be mentioned. Indeed, the want of sight seems little or no impediment to manual dexterity. Stengel mentions a young

Blind. cabinet-maker of Ingolstadt, who, having lost his sight by an explosion of gun-powder, amused himself by constructing pepper-mills, which he made without the use of any other instrument than a common knife, and executed with so much exactness and elegance that they were thought deserving of a place in the gallery of curiosities at Munich, where they may still be seen. (Laurentius Stengelius *De Monstris*, c. 16.) Sir Kenelm Digby has stated several extraordinary particulars of a preceptor of his son, who was so completely blind that he could not distinguish the light of noonday from midnight. He surpassed in skill the ablest players at chess; at long distances he shot arrows with such precision as almost never to miss the mark; he constantly went abroad without a guide, and frequented most of the public promenades; he regularly took his place at table, and ate with such dexterity that it was impossible to perceive he was blind; when any one spoke to him for the first time, he was able to tell with certainty his stature and the form of his body; and when his pupils recited in his presence, he knew in what situation and attitude they were. (Digbæus *De Nat. Corpor.* c. 28.) Aldrovandus mentions (*Hist. Monstr.*) a butcher of Boulogne, who estimated by touch the weight of the animal he was about to kill. M. de Piles saw in Italy a blind man, a native of Cambassy in Tuscany, who was a very good designer. M. de Piles met him in the Justiniani Palace, where he was modelling in wax a statue of Minerva. By means of touch, he had seized with precision the form and proportions of the original. The duke of Bracciano, who had seen him working, doubted whether he was completely blind; and, in order to put the matter to the test, he caused the artist to take his portrait in a dark cave. It proved a striking likeness. Some, however, objecting that the duke's beard, which was of patriarchal amplitude, had helped the artist to recognise him, the latter offered to execute a portrait of one of the duke's daughters, which he accordingly did, and it also proved an excellent likeness. "J'ai vû," says M. de Piles, "sortis des mains de cet illustre aveugle les portraits du feu roi d'Angleterre, Charles I., celui du pape Urbain VIII., et en France, le portrait de M. Hesselin, tous parfaitement exécutés." (*Cours de Peinture*, p 260, 1766.) "Nous avons vû, dès nos jours," says Dr Guillié, to whom we are indebted for the particulars of the more distinguished blind, "M. Buret, l'un des plus habiles sculpteurs de l'académie, devenu aveugle, à l'âge de vingt-cinq ans, par suite de la petite vérole, ne pas cesser pour cela de travailler, comme le faisait l'aveugle de Cambassy." (*Essai sur l'Instruction des Aveugles*, p. 94, Paris, 1817.)

Giovanni Gambasio of Volterra lost his sight at the age of twenty, and remained ten years in this state, ignorant of even the elements of sculpture. All of a sudden, however, "the desire of making a statue came upon him;" and having handled in every way a marble figure representing Cosmo de' Medici, he formed one of clay, so extremely like that it astonished all who saw it. His talent for statuary now developed itself to such a degree, that Prince Ferdinand, grand duke of Tuscany, sent him to Rome to model the statue of Pope Urban VIII. which he also rendered a striking likeness of the original. He also executed many others with equal success. (Aldrovandus, *Hist. Monstr.*) A Dutch organist, blind from his early youth, became very skilful in his profession; he also acquired the habit of distinguishing by touch the different kinds of money, and even, it is said, the primary colours. He was a first-rate card-player; for in dealing he knew the cards which he gave to others as well as those which he kept for himself. (Lecat, *Traités des Sens*, p. 11.) Chauvet, born blind, was for several years organist of Notre-Dame-de-Bonne-Nouvelle at Paris. Mademoiselle Paradis of Vienna, who had lost her sight when two years old, formed the delight of the spiritual concerts at Paris in the year 1784. This lady, who had great talents for musical composition, invented a method of writing whatever she composed, by figuring the concords. She began at first by tracing them on cards pricked with needles; but this first essay proving unsatisfactory, she fell upon another method, which, however, has not been explained,—a circumstance we regret the more, since it has been described as at once certain and of easy execution. Holman, the blind traveller, being still alive, can scarcely with propriety be made the subject of a notice in this place. Blind.

This catalogue might easily be extended; but enough has been said, and a sufficient number of facts accumulated, to show what the blind are really capable of. There seems, in truth, to be a sort of compensating power, alike subtile in its resources and refined in its operation, by which a multitude of latent faculties and unheeded perceptions are called into activity to supply the want of one great inlet of knowledge, and which, taken in the aggregate, and fully developed, appear almost sufficient to fill up the blank which has been left by nature or produced by disease in the catalogue of human organs. Hence there are few things practicable by persons possessed of sight which have not been done by those who want it; whilst in regard to several the balance of advantage is clearly in favour of the blind. This is at once a wise and beneficent provision of nature; in perfect harmony with the whole economy of providence in the structure of the body as well as of the mind of man; and singularly illustrative of that foresight which has provided, with such benevolent care, for the casualties as well as the wants to which we are exposed in the present state of existence. Had the case been otherwise every loss would have been irreparable, and the smallest deprivation would have driven us to despair. (J. B—E.)

The number of blind persons in Great Britain has been variously estimated; by the most recent authorities it is computed at 25,000. Of these the great majority belong to the poorer classes, and consequently possess few facilities for education or self-improvement. A good deal has of late years been attempted with a view to ameliorate their condition; but very much still remains to be done. Many causes conspire to retard and obstruct the kindly efforts of English philanthropists in their behalf, and none more than the tenacious rivalry of self-asserting system-mongers. While the public is engaged in deciding upon the respective merits of these "systems," it forgets the beautiful maxim "bis dat, qui cito dat;" and the objects of their benevolence meanwhile pine away in neglected helplessness. It is impossible here to discuss or even to enumerate all the methods that have been devised for the education of the blind; we shall therefore confine ourselves to those that, by their popularity or their intrinsic worth, recommend themselves most strongly to our consideration. Their object—the teaching of the blind to read, and in this way developing the higher faculties of their minds—is the only point they can be said to possess in common. From the characters they respectively adopt, these systems have been arranged into two classes—the *alphabetical* and the *arbitrary*—in the first of which the Roman letters of the ordinary alphabet are employed; in the latter arbitrary characters represent letters, words, and combinations of sounds. Of the alphabetical systems, the best are—1. Alston's system; 2. The American; 3. The French alphabetical; 4. Alston modified. Of the arbitrary systems, the best are—1. Lucas's system; 2. Frere's system; 3. Moon's; 4. Le Système Braille; 5. Le Système Carton.

The merits of these two great classes have been long and keenly canvassed by their respective propounders; but it is now generally admitted that of the two classes the alphabetical is the best; and that of the alphabetical systems Alston's is the most convenient for general use. The reasons for so decided a verdict in favour of the last-named method are briefly summed up in the *Tangible Typography* of E. C. Johnson, who thus defines the conditions which must be satisfied by every system intended to facilitate the intellectual improvement of the blind. "The system of embossed printing for their use should embrace at least the following features:—1. It must resemble as nearly as possible the type in ordinary use among those who have eyesight; (*a*) that the blind scholar learning to read may have every possible help from words which he may have formerly seen, but which now his fingers must decipher; (*b*) that he may derive help in learning from any one who can read an ordinary book; or, if needful, that his friend may be able to read to him. 2. It

Blind Coal ‖ Bloch.

must present the words correctly spelt in full, that when he learns to write, he may do so in a correct manner which others can read. 3. The raised characters must be clear, sharp, and well defined, which the finger hardened by long work, and the keen soft touch of the little child, may be alike able to discern." No system at present in use fulfils all these conditions save Alston's, and those framed upon its model.

Lucas's system is a stenographic one, differing however, from all stenographic systems in this, that the characters occupy more space than if the words were all written at full length in Roman capitals. The New Testament in Alston's system is comprised within 623 pages, whereas in Lucas's it occupies 841.

Mr Frere's system is also a stenographic one, based on the phonetic principle, or combination of elementary sounds. His alphabet consists of 29 arbitrary symbols, to each of which is attached a short descriptive versicle, intended to fix more strongly in the memory of the learner the force of the symbol. The vowels are represented by simple dots, which in different positions denote different vowels, and are divided into five long and five short. Twelve rules in doggrel metre are supplied, which teach the learner how to supply the omitted vowels correctly.

Moon's is perhaps more difficult and intricate than either Lucas's or Frere's. Its principles are thus propounded by Mr Moon himself. "In order to avoid the complicated form of the Roman letter, and the still less discernible angular type, I have invented an alphabet, each letter of which is formed of two lines only: most of the letters bearing a partial resemblance to those in ordinary use. Nine forms placed in different positions represent the whole alphabet and numerals; one form serving for A, V, K, L, and X, and another for E, L, M, and Y, while there are but four contracted forms, *ment, ing, tion*, and *ness*." It will be found, however, on examination, that the resemblance between the letters of Mr Moon's alphabet, and the Roman capitals of that in common use is by no means so great as the above announcement would reasonably warrant us in expecting. As Mr Moon's system is moreover the most cumbrous and expensive that has yet been devised, it is not probable in the meantime that its adoption will be so general, or its success so great, as its author would seem to have anticipated. The New Testament has been printed according to the plan propounded in each of the five systems already enumerated. If it be taken as a standard of comparison for the whole five, their relative position will be as follows:—

Block.

Systems.	No. of Volumes.	No. of Pages.	Square inches in Page.	Price.
				£ s. d.
American	2	430	117	0 16 0
Alston's	4	623	90	2 0 0
Lucas's.....	9	841	70	2 0 0
Frere's.....	8	733	110	2 10 0
Moon's	9	...	110	4 10 0

BLIND COAL, or ANTHRACITE, corresponds to the glance coal of England, and the stone coal of Wales. It is very common in Scotland and in Ireland, as well as in many parts of the Continent; and in America it is the staple fuel. See COAL. Its application to the useful arts is given in the article SMELTING. See also MINERALOGY.

BLINDING, a species of punishment anciently inflicted on thieves, adulterers, perjurers, and others, and from which the ancient Christians were not exempt. It was sometimes effected by a mixture of lime and vinegar, or scalding vinegar, poured into the eyes; sometimes a rope was twisted round the head till the eyes started out. In the middle ages, this punishment was effected by holding a red-hot iron basin before the eyes. See ABACINARE.

BLINDNESS, PERIODICAL, is that which comes and goes by turns, according to the season of the moon, the time of day, and the like. *Diurnal* blindness is called *hemeralopia*. *Nocturnal* blindness, called also *nyctalopia*, is that which ensues on the setting of the sun in persons who see perfectly in the day, but become quite blind as night approaches. (See *Phil. Trans.* No. 159, p. 560; and a singular case related by Dr Samuel Pye in the *Medical Observ. and Inquir.* vol. i. p. 111.)

BLOCH, MARK ELIEZER, an eminent ichthyologist and helminthologist, born at Anspach, of very poor Jewish parents, about the year 1730. Having entered the employment of a surgeon at Hamburg, he was enabled by his own exertions to supply the want of early education, and made great progress in the study of anatomy, as well as in the other departments of medical science. He established himself as a physician at Berlin, and found means to collect there a valuable museum of the subjects of all the three kingdoms of nature, as well as an extensive library.

He applied himself, however, more particularly to those parts of natural history which are the most connected with the practice of physic; and, on occasion of a prize question of the academy of Copenhagen, he entered into a very elaborate examination of the different species of worms which are found in the bodies of other animals. In his essay on this subject, to which the prize was adjudged, he maintains that the parasitical species are only found within the animal body; and since they often occur in the fœtus, and in cavities which are completely inclosed, he infers that they must be generated in some unknown way, and not taken in with the food in the form of eggs. For the general remedy in cases of worms in the intestinal canal, he recommends large draughts of cold water, followed by cathartics. He has added to his Essay a complete classification and description of all the species of intestinal worms, accompanied by figures.

M. Bloch also published a variety of papers on different subjects of natural history, and of comparative anatomy and physiology, in the collections of the various academies of Germany, Holland, and Russia, particularly in that of the Friendly Society of Naturalists at Berlin. But his great work was his *Ichthyology*, which occupied the labour of a considerable portion of his life. His attention was first directed to the subject by receiving a present of a species of salmon, which he could not find described in the Linnæan *System of Nature;* and he discovered a number of similar omissions in Artedi, and in all former ichthyologists. He accordingly undertook to collect into one work everything that was known respecting the natural history of fishes, and to give figures of all the species; and he passed several summers by the sea-side, and among fishermen and their nets, comparing the descriptions of authors with nature, and taking bold sketches of the most interesting subjects, not uncommonly on board of the fishing boats which furnished them. His publication was encouraged by a large subscription, and it passed rapidly through five editions in German and in French. He made little or no alteration in the systematical arrangement of Artedi and Linnæus, although he was disposed to introduce into the classification some modifications depending on the structure of the gills, especially on the presence or absence of a fifth gill, without a bony arch; a character which affords some useful subdivisions of several genera. To the number of genera before established, he found it necessary to add nineteen new ones; and he described 176 new species, many of them inhabitants of the remotest parts of the ocean; and by the brilliancy of their colours, or the singularity of their forms, as much objects of popular admiration as of scientific curiosity.

In 1797 he paid a visit to Paris, where he was secure of finding a variety of collections of such subjects of natural history as had been inaccessible to him on the shores of the Baltic; and he returned to Berlin by way of Holland. His health, which had hitherto been unimpaired, began now to decline. He went to Carlsbad for its recovery, but his constitution was exhausted, and he died there on the 6th of August 1799. (Coquebert in *Rapport de la Société Philomathique*, vol. iv. 8vo, Par. 1800.) (T. Y.)

BLOCK, an instrument or machine of wood, chiefly employed in the rigging and other parts of a ship, by means

Block-Machinery.

of which a facility is given to the hoisting or lowering of the masts, yards, and sails, or to the moving of any great weight, as guns, anchors, bales, casks, and the like. It is, in fact, a modification of the pulley, and the names may almost be considered as synonymous.

There is nothing in the appearance of a block which, to an unpractised eye, would seem to require any stretch of mental ingenuity or of manual dexterity to manufacture. It is a machine apparently so rude in its structure, and so simple in its contrivance, that the name was probably given to it from its general resemblance to a log of wood, as is obviously the case with a butcher's block, a barber's block, the block of the executioner, &c. Of the two constituent parts of a ship's block, the external *shell* and the internal *sheave*, every carpenter might make the one, and every turner the other; and yet, when blocks were made by the hand, it seldom happened that the several parts were adjusted to each other with sufficient accuracy, or that a strict uniformity was observed in the various sorts and sizes; without which they cannot be expected to work with that degree of ease and truth which is so desirable, and even necessary, in the important office they are designed to fulfil in the rigging and other parts of a ship.

BLOCK-MACHINERY. To acquire a greater degree of accuracy and uniformity, as well as celerity, in the making of blocks, Mr Walter Taylor of Southampton took out a patent in the year 1781, to secure to himself the benefit of some improvement he had made in the construction of the sheaves: he also shaped the shells, cut the timber, &c., by machinery, which was put in motion by water on the river Itchin, near Southampton, where he carried on so extensive a manufacture of blocks, as to be able to contract with the commissioners of the navy for nearly the whole supply of blocks and blockmakers' wares required for the use of the royal navy.

Mr Dunsterville of Plymouth had also a set of machines wrought by horse-power, for making the principal parts of blocks; his manufacture, however, of this article was not carried to any great extent; but the blocks made by this machinery, as well as those by Mr Taylor's, were said to be of a superior quality to those constructed by the hand, though still deficient in many respects.

No objection, however, would probably have been made to the quality of the blocks furnished by Mr Taylor, and used in the navy. It would rather appear that the enormous quantity consumed in the course of a long protracted war first called the attention of the admiralty or navy board to the possibility of some reduction being made in the expense of so indispensable and important an article in the naval service; and to the imprudence of depending entirely on a single contractor, whom accident or misfortune might disable from fulfilling his contract.

On these considerations, it seems to have been the intention of government to introduce, among other improvements then carrying on in Portsmouth dock-yard, a set of machines for making blocks, at the new wood-mills erected in that yard in 1801. About this time the improvements which had been introduced into private concerns were gradually finding their way into the great public establishments of the country. Still, however, an old maxim seemed to prevail, that government ought not to be its own manufacturer. This maxim, though perhaps generally just in political economy, is, we conceive, neither just nor wise when applied to those articles which are of the first necessity in the royal navy. Indeed, where the safety of so many thousand lives depends wholly, as is sometimes the case, on the strength of materials and goodness of workmanship, it is most desirable that the whole ship, and every part of it, from the pin of a sheave to the sheet anchor, should be manufactured under the immediate superintendence of respectable officers in the royal service.

Block Machinery.

About this time, too, Mr Brunel (afterwards Sir Marc Isambart Brunel) had completed a working model of certain machines for constructing, by an improved method, the shells and sheaves of blocks. This model was submitted to the inspection of the lords commissioners of the admiralty, and by them referred to General Bentham, the inspector-general of naval works, who represented that, as the making of blocks was one of the purposes for which a part of the force of the steam-engine erecting at the wood-mills was intended to be applied, he did not hesitate to recommend the new machine, as an invention which would enable the government to construct its own blocks with a greater degree of celerity and exactness than those which were then in use; and that it appeared to be well suited for manufacturing blocks of every description and size, with a degree of accuracy, uniformity, and cheapness, far beyond any of the methods hitherto practised. The adoption of Mr Brunel's machinery was the consequence of this opinion.

The advantages to be expected from blocks so made were stated by Mr Brunel to consist,—first, in bringing the shape of the outside of the shell to certain determined dimensions, so that those of the same size should actually be so, and not differ from one another, either in the proportion of the mortises, or in the shape and dimensions of the outside; secondly, in adding strength where it was wanted, by making the head and bottom more substantial, and less liable to split; and, thirdly, in leaving the wood between the two mortises thicker, so as to admit a sufficient bearing for the pins,—all of which would be accomplished without requiring any dexterity on the part of the workmen, but entirely by the operation of the machinery. The uniformity and exactness with which they were to be made would be attended with another important advantage to the public; the difficulty of counterfeiting them would act as a precaution against embezzlement. Another very considerable advantage would be derived from the employment of much waste wood in the dock-yard, usually sold for little or nothing, for firewood and other purposes.

The sheaves or shivers would, by this new machinery, be made so mathematically true, and so exact to each other in their thickness and diameters, that every sheave of any particular size would equally fit any shell of the size for which it was intended; and the inconvenience to which ordinary blocks are liable from the friction of the ropes against one or alternately both of the sides of the mortises, was intended to be removed by placing a sheet of metal on the upper part of the mortise, bent to the proper shape by an engine adapted for the purpose. Brunel also proposed a new form for the *clue-line* and *clue-garnet* blocks, so as to secure the sails from splitting, by preventing the points of the sails getting into the blocks; which has since been adopted and greatly approved of in the navy.

In the sheaves, instead of the double coak or cogue inserted in two halves, he substituted a mixed metal coak of a new and particular form, which will be described hereafter, of increased strength and durability. This coak was to be cast with precision in moulds, and fitted by an engine with the greatest nicety; and the pins or axes of the sheaves were to be of wrought iron, case-hardened and coated with tin, which would preserve the iron from rust in the parts which are not kept free from it by friction; as it has been found by experience that, however tight the pin be forced into the shells, the water will insinuate itself and corrode the pin; and when this is the case, the rust soon extends itself to the parts on which the sheave turns, and renders it unfit for use.

From the machines that were already completed for manufacturing blocks of certain dimensions, Mr Brunel

Block-machinery. was enabled to make a calculation of the saving as to the first cost, compared with the contract prices, which would be effected by the adoption of his invention. It was as under:

	Blocks of 8 inches.	12 inches.	16 inches.	21 inches.
	s. d.	s. d.	s. d.	s. d.
Brunell's prices.....	1 8¾	4 5	8 11½	18 1¾
Contract prices.....	2 3½	6 11½	13 6	27 0¾
Saving in first cost...	0 6¼	2 6½	4 6½	8 10¾

These savings, if realized to the full extent, were probably not more important than the increased strength, durability, and facility of working, which have been gained by the adoption of the block-machinery.

Those parts of the machinery which Brunel had completed in London under his patent were transferred to Portsmouth, and, in the course of the year 1804, were in operation; but the increased number of machines, the improvements that suggested themselves to the ingenious inventor, the application of other machines for making dead-eyes, trucks, and all manner of block-maker's wares, besides circular and upright saws, lathes, engines for turning pins, rivetting, polishing, &c. exercised his skill and ingenuity till the year 1808, when he considered the whole system to be complete in every part, and incapable, as far as he could judge, of further improvement. From that time to the present, the block-machinery has been in full and constant employment, without requiring the least alteration, and very little repair, beyond the unavoidable wear and tear of engines that are kept in almost constant motion; and, which is still more extraordinary, without requiring the aid of the inventor, though attended only by a few common workmen or labourers; but they are superintended by Mr Burr, the master of the wood-mills, who is considered as an able and ingenious machinist. The quantity of blocks of every description, manufactured by the machinery in Portsmouth wood-mills, is more than sufficient for the consumption of the whole navy and the board of ordnance, and if pushed to the utmost extent of the works, would also have been sufficient to supply the greater part of the shipping employed in the transport service.

It may be a matter of some curiosity to know the results of this system of machinery. It is put in motion by a steam-engine of thirty-two horses' power, which, however, is applied to a great variety of other purposes at the same time, wholly independent of the block-machinery. It has been found by calculation, that four men with the machinery, as it now stands, can complete the shells of as many blocks as fifty men could do by the old method; and that six men will furnish as many sheaves as before required sixty; and that these ten men, in displacing the labour of one hundred and ten men, can with ease finish in one year from 130,000 to 140,000 blocks of different sorts and sizes, the total value of which cannot be less than L.50,000; and this is stated to be the average number which has annually been made from the year 1808 to the conclusion of the war. This number is found to be fully sufficient for supplying the wear and tear of blocks, not only in the naval, but also in the ordnance department. The consumption, however, must depend on other circumstances besides the number of ships in commission, and will be greater or less according as ships have been employed on severe or easy service, in a good or bad climate, in fine or rough weather, &c. Nor will the number here stated appear to be enormous, when it is considered what a multitude of blocks are required for a thousand sail of ships, which at one period of the war were in commission at the same time. A ship of 74 guns, for instance, requires the following blocks for her equipment:

	No.
Single blocks from 5 to 26 inches.....	622
Double ditto from 7 to 26 ditto.....	130
Various other blocks, generally large, and several of them treble.....	74
For each of the 74 guns, 6 blocks.....	444
Total.....	1270
Besides dead-eyes, hearts, parrels, and puttock-plates, all manufactured at the mills.....	160
Of all kinds in a 74 gun ship,	1430

Block-machinery

The average number of ships of the line in commission appears to have been about 100; these would require 143,000 blocks; and allowing the remaining 900 ships and vessels to require only twice this number, there would be wanted for the first equipment of the 1000 ships of war 429,000 blocks, which, at the ordinary rate of making them at the mills, would require three years in completing.

The different sorts and sizes of blocks used in the navy exceed two hundred, and they vary from four to twenty-eight inches in length. Those above eighteen inches are more sparingly used, and the shells of the largest kinds are made in parts, and fitted together by hand.

To the completion of this ingenious machinery, Brunel gave his whole attention from the month of September 1802 to June 1808, during which time he received no other compensation beyond the daily allowance of one guinea; but as it was now in full operation, and ascertained to be capable of making a sufficient number of blocks for the whole naval and ordnance departments, it became a question in what manner the author of the invention should be rewarded. It was suggested by General Bentham, and agreed to by Brunel, that the savings of one year, as compared with the contract prices, would be a fair and not an unreasonable remuneration for the time, labour, and ingenuity bestowed on these extraordinary machines. It was no easy matter, however, to ascertain with precision what the actual savings amounted to.

Mr Brunel, by estimate, made them amount to.....	L.21,174	0	0
Mr Rogers, clerk to General Bentham, by estimate.....	12,742	0	0
General Bentham, after going into every possible detail of expense with the utmost minuteness that could be expected in a private manufacturing concern, calculated them at.....	L.16,621	0	0
Add six years' allowance at a guinea a-day, about.....	2,400	0	0
For the working-model.....	1,000	0	0
Total amount received by Brunel, about	L.20,000	0	0

Supposing, therefore, the whole cost of the buildings, steam-engine, machinery, interest of money, &c. to amount (which we understand to be about the mark) to L.53,000, and the net compensation for profits to about L.18,000, the whole expense of the concern was completely cleared in four years. The savings of L.18,000 on one year's manufactured articles of the value of L.50,000 amounts to something more than Brunel had originally made it by computation.

It would occupy too much space to enter into a minute description, and require more time than we can spare to prepare engravings in detail, of the various complicated systems of machinery that are employed for the completion of a block; and, after all, they would afford but little use or instruction, excepting perhaps to a professed machinist; and perspective views of the several systems would tend rather to mislead or confuse than to inform the

Block-machinery.

general reader. But as everybody who happens to inspect Portsmouth dock-yard makes a point of visiting the block-machinery, we think it may be of some use, in conveying a general idea of the most striking parts of the machinery, by following the process of making a block from the rough unsided tree, till the last finish is given to it.

We have stated that the original intention of the building was that of a wood-mill, in which all manner of sawing, turning, boring, rabbetting, and the like, was to be performed, and that the block-machinery was superadded to the first design, with which, however, it has interfered so little, that, in addition to the immense number of blocks manufactured at the mill, upwards of a hundred different articles of wood-work are made by other machinery, put in motion by the same steam-engine, from the boring of a pump of forty feet in length, to the turning of a button for the knob or handle of a drawer. (See DOCK-YARD, PORTSMOUTH.) Lest, however, the engine, with such a variety of work, might be overloaded, a second engine has been added, to assist, if found necessary, or to be substituted in the event of accident happening to the other. Among the many ingenious machines belonging to the wood-mills, exclusive of those for making blocks, one of very great effect, and at the same time great simplicity, is a circular saw for cutting rabbets in the edges of deal planks, invented by Mr Burr, the superintending master of the wood-mills.

The whole of the machinery in these mills is put in motion by straps passing over drum-heads, by which the several movements, numerous as they are, are carried on without the least noise; and all the engine-work, and every part of the machinery, are so truly made, and so firmly put together, and work with such accuracy in all their motions, that though the spectator is surrounded on all sides with movements in every possible direction, and some most rapid and violent, the only noise that disturbs him arises from the cutting, boring, turning, polishing, and other instruments which are actually in contact with the work that is under execution, and none of it from the working of the machinery. All the iron work, of which it is chiefly composed, was made by Mawdsley; and there is but another workman, perhaps, in the united kingdom, who could have finished the engines in a manner so worthy of the invention.

The first wing of the building is chiefly occupied by upright and circular saws, used for a variety of purposes not immediately connected with the making of blocks. The only operation for this department is that of converting the rough timber, which is generally elm or ash, most commonly the former, into its proper scantling; that is to say, squaring it by the upright or straight-cutting saw, and then, by a circular saw, cross-cutting it into a certain number of parallelopipedons, whose lengths may bear the required proportion to the thickness of the log. Some of these pieces are again cut longitudinally, according to the thickness that may be required for the shell of the block, especially those for single and double blocks, which of course are thinner than three and four-fold blocks. This operation is performed by what is called a ripping-saw. The logs thus cut out are then taken into the second wing of the wood-mills, where the machinery peculiar for the construction of blocks is erected; and here the first process may be said to commence in making the SHELL.

This operation is performed by the *Boring Machine*, which, by means of a centre bit applied to the middle of the shell, bores a hole for the centre pin of the sheave, while another bores one, two, or three holes, at right angles to the direction of the first, to admit the first stroke of the chisel, and, at the same time, to serve for the head of the mortise or mortises, according as the intended block is to contain one, two, or three sheaves. When thus bored, the log is carried from hence to the

Block-machinery.

Mortising Machine, which is an ingenious and striking piece of mechanism. The block being firmly fixed on a movable carriage, the latter is so contrived as to be made to advance to the cutting chisels, which are set fast in a movable frame. Every time the frame with the chisels ascends, the block in its carriage advances a little, so as to present to the chisels a fresh surface of wood to be acted upon at each stroke of their descent; and this up and down motion is continued with such rapidity, that the chisels make from one hundred to one hundred and thirty strokes in a minute, until the prescribed length has been mortised out; when, by raising a handle, which is done by a boy, the machine is stopped precisely when the chisels stand at their greatest elevation; and are thus left in the proper position, ready to commence a second operation. No harm, however, would happen, either to the block or the machinery, should the attending boy neglect to stop the work at the proper time, or even to fall asleep, notwithstanding the force and rapidity of the stroke; for, by a particular contrivance, the farther advance of the block is stopped, and the chisels, therefore, act in full space, and cut only the air. It is, indeed, a general characteristic of Brunel's machinery, to be so constructed as to carry with it a defence or protection against its own operations, and to counteract all ill effects that might otherwise arise from any neglect or inattention of the workmen.

The chips cut by the chisels are thrust out of the mortise by small pieces of steel attached to and projecting from the back of each chisel. They are each of them, besides, armed with two cutters placed at right angles to the edge, called *scribers*, which mark out the width of the chip to be cut by the chisel at each stroke. These scribers answer another purpose; their cutting is so true as to leave the two sides of the mortise so perfectly smooth as to require no further trimming or polishing.

The next process is to remove the block from the mortising machine to a circular saw, in order to have the four corners taken off, by which operation it is reduced to an octagonal shape. This saw being fixed into a table or bench, the workman has nothing more to do than to slide each log along the surface of the table, in the direction of the line marked out for the saw to cut it.

The next operation is to place the block upon the *Shaping Machine*. This is perhaps one of the most ingenious and most effective contrivances in the whole machinery of the wood-mills. It consists principally of two equal and parallel circular wheels moving on the same axis, to which one of them is firmly fixed, but on which the other is made to slide; so that these two wheels may be placed at any given distance from each other, and blocks of any size admitted between their two rims or peripheries. For this purpose, both rims are divided into ten equal parts, for the reception of ten blocks, which are firmly and immovably fixed between the two wheels. When the double wheel with its ten attached blocks is put in motion, the outer surfaces of the blocks, or those which are farthest from the centre, strike with great violence against the edge of a chisel or gouge fixed in a movable frame, which, being made to slide in a curved direction in the line of the axis, cuts those outward faces of the blocks to their proper curvature, which can be altered in any way the workman pleases, by a contrivance attached to the cutting tool. As soon as the tool has traversed the whole length of the block, or over the space contained between the two peripheries of the wheels, the machine is thrown out of the gear, and its prodigious velocity checked by a particular contrivance. The ten

Block-machinery.

blocks are then, by a single operation, and without removing them, each turned one fourth part round, and another fourth part of their surface brought outwards, which, being exposed to the cutting instrument traversing in the same direction as before, have the same curvature given to these new surfaces. A third side is then turned outwards, and, after that, the fourth and last side, when the whole ten blocks are completely shaped, and ten other octagonal logs applied to the peripheries to undergo the same operation.

The immense velocity with which the wheels revolve, and the great weight with which their peripheries are loaded, would make it dangerous to the workmen or bye-standers, if, by the violence of the centrifugal force, any of the blocks should happen to be thrown off from the rim of the wheels; to prevent the possibility of such an accident, an iron cage or guard is placed between the workman and the machine.

The shell of the block being now mortised and completely shapen, the last operation is performed by the *Scoring Machine*, which, by means of cutters, scoops out a groove round the longer diameter of the block, deepest at the ends, and vanishing to the central hole for the pin on which the sheave turns. The intention of this groove or channel is to receive the hempen or iron strap which surrounds the block. The only thing that now remains for completing the shell, is the removal of the little roughnesses from the surface, and giving to it a kind of polish, which is done by the hand.

The Sheaves. The wood generally used for making sheaves is lignumvitæ, but iron or bell-metal have occasionally been substituted for this wood. An attempt was made to introduce sheaves of a kind of porcelain, which answered well enough for some particular purposes, but were not to be trusted in situations where they were liable to sudden jerks and irregular motions. In the navy they are almost invariably of lignumvitæ, a few perhaps of ebony. The machinery employed for making this part of the block consists of a *Circular Saw*, by which the log is cut into plates of the thickness required for the sheaves, according to their several diameters. These plates are next carried to a *Crown Saw*, which bores the central hole, and at the same time reduces them to a perfect circle of the assigned diameter. The sheave, thus shaped, is next brought to the *Coaking Machine*, a piece of mechanism not inferior in ingenuity to the *Shaping Machine* for the shells. It would be useless to attempt to describe by words the movements of this engine, but the effect of the operation is singularly curious. A small cutter, in traversing round the central hole of the sheave, forms a groove for the insertion of the coak or bush, the shape of which is that of three semicircles, not concentric with each other, nor with the sheave, but each having a centre equally distant from that of the sheave. The manner in which the cutter traverses from the first to the second, and from this to the third semicircle, after finishing each of them, is exceedingly curious, and never fails to attract the particular notice of visitors. So very exact and accurate is this groove cut for the reception of the metal coak, and so uniform in their shape and size are the latter cast in moulds, that they are invariably found to fit each other so nicely and without preparation, that the tap of a hammer is sufficient to fix the coak in its place. The coaks are cast with small grooves or channels in the inside of their tubes, which serve to retain the oil or grease, without which it would soon ooze out, and the pin become dry.

The sheave, with its coak thus fitted in, is now taken to the *Drilling Machine*, which is kept in constant motion. In casting the coaks a mark is left in the centre of each of the three semicircles. This mark is applied by a boy to the point of the moving drill, which speedily goes through the two coaks and the intermediate wood of the sheave. A copper pin, cut from wire, of the proper length and thickness, is inserted into the holes thus drilled. And the sheave is then taken to the *Rivetting Hammer*, which is something like a small tilt hammer, and can easily be made to strike on the pin with greater or less velocity, according as the workman presses with more or less force on the treadle. The rivetting being performed, the next operation is that of broaching the central hole on which the sheave turns, by means of a steel drill or cutter.

Blockade.

The last process is that of turning a groove for the rope to run in round the periphery of the sheave, and this operation is performed by a lathe, which is so constructed, that while this groove is cutting round the rim of the sheave, another part of the engine is turning smooth the two surfaces or faces of the sheave; and this lathe can be made to adapt itself to sheaves of different diameters.

The shell and the sheave being now completed, there remains only the iron pin, which, passing through the two sides of the former, serves as the axis on which the latter turns within the mortise. These pins are also made, turned, and polished by engines for the purpose, so that, with the exception of strapping by rope or iron, the whole block is completed at the wood-mills. It may here be remarked, that the French, in the dock-yard of Brest, have long been in the practice of making blocks by machinery; but they have not attempted anything like a shaping machine, nor any substitute for it, the external shape of the shell being made entirely by hand; nor have they such a coaking machine as that invented by Brunel. The machinery at Brest is put in motion by horses. (See Dock-Yard.) (J. B—W.)

BLOCKADE, in war, the shutting up of any place or port by a naval or military force, so as to cut off all communication with those who are without the hostile line.

There is, perhaps, no part of the law of nations which, in practice, presents so many perplexing questions as that which concerns the respective rights of neutral and belligerent states. No definite line of distinction has yet been drawn between the privileges of war and peace; and the consequence has been, that, in all the wars which have been waged in Europe, the general tranquillity of the world has been endangered by the jarring of these two different interests. It has commonly happened, too, that all these important questions have been agitated during a season of war; when the passions of the contending parties were keenly engaged in the dispute; when principles were already subverted; and when the minds of men, exasperated by the glaring infraction of acknowledged rights, were not in a state to agree on any system of general equity by which to regulate and reform the erring policy of states. In these circumstances, many points of international law, which appear to rest on the most obvious principles, and which are very clearly settled in the writings of civilians, have, nevertheless, been the occasion in practice of no small controversy, and have frequently involved nations in all the miseries of protracted war. This has been in some measure manifested in the case of the *Rights of Blockade*, respecting which, though no difference of opinion has ever prevailed amongst speculative writers, a controversy arose during the late contests in Europe, which, along with other points, ultimately involved Great Britain in a war with the neutral powers. We propose, in the course of the subsequent observations, to state, 1*st*, The general principles from which the most approved writers have deduced the rights of blockade; and, 2*d*, To give a short account of the differences which took place between the neutral and the belligerent states, respecting the extent of those rights.

Blockade. In regulating the respective privileges of the neutral and the belligerent, it has generally been held as a fundamental principle, by writers on the law of nations, that those rights, from the exercise of which less benefit would accrue to the one party than detriment to the other, should be abandoned; and in all cases where the rights of peace and the rights of war happen to come into collision, the application of this rule will decide which of the two parties must yield to the convenience of the other. Thus the neutral state is debarred from carrying on any trade with either of the belligerents in warlike stores. The general right to a free trade is modified, in this particular instance, by the paramount rights of the belligerent. To refrain for a time from trading with an individual state in warlike stores, can at most only impose a trifling inconvenience on the neutral power, whilst the continuance of such a trade might terminate in the destruction of the belligerent. The detriment occasioned to the one party, by the existence of such a trade, is, in this manner, infinitely greater than the loss suffered by the other from its abandonment. Warlike stores, and whatever else bears a direct reference to war, are accordingly proscribed as unlawful articles of trade, and made liable to seizure by either of the belligerents. To this inconvenience the neutral is exposed, to avoid the greater inconvenience and damage which might fall on the belligerent by the licensing of such a trade. On the other hand, the neutral state enjoys the most unlimited freedom of trade in all other articles with either of the powers at war; and though, by means of this beneficial intercourse, they may be both furnished with the means of carrying on a protracted contest, this is a contingent and incidental consequence of the trade, which, in its character, is substantially pacific, and which is attended with such great and immediate advantages, that they could not, with any regard to equity, be sacrificed to the remote convenience of the belligerent.

Applying these principles to a siege or to a blockade, it is evident that the belligerent who had an expensive scheme of hostile operations of either kind in dependence would be far more seriously injured by its interruption than the neutral would be benefited by a free intercourse with the blockaded place. On this ground, therefore, a belligerent who has formed a siege or a blockade, has an indisputable right to debar the neutral from all intercourse with those who are included within his lines; and any attempt to penetrate the blockade for the purposes of trade, subjects those who attempt it to destruction, and their properties to confiscation. The very existence, indeed, of a siege or a blockade, as a lawful act of hostility, implies the right of enforcing it by an indiscriminate exclusion of all who seek access to the besieged.

But although this view of the nature of a blockade, and of the rights attaching to it, is clearly laid down by all writers on the law of nations, and although it has been acknowledged in practice by all civilized states, a question was agitated in the late wars of Europe, between the neutral and the belligerent powers, as to the *degree* of restraint necessary to constitute a blockade, and, of course, to entitle the blockading party to all the rights consequent upon this scheme of operations; and it is this dispute which was, in a great measure, the occasion of a general war with the neutral powers.

The unexampled success which attended the naval operations of Great Britain, during the war with France, naturally suggested to her rulers the possibility of extending this species of annoyance, and of converting the all-powerful navy which they possessed into an instrument of active hostility. With this view, instead of confining its efforts to the mere watching of the enemy's already ruined trade, it was resolved to give greater scope to such an immense engine of maritime power, by placing under Blockade. blockade the enemy's ports, the mouths of navigable rivers, and even extensive tracts of his coast. Proclamations to this effect were accordingly issued; and the neutral trader was duly warned off, and prohibited, under the peril of detention, from all intercourse with the interdicted coast. But the legality of these blockades by proclamation being disputed, both by the neutral powers and by the enemy, their execution was resisted by a counter-decree, which, on the plea of retaliation, placed under blockade the whole island of Great Britain, and subjected all neutral vessels to detention and capture which should have been found touching at any of its ports. On the same plea of retaliation, several decrees, or orders in council, were issued by Britain, ordaining, that no neutral vessel should have any intercourse with France and her dependencies, except such vessel should first touch at a British port, where, in some cases, the cargo was to be landed, and was to pay certain duties to the British government. From this period the maxims of equity, and the rules of international law, were set aside, and the ocean became a scene of proscription and pillage. All this anarchy having originated in a disagreement respecting the nature and extent of a blockade, it becomes of importance to bring back the question to its true elements, and to fix the principles by which alone it should be settled.

The object of a blockade is to reduce the inhabitants of the blockaded town to such straits that they shall be forced to surrender to the discretion of their enemies in order to preserve their lives; and hence the legality of every blockade, except with a view to capture, has been questioned. But without entering into this question, it seems obvious that, in order to constitute the blockade of a town, either with a view to capture or to temporary annoyance, the line by which it is surrounded should be so complete as entirely to obstruct all access into the place. When a place is blockaded with a view to capture, the task of maintaining a real blockade may safely be left to the blockading party. But when a port is blockaded with a view to mere maritime annoyance, the case is widely different; because, in these circumstances, the belligerent will equally attain his end by maintaining the mere show of a blockade, while he is in possession of all its substantial rights. He may, to save himself expense and trouble, relax the blockade of his enemy's ports, while he enforces the exclusion of all neutrals as rigorously as if he were maintaining an effectual blockade; and, in this case, his proclamations, while they are issued ostensibly for the blockade of the enemy's ports, would, in reality, amount to edicts for the suppression of the neutral trade. The urgent, immediate, and obvious interests of the neutral would here be sacrificed to the remote, and in many cases imaginary, convenience of the belligerent. An edict might be issued for the blockade of the enemy's ports, or of extensive tracts of his coast, round which no hostile line could ever be drawn so as to constitute a real blockade; and the whole trade of the neutral, with those interdicted parts of the enemy's territory, would be immediately annihilated at the arbitrary mandate of one of the belligerents. Instead of being carried on as a matter of right, instead of being regarded as a common benefit to the civilized world, and on this account as proper to be cherished and encouraged, the neutral trade would, under such a system, be looked upon in the light of a tolerated evil, existing only by the sufferance of those who imagined they had an interest in obstructing and in crushing it. The law of nations is not a partial system, modelled to suit the convenience of one party. It is a system of general equity, and its edicts are founded on a comprehensive view of what is for the com-

Blockzyl || Blois.

mon welfare and protection. In this view, then, the consequences to the neutral of those extensive and nominal blockades are sufficient to constitute them illegal. The damage to the neutral is infinitely greater than the benefit to the belligerent. The rights of blockade, and the limitation of those rights, must stand upon the same principle of justice and of public law; and their extension beyond this equitable principle must terminate in universal confusion and anarchy.

In opposition to these arguments in favour of the neutral powers, it has been urged that the new system of naval annoyance, introduced by Great Britain in 1806, was legal according to the strictest construction of the law of blockade, because the proclamations for interrupting all intercourse between the different parts of the French coast were not issued until it was ascertained, by the most particular inquiries, that Great Britain possessed an effectual naval force to blockade the enemy's coast from Brest harbour to the mouth of the Elbe. It is solely upon this principle that the ministers of our country maintained the legality of those blockades; and any breach in the line of blockade, they admitted, would be sufficient to constitute them illegal. Such, then, is the state of this important controversy, which seems to resolve itself into a mere question of fact, namely, whether the blockading power has actually carried into effect the blockade, of which notice by proclamation has been given to the neutral powers.

At the conclusion of the last treaty between Great Britain and America, no settlement of these disputed questions took place. The main war between the European belligerents, out of which the American dispute had incidentally sprung, being at an end, the controversy respecting rights which could only be exercised in a state of war had lost all practical importance. It had become a mere question of abstract right, the decision of which was wisely adjourned by the powers at war, and not suffered to clog the work of a general peace. It is likely, however, that on the breaking out of any new war, this and other questions of a like nature would recur, and on this account it might be of importance to the future peace of the world if these questions could be settled according to some acknowledged rule of equity or policy, and that without delay. (D. B—N.)

BLOCKZYL, a town of Overyssel, in the Netherlands, on the river Aa, at its junction with the Zuyder Zee. It has a port sufficient to contain 200 vessels. Its fortifications, which were considerable, have been allowed to fall to decay. Long. 5. 52. E. Lat. 52. 45. N. Pop. 1650.

BLOEMART, Abraham, a Dutch historical painter, born at Gorkum in 1567, who also painted landscapes with good effect, and etched with considerable skill. He died in 1647. His son Cornelius was an eminent engraver, and remarkable for the softness and purity of his burin.

BLOIS, the capital of an arrondissement of the same name, and also of the department of Loire et Cher in France, is pleasantly situated in the form of an amphitheatre on the steep slope of a hill on the right bank of the Loire, 35 miles S.W. of Orleans. The town itself cannot be said to be either handsome or well built; on the contrary, the houses are generally mean, and the streets narrow and crooked. It contains, however, several remarkable monuments of antiquity. The castle is an immense structure built at different periods, part of it as early as the thirteenth century. Here Louis XII. was born, and the Duke of Guise and his brother the cardinal basely murdered by the command of Henry III. It is now used as barracks. Among its other remarkable buildings are the Hotel de Ville, the episcopal palace, now the Hotel of the Prefecture, the Cathedral, the Church of St Vincent, &c. An ancient aqueduct, cut in the solid rock by the Romans, conveys the waters of several springs to a reservoir, whence they are distributed to different parts of the town. It is the seat of a bishopric founded by Louis XIV., and has a communal college, normal school, diocesan seminary, botanical garden, theatre, and public library. It manufactures gloves, hosiery, hardware, and leather, and has an extensive trade in wine, timber, brandy, &c. Population (1851) of town, 16,104; of arrondissement, 131,817.

Blond || Blood.

BLOND, J. Christopher le, a painter of portraits and other subjects in miniature, was born at Frankfort in 1670. He became known at Rome in the year 1716, being at that time painter to the Count Martinetz, ambassador at that court. He next went to Amsterdam; and, after some years' residence in the Low Countries, he came to England, where he established a new method of printing mezzotinto plates in colours, so as to imitate the pictures from which they were copied. This invention,—which was not his own, but borrowed from Lastman and others,—consisted in having several mezzotinto plates for one piece, each expressing different shades and parts of the piece in different colours. Le Blond next embarked in a scheme for copying the cartoons of Raphael in tapestry, and made drawings from them for that purpose. Houses were built and looms erected at the Mulberry Ground at Chelsea; but the contributions not being equal to the first expectations, the scheme was suddenly defeated, and Le Blond disappeared, to the no small dissatisfaction of those who were engaged with him. He died in an hospital at Paris in 1740. Le Blond explained his art in a book entitled *Il Colorito*, published in 1730, and he was also the author of a treatise in French on Ideal Beauty, which was published in 1732, and has since been translated into English.

BLONDEL, a troubadour, the friend and companion of the English Richard (Cœur de Lion) to the Holy Land. He is said to have discovered the place where his master was confined by his singing, when the gallant crusader was imprisoned by the mean revenge of the Duke of Austria, though modern scepticism has thrown doubts on the minstrel's part in that event. (Berrington's *Richard I.*)

Blondel, *David*, a Protestant minister, distinguished by his skill in ecclesiastical and civil history, was born at Chalons-sur-Marne, and was admitted to the ministry at a synod of the Isle of France in 1614. He soon made himself known by certain learned works, and in 1650 he succeeded G. J. Vossius in the professorship of history at Amsterdam. Bayle says he had a very singular way of studying. He lay on the ground, and had around him the books which he wanted for the work he was composing. He died in 1655.

Blondel, *François*, an eminent architect, born at Ribemont in Picardy, A.D. 1617. He was employed in various negotiations; arrived at the dignity of marechal-de-camp and counsellor of state; and instructed the dauphin of France in mathematics. He was also made member of the Academy of Sciences, and director of the Academy of Architecture. He died at Paris in 1688.

BLONDUS, Flavius, an antiquary and historian, born at Forli in 1388. He was secretary to Eugenius IV. and several of the popes. Besides other works he wrote a history extending from the year 400 to 1440. He died in 1463.

BLOOD. See Anatomy and Physiology, Animal.

Religious uses of Blood. Amongst the ancients blood was used for the sealing and ratifying of covenants and alliances, on which occasions the contracting parties drank a little of each other's blood; and also for appeasing the manes of the dead, in order to which blood was offered on their tombs as part of the funeral ceremony.

The blood of victims was anciently the portion of the gods; and accordingly it was poured or sprinkled on the altars in oblation to them. But the priests made another use of blood, namely, for divination; the streaming of blood being held a prodigy or omen of evil.

The Roman priests were not unacquainted with the use of blood in miracles; and they had their fluxes of blood from images, ready to serve a turn, as, for instance, that said to have streamed from the statue of Minerva at Modena before the battle at that place. But we know not whether, in this

Blood. species of legerdemain, their successors have not gone beyond them. How many are the relations, in ecclesiastical writers, of madonnas, crucifixes, and wafers, bleeding? The liquefaction of the blood of St Januarius at Naples, repeated annually for so many ages, seems to transcend all the frauds of the Grecian or Roman priesthood. But the chemists at last got into the secret; and M. Neumann of Berlin performed the miracle of the liquefaction of dried blood, with all the circumstances of the Neapolitan experiment.

Amongst the schoolmen we find a famous dispute, under Pope Pius II., whether the blood of Christ, which fell from him in the three days' passion, retained or lost the hypostatic union; and consequently whether it was the proper object of adoration. The Dominicans maintained the former, the Franciscans the latter. But the Dominican doctrine gained the ascendency, as being fitted to favour the profits of the monks, who becoming somehow possessed, as they said, of a few drops of this precious liquor, were certain of receiving ample offerings from the deluded laity, who flocked to pay their homage to the sacred relic. Joseph of Arimathea is said to have first brought into Britain two silver vessels filled with the blood of Christ, which by his order was buried in his tomb. King Henry III. had a crystal, containing a portion of the same blood, sent him by the master of the temple of Jerusalem, attested with the seals of the patriarch; which treasure the king committed to the church of St Peter's, Westminster, and obtained from the bishops an indulgence of six years and a hundred and sixteen days to all who should visit it. And Matthew Paris assures us, that the object of the king in summoning his nobles and prelates to celebrate the feast of St Edward in St Peter's Church was chiefly *pro veneratione sancti sanguinis Christi nuper adepti*, in veneration of the holy blood of Christ lately acquired. Divers others of our monasteries were possessed of this profitable relic; as the college of Bons-Hommes at Ashridge, and the abbey of Hales, to which it was given by Henry, son of Richard, duke of Cornwall and king of the Romans. This supposititious blood was resorted to by a great concourse of people for devotion and adoration; till, in 1583, when the Reformation commenced, it was perceived to be only honey clarified and coloured with saffron, as was shown at St Paul's cross by the bishop of Rochester. The like discovery was made of the blood of Christ found among the relics in the abbey of Feschamp in Normandy, pretended to have been preserved by Nicodemus when he took the body from the cross, and given to that abbey by William duke of Normandy. It was buried by his son Richard, and again discovered in 1171, and attended with different miracles; but the cheat, which had long been winked at, was at length exposed, and a relation of it is given by Speed.

Avenger of Blood, among the Jews, was the next of kin to the person murdered, who was authorized to pursue the murderer, and, unless he found shelter in one of the cities of refuge or sanctuaries, to take life for life.

Ecclesiastical judges retire when judgment is to be given in cases of blood, by reason of the maxim, *Ecclesia non novit sanguinem*. The church condemns no person to death; and by law, its members become disabled from their functions by the effusion of blood.

Blood-Hound, the *canis sagax* of Linnæus, *le chien courant* of Buffon, the *sleuthounde* of the Scots, a hound or dog, with long, smooth, and pendulous ears. It was a dog of great use, and in high esteem with our ancestors, being employed to recover any game that had escaped wounded from the hunter, or been killed and stolen out of the forest. It was remarkable for the acuteness of smell, tracing the lost beast by the blood it had spilt, from which the name is derived. This species could, with the utmost certainty, discover the thief by following his footsteps, let his flight be rapid, and through the most secret and thickest coverts; nor would it cease its pursuit till it had taken the felon.

The true blood-hound was large, strong, muscular, broad-breasted, of a stern countenance, of a deep tan colour, and generally marked with a black spot above each eye.

Blood-Whyte ‖ Bloomfield

Blood-Whyte, or *Blood-wyte*, in ancient law, signified a customary amercement paid as a composition for the shedding of blood. The word is also written *blodwhite*, *blodwita*, *blodwyta*, *bloodwit*, *blodwit*, *bloudwit*, *bluidweit*; being formed from the Saxon *blud*, blood, and *vite* or *wite*, a fine or penalty. It also denotes an exemption from this penalty, granted by the king to certain persons and communities as a special favour. King Henry II. granted to all tenants within the honour of Wallingford, *Ut quieti sint de hidagio et blodwite et bredwite*.

Blood, *Thomas*, generally known by the appellation of *Colonel Blood*, was a disbanded officer of Oliver Cromwell's, famous for his daring crimes and his good fortune. He was first distinguished by engaging in a conspiracy to surprise the castle of Dublin; but this scheme was defeated by the vigilance of the duke of Ormond, and some of Blood's accomplices were executed. Escaping to England, he meditated revenge against Ormond, and actually seized him one night in his coach in St James's Street, where he might have finished his purpose if he had not studied refinements in his vengeance. He bound his captive on horseback behind one of his associates, resolving to hang him at Tyburn, with a paper pinned to his breast; but when they had got into the fields, the duke, in his efforts for liberty, threw himself and the assassin to whom he was fastened to the ground; and, while they were struggling in the mire, his grace was rescued by his servants. But the authors of this attempt were not then discovered. A little while after, in 1671, Blood formed the design of carrying off the crown and regalia from the Tower; an attempt which had very nearly been successful. He had bound and wounded Edwards, the keeper of the jewel-office, and had escaped out of the Tower with his prey; but he was overtaken and seized, together with some of his associates. One of these was known to have been concerned in the attempt upon Ormond, and Blood was immediately concluded to be the ringleader. When questioned, he frankly avowed the enterprise, but refused to discover his accomplices. All these extraordinary circumstances made him the general subject of conversation; and the king was moved with an idle curiosity to see and speak with a person so noted for his courage and his crimes. Whether the communications at this interview excited the fear or admiration of the king, they confirmed his resolution of granting a pardon to Blood. Charles carried his kindness to Blood still further, granting him an estate of L.500 a-year in Ireland, encouraging his attendance about his person, and showing him great countenance. Whilst old Edwards, who had bravely ventured his life in defending the crown and regalia, was forgotten and neglected, this villain became a kind of royal favourite. Blood enjoyed his pension about ten years; but at last being charged with fixing an imputation of a scandalous nature on the Duke of Buckingham, he was obliged to find bail to avoid being thrown into prison, and before the trial came on he died at his house in Westminster, August 24. 1680.

BLOODSTONE, or Heliotrope, in *Mineralogy*, a chalcedony or agate of a deep green colour, with blood-red spots interspersed through it. Tartary and Siberia are its chief localities. It occurs in Scotland in the isle of Rhum, in veins in trap rock.

BLOOMFIELD, Robert, the author of several pastoral poems of great beauty, was born of very humble parents at the village of Honington in Suffolk, in 1766. Without education but what a village school afforded, and losing his father at the age of eleven, he was apprenticed to a farmer, and could only improve his taste by perusing such books as he could borrow. Among these, Thomson seems to have been his favourite author, and *The Seasons* inspired him

Blow-pipe. by treating a mineral with that substance. Phosphate of ammonia is also sometimes used as a flux in the same manner as borax, and carbonate of soda; but both these, especially the latter, have the inconvenience of sinking into the charcoal, which borax is free from.

Characteristic phenomena of minerals treated by the blow-pipe.

Mention must be made here of a few of the most prominent phenomena, characteristic of different mineral substances when treated by the blow-pipe. Some minerals are fusible alone, such as garnet and felspar; the last, however, is rather difficult to fuse. Some are infusible, and change colour; bituminous shale loses its black colour, and becomes white; green and dark coloured steatite become white. Some dissolve in borax without effervescence, as agate, quartz, felspar, amiantus, garnet. Some dissolve in borax with effervescence. This is the case with carbonate of lime; it forms with borax a globule transparent whilst in fusion, but in cooling the globule becomes opaque, the lime being no longer held in solution by the borax, in like manner as the watery solutions of certain salts, saturated when hot, deposit a part of the salt on cooling. Some of the metals communicate peculiar colours to borax. Copper, in certain proportions, and at a certain degree of oxidation, gives a brown colour to borax when heated by the blow-pipe; cobalt gives a deep blue tinge; manganese communicates a violet colour; iron tinges borax brown, and, if in greater quantity, black. These colours are produced by the metals in a state of oxide. The smell emitted by some minerals when heated by the blow-pipe is another character serving to distinguish them. That of minerals containing sulphur is the peculiar suffocating smell of sulphureous gas; minerals that contain arsenic emit, when heated, a smell like that of garlic. The nature of some minerals is recognised by the particular form of crystallization which they assume in cooling. This is the case with phosphate of lead, which, after being fused, cools on the charcoal into an opaque white spheroidal polyhedron. Some ores are reduced to a metallic globule with great ease on the charcoal; thus the native sulphuret of lead, called galæna, being heated by the blow-pipe, the sulphur is driven off, and the lead remains in its metallic state. A small particle of silver may be melted by the blow-pipe; likewise gold, copper, and, Bergman says, cast-iron. Metallic zinc, when exposed to the flame of the blow-pipe on the charcoal, melts and burns with a bluish-green flame, and becomes covered with oxide, which flies off and floats in the air in light white flocks. Metallic antimony becomes red hot, and melts on the charcoal; and if the operator ceases to blow, a white fume rises, and oxide of antimony forms upon the globule, in whitish crystalline spiculæ; but if the globule, in a state of fusion, be thrown upon a brick floor, it runs along for a considerable way, rebounding several times, and leaving a trace of white oxide of antimony.

Some substances communicate colour to the flame of the blow-pipe. Muriate of copper, whose crystals are green, communicate a vivid green to the flame; sulphate and nitrate of copper, whose crystals are blue, likewise impart a green colour to the flame when they are exposed to its action. Some of the salts of strontian give a purple tinge to the flame.

Glass-blower's bellows.

The preceding observations relate to the blow-pipe worked by the breath. When it is required to continue the use of the blow-pipe so long that it would be fatiguing if the breath merely were employed, the glass-blower's table, fig. 9, is used. It consists of a double bellows, so fixed as to be worked by the foot, and to impel a current of air through a tin blow-pipe against the flame of a lamp fixed on the table. For the sake of durability, the blow-pipe is sometimes of brass, on which is screwed a nozzle of platina. The blow-pipe may have a stop-cock, as in fig. 9, serving to regulate the blast. The lamp has a cotton wick of nearly an inch in thickness; the wick is kept together by a tin wick-holder, which is soldered to the lamp; and melted tallow fills the lamp, and feeds the wick with fuel. In order to get rid of the smoke, which is in considerable quantity, there may be placed at a convenient distance above the flame a tin funnel ending in a tube, which conveys the smoke out of the room. A convenient method of carrying away the smoke from the glass-blowers' lamp is represented in fig. 13. It consists of a cover of thin sheet copper, which is placed on the table, covering the lamp and nozzle. The fore-part of this cover is open, so as to allow the jet of flame to pass freely. From the upper part of the cover two tubes run upwards for the exit of the smoke; and between these the glass-blower has a view of the object he is at work upon, whilst his eyes are screened from the light of the flame. The two tubes join above in one short tube; and over the open end of this short tube, at a small distance above, is a tube suspended from the ceiling by wires, which conveys the smoke into the chimney of the room. By a handle attached to the cover, the cover with its tubes is removed when it is necessary to trim the wick. The flame of gas from pit-coal may be used instead of a lamp, with a bellows of this kind.

Blow-pipe.

Water-pressure apparatus

The regularity of the blast in the double bellows is effected by means of a weight pressing on the air contained in the second compartment of the bellows; just in the same way as a stream of air is made to issue regularly from a tube fixed in the mouth of an inflated bladder, when a weight is placed on the bladder. A regular stream of air may also be obtained, by subjecting inclosed air to the pressure of a column of water, mercury, or some other liquid. If a vessel containing air, and open at the mouth, be plunged into the water with the mouth downwards, and if the water on the outside of the vessel rise higher than the surface of the water within the vessel, then the column of water, whose height is the difference of level, exercising its pressure, as all liquids do, in every direction, will act upwards on the inclosed air; the inclosed air, pressed and more condensed than the external air, will escape in a current, by a stop-cock opened on the top of the vessel for its issue; and this issue will continue till the surface of the exterior and interior water come to a level, when the air in the vessel will have the same density as the external air. The force with which the inclosed air is pressed is equal to the weight of a column of water whose height is the difference of levels, and whose base is the surface of water exposed to the inclosed air. The gasometers used by Lavoisier, to afford a stream of oxygen gas and a stream of hydrogen gas, for effecting the composition of water, are constructed upon this principle. An apparatus of the same nature has for many years been employed upon a great scale in different parts of Britain, to regulate the most powerful blast used in the arts,—that for reducing ironstone to the state of cast-iron. In blast-furnaces upon this construction, the blast is raised by means of a large cast-iron cylinder, which acts as a bellows, having a valve in the bottom that opens inwards, and that admits the air during the ascent of the piston; when the piston descends, the valve shuts, and the air is driven into a large parallelopipedal vessel, less in height than in the other dimensions, immersed in water, and having its under surface closed only by the water. In this vessel the air is pressed by the column of water, whose height is the distance between the surfaces of the exterior and interior water; and a pipe of issue, terminating in a nose-pipe, conducts the blast to the furnace.

Melograni's blow-pipe.

The blow-pipe of the Abbé Melograni of Naples, for the use of the mineralogist, operates by the pressure of water.

Blow-pipe. It is composed of two hollow globes, the upper filled with water, which, by running into the lower, forces the air contained in the lower to issue through a nozzle. This apparatus is described by Mr Greenough, in *Nicholson's Journal*, vol. ix. p. 25 and 143. It has some inconveniences, and does not appear ever to have come into much use.

Water-pressure blow-pipe for glass-blowers. The water-pressure apparatus, applied to the blow-pipe, of which a section is given at fig. 10, was contrived by Mr Tilley, an ingenious fancy glass-blower. It consists of a tin box with a partition in it, reaching within half an inch of the bottom; water is poured in, equal in bulk to three fourths of the capacity of the box. The water in the cavity DE is open, and subject to no other pressure but that of the atmosphere, being only covered by the lid of the vessel; the apartment F is closed at top, so as to be air-tight, and the water in it is pressed by the elasticity of the air confined in its upper part. The tube C has its lower extremity always plunged in water, so that when air is blown in through it, the return of the air by that tube is prevented. Before the apparatus is set to work, the surface of the water in both compartments is at the same height, both being pressed by air of the density of the surrounding air; but when air is blown in through C, the air rises through the water to the top of the compartment F; and as the only issue for the air is through the small aperture of the blow-pipe, by which it cannot escape nearly so fast as it is blown in, the air consequently becomes condensed in the upper part of the compartment F; and this condensed air pressing on the water in F more strongly than the atmosphere does on the water in DE, depresses the surface of the water in F, and causes it to rise in DE, which is effected by a portion of the water passing under the partition into the open compartment DE. Thus the pressure exerted by the column of water whose height is the difference of level of the water in DE, and of the water in F, forces the air from the compartment F through the blow-pipe *a*, which is directed against the flame of a lamp; and this pressure keeps up a constant blast till the water in the two compartments comes nearly to the same height. The degree of condensation of the inclosed air, and the height of the column of water pressing on the condensed air, are measures of each other, when much air is blown in, so as to occasion a considerable degree of condensation. The difference of level resulting is considerable; and the column of water, which is always re-acting with an equal and contrary pressure on the condensed air, causes it to issue with greater velocity from the blow-pipe. When the condensation diminishes, so does the column of water, and the velocity of the issuing stream of air. More air is to be blown in with the mouth through the tube C from time to time, so as to keep the blast regular. Mr Tilley is of opinion that this apparatus produces a more regular stream of air than a double bellows, and it has likewise the advantage that the operator is free from the trouble of moving a pedal. The dimensions of the vessel AA, which is either of tinned iron or of tinned copper, are seventeen inches in height, five inches in width, and nine in breadth; the lid of the vessel opens and shuts on hinges, and supports the tallow lamp B. The bent glass tube *a*, which terminates in a small hole, is fitted air-tight into a tin tube, which is made conical, and which forms the issue from the top of the compartment F; for this purpose paper is wrapped round the glass tube, and then cotton wick yarn, in a conical form, so that the glass tube thus clothed may fit tight into the socket, and may nevertheless be moved round, that the blast may act properly on the flame. The bent metal tube C is also fixed into its socket in the same manner: its junction with the socket is seen in fig. 10. There is a screen formed of a tin plate sliding vertically in grooves between two upright pieces of tin; the edge of this is seen at S, in fig. 10. It is intended to protect the eyes of the operator from the light of the lamp, whilst, at the same time, he can see the subject of his operation over the top of the screen. This screen is not soldered to the vessel, but is held fast by its foot being placed between the lid of the vessel and the top of the close chamber F. Two rests for supporting the operator's arms project, one from each side of the vessel; upon these the arms are placed when any substance is held to the flame. These rests are wrapped round with woollen list or leather, so as to be more convenient for leaning upon. The whole of the apparatus, including the lamp and case, weighs only three pounds and a half. When it is to be used, the vessel is fixed to a table or bench by means of a leather strap buckled to two loops, which are on the sides of the vessel opposite to each other; and the strap is passed under the table or bench. The long flat cotton wick is preferred by some glass-blowers to the usual round cotton wick. The lamp is filled with tallow, which melts after the lamp has been lighted for some time, and then it burns as freely as oil, and with a less offensive smell. When not in use the tallow becomes solid, and is more conveniently carried about than oil. Hogs' lard also does well for burning in this lamp. Some glass-blowers mix cocoa-nut oil, which is solid at the temperature of the climate of Britain, with hogs' lard, and find it to answer well in the lamp. The lamp is placed within another vessel, marked K, which supports it at a proper height, leaving a space between them, to receive any tallow that may run over the edge of the lamp. A wire bent at the end is convenient for trimming the wick, and forming it into a channel through which the stream of air is to be directed. It is convenient to have several lamps with wicks of different thicknesses, namely, one to hold two flat cottons of about one inch and a quarter broad, another to hold four, a third to hold six, or as much common wick-yarn as is equal to those wicks in bulk, and glass adjutages of different sized apertures to suit the different sized wicks. (See *Transactions of the Society for Encouraging Arts*, vol. xxxi.)

Blow-pipe.

Eolipile. The eolipile, fig. 11, has been applied to act as a blow-pipe. It is a hollow vessel of brass, sometimes made in form of a small kettle, sometimes in form of a ball of two inches in diameter, with a tube of brass that screws into it. The tube is to be screwed off in order to pour in alcohol by a small funnel, and then the tube being replaced, and heat applied to the bulb, the vapour of the alcohol issues from the small aperture of the tube, and being directed against the flame of a lamp, the flame is driven in a horizontal stream, such as the blow-pipe produces. The instrument has a safety valve, S, to prevent the danger of explosion, which might happen if the nozzle were stopped. The same wick that heats the bulb may serve to furnish the jet of flame, as is the case in the eolipile represented in fig. 11. This instrument has been proposed to be applied to the purposes of the mineralogist; but it does not appear to be either so readily put in action or so efficacious as the common blow-pipe, which is also simpler in its construction, less bulky, and more easily carried about.

Newman's blow-pipe. Mr Newman, philosophical instrument-maker, of Lisle Street, London, having observed that air condensed in a cavity required a considerable time to escape through a small aperture made to give it issue, contrived the apparatus represented at fig. 12, which acts as a blow-pipe. This apparatus consists of a strong plate-copper box, perfectly air-tight, three inches in width and height, and four in length; a condensing syringe to force air into the box; and an adjutage with a stop-cock at one end of the box,

Blow-pipe.

by which the issue of the air is regulated. The piston rod of the condensing syringe works through collars of leather in the cap, which has an aperture in the side, and a screw N connected with a stop-cock, which may be made to communicate with a jar, bladder, or gasometer, containing oxygen, hydrogen, or other gases. When this communication is made, and the condenser worked, the gas contained in the jar or bladder is thrown into the box, and issues through the adjutage upon the flame of a lamp placed near it. When the apparatus is worked with common air, a few strokes of the piston fills the chamber with compressed air. When the cock of the adjutage is opened, the air issues with great velocity in a small stream, and, when directed on the flame of a lamp, produces a jet of flame as the common blow-pipe does, but with more precision and regularity. The force of the stream of air is easily adjusted by opening more or less the stop-cock of the adjutage; and, when the box has been moderately charged, the stream will continue to issue uniformly for twenty minutes; when the strength of the blast begins to decline, it will be restored by working the syringe. The apparatus is very portable, and not liable to injury. It is made by Mr Newman, the inventor, with a lamp adapted to it, so as to pack up in a box not more than six inches in length and four inches in width and height, enough of space being left for other small articles; others he makes in boxes somewhat larger, so as to contain also a selection of chemical tests. (See *Journal of Science*, edited by the Royal Institution, No. 1.)

with a mixture of oxygen and hydrogen.

Sir Humphry Davy having discovered that the explosion from oxygen and hydrogen gases would not communicate through very small apertures, Mr Children proposed to him to employ Newman's blow-pipe for effecting a combustion of a mixture of oxygen and hydrogen gas issuing from a small aperture. This Sir Humphry did, and found that the flame produced an intense heat, which instantly fused bodies of a very refractory nature. Dr Clarke, professor of mineralogy at Cambridge, having consulted Sir Humphry on the subject, proceeded to expose a great variety of mineral substances to the flame, for the purpose of observing its effects upon each of them. The tube of glass through which the mixture of the two gases issues, is cemented on the pipe of issue of Newman's blow-pipe. The tube at first used by Dr Clarke was three inches in length, and the diameter of its cavity $\frac{1}{10}$th of an inch. The end of the tube was constantly breaking during the experiments, owing to the sudden changes of temperature, until at last he usually worked with a tube only one inch and three-eighths in length. When the current of gas is feeble, from the gas in the reservoir having come nearly to the same degree of density as the surrounding air, or from the current being suppressed in the beginning of an experiment, then the flame has a retrograde movement, passing up the capillary cavity of the tube about half an inch, and, after splitting the end of the glass tube, the flame goes out of itself; so that, even in this case, there is no danger of explosion. In order to try the effects of an explosion, four pints of a mixture of the two gases were condensed into the chest, which was all that the syringe could force into it. The glass tube was taken off, so that the diameter of the nose-pipe, by which the gas was to issue, was about one eighth of an inch. A burning spirit-lamp was placed at this aperture, and the stop-cock being opened by means of a long string attached to it, the whole gas exploded with a report like that of a cannon; the chest was burst, the stop-cock driven out, and one end of the chest was torn off and thrown against the wall of the room. This shows the danger of using the apparatus with too large an aperture, and the necessity of employing a capillary tube.

Blow-pipe || Blowing.

Dr Clarke's experiments.

When the mixture of the two gases is to be employed in Newman's blow-pipe, the chest is first exhausted of air, and then the gaseous mixture in a bladder, screwed on at N, is to be forced into the chest by the condensing syringe. The proportions of the two gases which Dr Clarke found to produce the greatest heat are, two volumes of hydrogen and one of oxygen gas. The intensity of the heat is much greater when the gases are pure; the oxygen procured from manganese does not produce nearly so great a heat as that got from the hyper-oxymuriate of potass. The intensity of the heat may be regulated by allowing the gas to issue in a more or less copious stream, which is done by turning the stop-cock. The heat, Dr Clarke thinks, is greater than that produced by the largest galvanic batteries. Most substances hitherto tried are fused by it, so that it is difficult to find supports for holding the subject of experiment to the flame. The supports employed by Dr Clarke were, charcoal, platina, a piece of tobacco-pipe, black lead. Lime, strontian, and alumine, were fused. The metal of strontian was got, and retained its lustre for some hours. The alkalies were fused and volatilized almost the instant they came in contact with the flame. Rock-crystal fused into a transparent glass full of bubbles. Quartz gave the same result. Opal fused into a pearly white enamel. Flint fused rapidly into a white frothy enamel. Blue sapphire melted into greenish glass balloons, ramified singularly. Foliated talc fused into a greenish glass. Peruvian emerald melted into a transparent and colourless glass, without bubbles. Lapis lazuli fused into transparent glass, with a slight tinge of green. Pure foliated native magnesia, from America, is the substance the most difficult of fusion; it is, however, at last reduced to a white opaque enamel. Agalmatolite of China fuses into a limpid colourless glass. Iceland spar is next in difficulty of fusion to the native magnesia; but it does at last melt into a limpid glass, and, during the process, gives an amethyst-coloured flame, as strontian does; the fusion of pure lime and of all its compounds is attended with a flame of the same colour. Diamond first became opaque, and then was gradually volatilized. Gold, fused along with borax, on a piece of tobacco pipe, was nearly all volatilized. Platina wire, $\frac{2}{10}$th of an inch in diameter, melted the instant it was brought into contact with the flame of the gas; the melted platina ran down in drops, and the wire burnt as iron wire does in oxygen gas. Brass wire burnt with a green flame, differing from the green flame that salts of copper give. Copper wire melted rapidly without burning. Iron wire burnt with brilliant scintillation. Plumbago melted into a bead which was attractable by the magnet. Blende or native sulphuret of zinc melted, and metallic zinc appeared in the centre of the melted mass. And metalloid oxide of manganese, crystallized in prisms, was reduced to a metallic state. (See Dr Clarke's Account of his Experiments, in the *Journal of Science*, edited at the Royal Institution, October 1816.) (W. A. C.)

BLOW-PIPE, a straight metal tube used by anatomists for inflating with the breath the collapsed vessels of the dead subject in order to ascertain their course. This tube is of an elongated conical form, six inches in length; the aperture of the large end being $\frac{4}{10}$ths of an inch in diameter, and that of the smaller end the size of a needle's point.

BLOWING, in a general sense, denotes an agitation of the air, whether performed with a pair of bellows, the mouth, a tube, or the like.

BLOWING, among gardeners, denotes the action of flowers in opening and displaying their leaves. In this sense, blowing is the same with flowering or blossoming.

The regular blowing season is the spring, although

Blowing Machines.

some plants have other extraordinary times and manners of blowing, as the Glastonbury thorn. Different flowers, also, as the tulip, close every evening, and blow again in the morning. Annual plants blow sooner or later according as their seeds are put in the ground; and hence the curious in gardening sow some every month in summer, to have a constant succession of flowers. The blowing of roses may be retarded by shearing off the buds as they are put forth.

Blowing of Glass, one of the methods of forming the various kinds of work in the glass manufacture. It is performed by dipping the point of an iron blow-pipe in the melted glass, and blowing through it with the mouth, according to the dimensions of the glass to be blown. See Glass.

Blowing of Tin denotes the melting its ore, after being first burnt to destroy the mundic.

BLOWING Machines, in the arts and manufactures, and in domestic economy, are instruments for producing a continued current of air, principally for the purpose of facilitating the combustion of fuel. The first idea of such a machine was doubtless derived from the lungs, which we are constantly in the habit of using for the purpose of blowing, but more especially in the simple and useful application of the blow-pipe.

Common bellows.

Of these different machines, the common bellows bears the greatest resemblance to the lungs, and was in all probability the first contrivance for artificial blowing. In the first instance, this instrument might be a simple bag, capable of distension by a mechanical force, the air being drawn in and pressed out of the same aperture in the manner of breathing. The first improvement upon this simple form would be to admit the air by a valve opening inwards when the bellows were distended, the blast outwards being from another aperture. This improvement consists in the air being admitted at a wider aperture, which fills the bellows in less time than would be required by the small pipe through which the air is allowed to escape. The blast, in this state of the machine, is not continuous, but in puffs, at intervals of time required for the air to enter the bellows through the valve; the blowing interval being to the filling interval as the areas of the apertures. This irregular blast was for some time remedied by employing two bellows which blew alternately, the blowing on one taking place while the other was filling. The inconvenience, however, was but partially remedied by this contrivance. The invention of what are called double bellows must have been considered a valuable acquisition in the art of blowing. But previous to describing these, it will be necessary to give a description of single bellows above mentioned.

Single bellows.

It will be needless, however, to say more than refer the reader to common domestic bellows, which are in every respect the same as the single bellows first used. The leather nailed to the upper and lower boards is prevented from collapsing, when the boards are separated, by a hoop of wood contained within, performing the office of the ribs in the sternum of animals, without which the breathing would not be performed. The lower board contains the valve which admits the air. When the two boards are separated, the air lifts the valve in entering the cavity. When full of air, the closing of the boards causes the air within to close the valve, thus preventing its return in that direction, and compels it to escape at the pipe, the mouth of which is called the nozle or nose-pipe.

Double bellows.

In order to conceive the construction of the double bellows, we have only to take a third board of exactly the same shape as the other two, and connect it with the lower board by a piece of leather similar to that of the single bellows, making two cavities exactly similar, and separated by the lower board of the single bellows, which now becomes the middle board of the double bellows. The third board we shall now call the lower board. This latter has a valve in it exactly similar to the first, which still retains its place in the new construction.

Blowing Machines.

The middle board is now fixed in a horizontal position, the pipe being placed to the fire to be blown. The lower board is held down by a weight, which keeps the lower cavity constantly full of air. The top board has a weight laid upon it, which presses all the air out of the upper cavity through the pipe.

The machinal action by which the blowing is performed is, first, to lift up the lower board. This forces the air from the lower into the upper cavity, the valve in the middle board preventing its return. The weight on the upper board now presses the air with a uniform blast through the pipe. During this time the lower board descends, which fills the lower cavity with air from the atmosphere; and this again rises and gives its contents to the upper cavity, and thence passes through the nose-pipe. Hence we see that that irregular puffing blast which belongs to the single bellows is here confined to the lower board, which supplies air to the upper cavity, while the upper board is constantly pressing uniformly upon the air in it. Although this is a considerable improvement upon the single bellows, it does not completely obviate the irregularity of the blast. So long as the lower board is not in action, the pressure on the upper board being uniform, the blast is the same. Every time, however, the bottom board rises to force the air into the upper cavity, an extra pressure is given to the air in the upper cavity, and a temporary puff is produced. In the application of bellows to the smith's forge, the continued blast was of less importance than in the blast-furnaces applied to the smelting or refining of ores. The single bellows are at present almost exclusively employed by anchor-smiths and cutlers; while the blacksmith and most others use double bellows, which are doubtless better for all purposes.

Wooden bellows.

In France and other parts of the Continent, bellows have been formed entirely of wood, instead of the flexible sides of leather, which serves to increase and diminish the capacity. The wooden bellows consist of two boxes, each open on one side, the one being just capable of containing the other; the outer box being placed with the mouth upwards, the other is made to descend into it with the mouth downwards, the latter being capable of moving up and down, while the other remains fixed. In the bottom of the fixed box is a valve like the common bellows, and a pipe on the same level to let out the blast. The change of capacity, by the motion of this box, causes the blast, and with less waste of power than that occasioned by the bending of the leather in the common bellows. This advantage is, however, probably more than compensated by the loss of air from the box not fitting on the sides. See a description of this and some other blowing-machines under Pneumatics.

Circular bellows.

The common smith's bellows have latterly been constructed of a circular form. The boards of these bellows are round, and the movable boards parallel to the horizon and to each other. We have given a view of this construction in Plate CVIII. figures 4 and 5. A is the blast-pipe, B the movable lower board, C the fixed board, into which the pipe is inserted, and D the upper movable board, on which is placed a weight to regulate the strength of the blast. Motion is given to the lower board by the lever L, and the chain H working on the roller R.

The form of these bellows being cylindrical, the weight required to produce a certain pressure and strength of blast will be easily determined. If the diameter be one foot, the area will be 113·19 inches. The most convenient and pro-

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per blast for smiths' bellows is about $\frac{5}{4}$ lb. upon the inch, or from that to $\frac{1}{2}$ lb. The upper board, in this case, would require a weight of 56·5 to give a blast equal to half a pound upon an inch. This pressure would give a velocity equal to about 207 feet in a second. If the diameter of the nose-pipe be changed, the number or length of the strokes, or both, must be changed, in order that the pressure and the corresponding density of the blast may remain the same. If the number and length of the strokes be kept up, and the aperture diminished, at the same time that the capacity of the bellows admits not of enlargement, the pressure and density of blast will be increased, although no additional weight be laid on. This frequently happens in the smith's bellows when he makes an increased effort to blow after the upper cavity is full. It is much better, however, not to exert the bellows in this way when a stronger blast is required, but to produce the effect by an additional weight. A very strong blast is found to be injurious to the iron when welding heats are required, and still more so in working steel. It is much better that an increase of air, which is frequently wanted, should be furnished by increasing the aperture, supposing the power to be at the time adequate to keep up the increased supply. Bellows should therefore be so constructed that the pressure may be uniform, and not immediately under the control of the workman. When he wishes to quicken his heat, he should have the means of increasing the aperture by a circular plate turning on an axis at right angles to the length of the pipe, as seen in fig. 9. When in the position *ab*, the whole area is filled; when in that of *cd*, the air passes in its full quantity. The index being placed at any intermediate points *ef*, will let in any proportionate quantity required.

The aperture might be made to change, by the increase of power upon the machine, and thus caused to regulate itself. Several simple contrivances of this kind may be applied by any one skilled in machinery.

New blowing machines.

These improvements would render the common leather bellows, of the form above given, very useful for smiths. The irregular blast occasioned by their present construction is found to be very injurious to the iron, both as to its quality and economy. This is abundantly shown in the use of some blowing machines lately invented, which have the advantage of a blast that is uniform, and at the same time much softer, being produced by a small pressure.

These blowing machines are also found to answer very well for melting cast iron, the soft blast having less tendency to destroy the carbon, and the quantity of air being compensated by increasing the aperture.

One of these machines is the invention of Mr Street, for which he took out a patent. It consists of a barrel-shaped vessel, from four to five feet in diameter, and of a length more or less proportionate to the work it has to perform.

This cylinder is supported on two bearers by the two ends of its axis, like a barrel churn. The cylinder is divided into two equal parts by a plane in the direction of its length, fitting the two ends and the upper side, water-tight, and extending downward to a small distance from the opposite side. This septum is in a perpendicular position when the cylinder is at rest. When this vessel is partly filled with water, and is made to pass through a certain space on its axis, the air which occupies the upper part of the vessel will be compressed on one side by the water, which flows from one side of the septum to the other, and will become in the same degree rarefied on the other, from a contrary cause. If, however, in this situation, a valve be made to open inwards from the atmosphere on the rarefied side, and another to open outwards on the condensed side, two equal and contrary currents will be established, one inwards and the other outwards On the returning stroke both these valves will shut, and the other two sides will be put in the same situation with the first cavities. If, now, two similar valves to the last be introduced, two similar currents will be produced. If the two valves at which the air escapes from the machine, one on each side of the septum, be made to communicate with one cavity from which a nose-pipe proceeds, while the other two valves communicate with the atmosphere, every stroke will discharge a quantity of air through the nose-pipe from one cavity, and introduce the same volume of air from the atmosphere into the other cavity. These strokes are produced by the oscillating motion of the machine, the limit of its vibrations being about a quarter of the circle, or 90°.

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These alternate puffs of air are first propelled into a vessel containing water to regulate the blast. This vessel is divided into two portions by a septum, which passes from the close cover at the top nearly to the bottom. When the air is forced into the cavity, which is close at the top, it expels the water under the septum at the bottom into the open cavity, so as to keep a constant head in the latter, compressing the air in the former. From this air-chest a nose-pipe proceeds to the fire, and the air escapes from it with a uniform velocity so long as the same column of water in the chest is preserved. This description answers to the first machine of the inventor; he has since taken out a second patent, the specification of which is given in the *Repository of Arts*, vol. xxviii. p. 193. We shall here give a description of this machine, with the patentee's improvements. See Plate CVIII. figs. 1, 2, and 3.

Fig. 1 is a longitudinal section of this machine. AB is the cylinder resting upon the axis *ab* and *cd*, which are supported on the uprights *gg*. The oscillating motion is given to it by a rod working upon the pivot *p*, the other end of which is connected with a crank of such a length as to cause the cylinder to move through an arch of 90 degrees. The vessel is filled with water to the height *ws*.

The part CBD (fig. 2) is cut off from the rest of the cylinder by two planes meeting at *c*, and continuing down to the axis *x*, so as to work upon its convex surface. These planes extend the whole length of the cylinder, and are then divided transversely into three cavities GHI, as seen in fig. 1. The cavity G is for the reception of the external air, and is called by the patentee a receiving box. The cavity H is open to the atmosphere, the periphery of the cylinder being removed in that part. The cavity I is appropriated to the air which is driven out of the machine, through the valves *tt* and *qq* (fig. 3), which open alternately on each side. The cavity G is divided longitudinally in the middle, forming two cavities, *m* and *n*, fig. 2; two valves, *e* and *f*, fig. 1, open into each, one from the end of the cylinder, and the other from the cavity H. Each of the cavities *m* and *n* communicate with the body of the cylinder by the holes *hh* in the dividing planes. The cavity I has no division, as it receives the air from both sets of exit valves, which escapes at the pipe P.

The axis *av* works within the axis *ab* and *cd*, and is rendered air-tight by a stuffing-box within the latter. This axis will have the effect of remaining at rest while the cylinder is in motion, there being no other force exerted to turn it than the friction of the stuffing-box. The use of this axis is to support and turn a swing valve MV, which is made of rolled iron, strengthened by ribs connected with the axis. This valve is a plane, which would exactly sweep the interior surface of the cylinder without touching it. If the axis *vx* be held fast, the valve will retain its perpendicular position, while the cylinder performs its vibrating motion. The water would also remain at

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rest, with the exception of the motion which its friction and the compression of the air occasions. When the machine moves from D (fig. 3) till the plane DC comes very near to the surface of the water *ws*, the valves *qq* open, and a volume of air equal to the space DCS will be expelled through the cavity I (fig. 1), along the pipe P, during the time the valves in the cavity *m* (fig. 2) have opened to admit the same volume of atmospheric air on the returning stroke. The point B is carried the contrary way, by which another portion of air opens the valves *tt* to pass through the pipe P, while the same volume of air from the atmosphere enters the cavity *n*, which in its turn is forced through the exit valves *tt*.

The use of the swing valve MV will now be obvious. If it did not exist, every time the air was compressed on one side the water would be depressed on that side, and the compression of the air would be limited by the increased column of water on the other side. This valve, however, prevents the water from immediately changing its situation, no more escaping from one side of the valve to the other than what can pass between the edges of the valve and the cylinder, which, in the short space of one stroke, can be only a very small quantity. This may be considered as a great improvement upon the first machine, which we have before described. The patentee further intends occasionally to give to this swing valve a contrary motion to that of the cylinder, and thus still more to increase the blast. Or, in the use of a very small blast, the valve may be left at liberty, and used merely to prevent the too great agitation of the water, which in the original machine was considered as an objection. Two of those machines are frequently used together, and worked by cranks, forming an angle of 45° with each other, to make the strong part of the blast of the one to concur with the weak part of the blast of the other.

The part I of the exit pipe PL, must be precisely to the centre of motion. The part L works in a stuffing part, or a ground socket connected with the pipe LN. The latter should communicate with a regulator, which the patentee does not describe, but recommends one of water. This may be a vessel at least of the capacity of the cylinder, inverted in a reservoir of water, and may stand near to the bottom. The pipe N is inserted into the bottom, which is now uppermost. The height of the water in the reservoir must be such as to give the required pressure to the air.

When the air is forced into the inverted vessel by the machinery, the water descends in this, and rises in the reservoir, which now gives a pressure to the contained air equal to the difference of the height of the water in the inverted vessel and the reservoir. The surface of the reservoir should be the greatest possible, in order that it may be raised in the least degree by the water coming from the inverted vessel, which will have the effect of keeping the blast more uniform.

The water regulator is certainly the best for smiths' bellows, for refineries, forges, and perhaps the common melting furnace, but they have been found very objectionable in the blowing of large blast-furnaces. The air in the common blowing engine undergoes a great increase of temperature during its passage through the machine, often as much as 40 or 50 degrees. The heated air has the effect of carrying a greater quantity of water along with it into the furnace, which destroys a larger quantity of carbon than the same bulk of common air, without producing an adequate portion of heat. A great part of the heat of the air is doubtless produced by the friction of the piston of the blowing cylinder, which, in this construction, has a very tight wading. In the blowing machine above described, the water would doubtless be an objection in blast-furnaces, but, as its little friction would not heat the air like the common blowing cylinder used in blast furnaces, the objection would be less formidable. Air must doubtless give out some heat by its decrease of volume, just as it will absorb the heat by rarefaction, as is experienced in exhausting the receiver of an air-pump. The converse of this is equally shown in the little instrument employed to kindle tinder by condensing the air within it.

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The heat by the friction of this piston is probably much more than by the condensation of the air; the latter is obviated in the machine above described, and in another blowing machine lately introduced, of which we shall give a description.

This machine, in its general appearance, does not seem to have any advantage over the common blowing cylinder, but in practice it is found superior.

It resembles in some degree the common smith's bellows of the Chinese, which consists of a square wooden trunk, in the form of a parallelopipedon. A board is made to fit pretty nearly its cross section, to which is attached a long rod, by which the board is pushed backwards and forwards like a piston. At one end of the trunk is a valve opening inwards to admit air, and at the same end is a pipe with a valve opening outwards.

The machine above alluded to as having some resemblance to this, is the invention of a Mr Vaughan, who has fitted up several of them for founderies, and they are much approved. The writer of this article took a drawing from one of these machines employed to melt cast-iron at the Phœnix Foundery in Sheffield.

Figs. 6 and 7 are two views of the machine. ABCD is a square box formed of pieces of cast-metal, screwed together by hinges. Two of these are placed side by side, as may be seen in the end view, fig. 7. MQ is a piston fitting the square box, which is drawn backward and forward by the rod EF, which works horizontally on the wheels *wx* by the spear G, which communicates with the crank of a wheel at a distance.

The piston MQ, which is the most ingenious part of this machine, is enlarged in fig. 8, to render it clearer. The body of the piston is a cast-iron plate about half an inch thick, with a socket in the middle to receive the rod. The diameter of this plate is about one fourth of an inch less than that of the box. Two pieces of wood, *v n*, are cut diagonally, in order to place the pieces of leather, *l l*, between them. These leathers, with the wood, are firmly fastened to the plate by bolts, such as *gh*.

The leathers extend about two inches beyond the wood; and their slight elasticity keeps them in contact with the metallic surface, which is not required to be very smooth. When the piston moves towards the end of the box, to which the leather projects, the leather claps close to the surface, rendering it air-tight, while the leather on the other side of the piston becomes loose, and has no friction. These leathers will be contrarily acted upon when the piston acts the contrary way. The projecting curved pipes HI form a communication between the box where the piston works and the air-chest N. When the piston moves from B to D, the valves F and V open, while L and S are shut. The air contained in the box is now forced through the valve R into the chest N, and from thence along the blast-pipe P.

In the returning stroke, which is the whole length of the box, the valves R, V, and K, are shut, while L and S open. The air is forced through H to N, and then through P.

Two of these work at the same time by two cranks, which cause one to be in full blast at the time the other is returning the stroke; so that, with due management,

Blubber || Blücher.

the four puffs produced by two double strokes may be made to succeed each other at equal intervals, which almost amounts to a steady blast. The inventor recommends four of these boxes all to work together, which would produce eight puffs in the time of one double stroke, which, if divided into equal intervals, would produce a sufficiently uniform blast for any purpose.

When the leathers of the piston are rubbed with black lead, the friction amounts to almost nothing. The leather acts so easy to the surface, and is so flexible, that it may be very easily raised with the fingers. This could not be the case if it were applied in the same way in a cylinder; and this is a sufficient reason for using the square box instead of the cylinder.

This machine makes 70 strokes in one minute; the nose-pipe, where the blast enters the furnace, is $2\frac{1}{2}$ inches in diameter. When the length of stroke is the greatest, at the above speed, it furnishes about 1200 cubic feet per minute.

This machine steers clear of the objection of the water, and, from its small friction, will have less tendency to heat the air. Its original cost is also less than any other machine yet constructed. In the situations where it has been adopted it gives the highest satisfaction. The first construction of Street's bellows, above described, was only fitted for some smiths' fires, where a very soft blast was required. In their improved state they may be employed for most purposes.

All the calculations relative to bellows will be easily made, by the following rules and formula:

First, get the space or capacity formed by one stroke of the machine; call this c, cubic feet.

Then get the number of strokes per minute, which call n.

The area of the nose-pipe, in feet, call a.

The pressure on the air to be discharged, whether by a column of water or by a weight, call p.

v = the velocity with which the air escapes.

r = the resistance, in pounds, which the blast will give.

Then $cn = q$, the quantity discharged in one minute, and $v = \frac{cn}{a}$ in one minute, or $= \frac{cn}{60\,a}$ for one second.

Then, since the resistance is equal to a column of the fluid of the area a, and twice the height to give the velocity, $\frac{v^2 a}{32 \times 14} = p$; the weight of 14 cubic feet of air being equal to one pound.

The energy of air in blowing fires is as the quantity, and inversely as the space it occupies. For if the same quantity of air be consumed in half the space, the intensity of the heat, or the temperature of that particular place, will be double. Hence it is found that the same quantity of air, by weight, in winter will produce a greater effect on a blast-furnace than in summer, merely from the difference of density. The great difference in produce of iron in the cold and hot seasons of the year is a fact notorious to iron-masters. For a description of the more recent and improved method of blowing, see Iron-making, and Smelting. (C. S—R.)

BLUBBER, the fat of whales and other large sea-animals, from which train-oil is extracted. It is properly the *adeps* of the animal, and lies immediately under the skin. In the whale its thickness is ordinarily six inches, but about the under lip it is found two or three feet thick. The quantity yielded by one of these animals usually amounts to from 20 to 30 tons of blubber, yielding from 15 to 22 tons of oil.

BLÜCHER, Lebrecht von, field-marshal of the Prussian armies, Prince of Wahlstadt in Silesia, was born at Rostock in 1742. In his fourteenth year he entered into the service of Sweden; and in the war between that power and Prussia he was taken prisoner. He afterwards entered into the service of Prussia, in which he became distinguished by his activity; but conceiving himself neglected by the great Frederick, he became a farmer in Silesia, and by his enterprise and perseverance in fifteeen years he acquired an honourable independence. On the accession of Frederick-William II., he was recalled to the military service, and replaced as major in his old regiment, the Black Hussars, where he distinguished himself in six general actions against the French, rose to the rank of colonel and major-general in 1793–4, and gained a great reputation by his energy, promptitude, and foresight. He was in a subordinate command in the disastrous battle of Jena in 1802; but he made a masterly retreat with his column to Lubeck; and extorted the praises of his adversaries, who testified on his capitulation that it was caused by "want of provisions and ammunition." He was soon exchanged for General Victor, and was actively employed in Pomerania, at Berlin, and at Königsberg, until the conclusion of the war. When Prussia shook off the French yoke in 1813, he first obtained a separate command; and at the head of 60,000 troops, chiefly composed of raw militia, he defeated four French marshals at Catsbach; and rapidly crossing the Elbe, materially contributed to the signal victory of Leipzig. In several severe actions he fought his way to Paris, which he entered on 31st March 1814; where it has been stated, that but for the intervention of the other allied commanders, he was disposed to make a severe retaliation for the calamities that Prussia had suffered from the armies of France. Blowing up the *Bridge of Jena* over the Seine, was said to be one of his contemplated acts. When war again broke out in 1815, the veteran was at the head of the Prussian armies in Belgium, and exhibited his wonted enterprise and activity. But partly owing to his own confidence and temerity, partly to the skilful strategy of his celebrated opponent, he was defeated in the severe battle of Ligny on 16th of June; yet, with his characteristic spirit and energy, Blücher rallied his defeated forces, and appeared on the field of Waterloo on the 18th, just as Wellington had repulsed the last attack of Napoleon on the British position. At that critical moment Blücher was seen emerging from the wood of Frichemont on the French right; and the simultaneous irresistible charge of the British forces converted the retreat of the French column into a tumultuous flight, followed by that of the mighty victor on a hundred well-fought fields. The allied commanders met at a chateau called La Belle Alliance. The pursuit was continued through the night by sixteen fresh Prussian regiments with terrible carnage. The allies soon again entered Paris, where Blücher remained for several months; but the health of the aged commander having declined, he retired to his Silesian residence at Kirblowitz, where he died on the 12th of September 1819, aged seventy-seven. (T. S. T.)

Blue || Blueing.

BLUE, one of the seven colours into which the ray of light is decomposed when refracted through a glass prism. See Chromatics.

Blue-John, a name applied by the Derbyshire miners to the massive variety of fluorspar from the Odin mine near Castleton, which is fabricated into vases and other ornaments.

Blue Vitriol, the sulphate of copper; a salt of a fine blue or bluish-green colour, containing 32·13 per cent. of copper, 31·57 of sulphuric acid, and 36·30 of water. It is employed as an escharotic and astringent, and in the arts it is used in dyeing, cotton-printing, and the like. It owes its existence in nature to the decomposition of other minerals, particularly copper pyrites; and, after having undergone the process of purification, forms regular crystals of a blue colour. It reddens litmus paper, and is soluble in about four parts of cold and two of boiling water. Its chief localities are the Rammelsberg near Goslar, in the Hartz; Anglesea in England; and Fahlun in Sweden.

Blueing *of Metals* is the process of heating them in the

Bluff-Headed || Blumenbach.

fire till they assume a blue colour. The blueing of iron is done thus: A piece of grindstone or whetstone is rubbed hard on the work to take off the black scurf; the iron is then heated in the fire, and as it grows hot the colour changes by degrees, becoming first of a light, then of a darker gold colour, and lastly blue. Sometimes also indigo and salad-oil are ground together, and the mixture rubbed on the work with a woollen rag while it is heating, after which it is left to cool. Among sculptors is used the term blueing a figure of bronze, by which is meant the heating of it, to prepare it for the application of gold leaf; and it is so called because of the bluish cast the metal acquires in the operation.

BLUFF-HEADED, a term applied by sailors to a ship with an upright stem. It is the opposite of sharp-headed.

BLUMENBACH, JOHANN FRIEDRICH, M.D. This most distinguished man was born at Gotha on the 11th of May 1752. He studied medicine at Jena, and afterwards at Göttingen, where he took the degree of physician in 1775. His thesis on that occasion *De Generis Humani Varietate Nativa*, published in quarto, was the germ of those craniological researches to which so many of his subsequent inquiries were directed; and such was the opinion entertained of his acquirements, that he was appointed an adjunct or extraordinary professor of medicine in the following year, and ordinary professor in 1778; soon after which period he began to enrich the pages of the *Medicinische Bibliothek*, of which he was editor from 1780 to 1794, with various contributions on medicine, physiology, and anatomy. In physiology he was of the school of Haller; and was in the habit of illustrating it by comparing the animal functions of man with those of the inferior creation. He obtained a well-merited reputation by the publication of his excellent *Institutiones Physiologicæ*, a condensed, well-arranged view of the animal functions, in which the reader is supposed to be sufficiently acquainted with anatomical details to render such unnecessary. This work appeared in 1787, and between its first publication and 1821 went through many editions in Germany where it was the general text-book of the science. It was translated into English in America, by Caldwell in 1798, and in London by Elliotson in 1807.

Blumenbach was perhaps still more extensively known by his admirable *Handbuch* of Comparative Anatomy, of which the German editions were numerous, from its appearance in 1805 to 1824. It was translated into English in 1819, by our eminent surgeon Lawrence, the legitimate successor of Hunter in comparative anatomy; and again, with the latest improvements and additions, by Coulson in 1827. This Outline of Blumenbach, though slighter than the subsequent works of Cuvier, Carus, and other writers, will always be esteemed for the accuracy of his own observations, and his just appreciation of the labours of his predecessors.

One of our author's favourite works is *Decades Collectionis suæ Craniorum Diversorum Gentium*, in which accurate though slight delineations of the skulls in his noble collection are given, with brief descriptions of each. It appeared in *fasciculi*, until sixty crania were represented; exhibiting in a striking manner the peculiarities in form of the skulls of diverse nations, and justifying the division of the human race into several great varieties or families, of which five are most generally received—the Caucasian or white race, the Mongolian or Tätar, the Malayan or brown race, the Negro or black race, and the American or red race, though some have identified this race with the Mongolian.

Although the greatest part of Blumenbach's long life was passed at Göttingen, in 1789 he found leisure to visit Switzerland, and gave a curious medical topography of that country in his *Bibliothek*. He was in England in 1788 and 1792. The Prince Regent conferred on him the office of physician to the royal family in Hanover in 1816, and made him knight companion of the Guelphic order in 1821. The Royal Academy of Paris adopted him as a member in 1831. This eminent philosopher died at Göttingen on the 22d of January 1840. (T. S. T.)

Blunderbuss || Boar.

BLUNDERBUSS, a short fire-arm of a large calibre, widening towards the muzzle, and adapted for discharging many bullets at once.

BLUSHING, a sudden suffusion or redness of the cheeks, excited by a sense of shame, confusion, or surprise, or by the consciousness of some failing or imperfection, real or imaginary.

Blushing is supposed to be produced by a kind of sympathy between several parts of the body, occasioned by the same nerve being extended to them all. Thus the fifth pair of nerves being branched from the brain to the eye, ear, muscles of the lips, cheeks, palate, tongue, and nose, a thing seen or heard that is shameful covers the cheeks with blushes, driving the blood into the minute vessels there dispersed, and also affecting the eye and ear in a similar manner. For the same reason it is, that a savoury thing seen or smelled affects the glands and parts of the mouth; that if anything pleasing be heard, the muscles of the face are affected with laughter; and that if it be melancholy, it affects the glands of the eyes, and occasions weeping.

BO, a cluster of six or seven islands in the Eastern Seas, lying E.S.E. of the southern extremity of Gilolo. They are inhabited, and supply navigators with cocoa-nuts. Long. 126. 25. E. Lat. 1. 27. S.

BOA. See REPTILIA, *Index*.

BOADICEA, a valiant British queen in the time of the emperor Nero. She was the wife of Prasutagus, king of the Iceni, a people inhabiting the eastern coast of Britain. On his deathbed, A.D. 60, Prasutagus named the emperor heir to his accumulated treasures conjointly with his own two daughters, in expectation of securing thereby Nero's protection for his family and people; but he was no sooner dead than the emperor's officers seized all. Boadicea's opposition to these unjust proceedings was resented with such cruelty, that orders were given that she should be publicly whipped, and her daughters exposed to the brutality of the soldiers. The Britons took up arms, with Boadicea at their head, to shake off the Roman yoke; and the colony of Camalodunum or Colchester was taken, and the Romans were massacred wherever they could be found. The whole province of Britain would have been lost to Rome, if Suetonius Paulinus had not hastened from the Isle of Mona or Man to London, and at the head of 10,000 men engaged the Britons, who are said to have amounted to 230,000. A battle was fought with great obstinacy on both sides, and for a time with doubtful success, but at last victory inclined to the Romans. This conflict took place A.D. 62. Boadicea, who had displayed extraordinary valour, soon after despatched herself by poison. (Tac. *Ann.* xiv., *Agric.* 15–16.; Dion Cass. lxii.)

BOAR, a term in the manège. A horse is said to boar when he shoots out his nose as high as his ears, and tosses his nose in the wind.

BOAR, a male swine. See MAMMALIA.

The wild boar, among huntsmen, has several names, according to his different ages. The first year he is called *a pig of the saunder*; the second, *a hog*; the third, *a hog-steer*; and the fourth, *a boar*. When leaving the saunder, he is called a *singler* or *sangler*. The boar generally lives to the age of twenty-five or thirty years, if he escape accidents. The time of rutting is in December, and lasts about three weeks. Wild boars feed on all sorts of fruits, and on the roots of many plants. The root of fern in particular seems a favourite with them: and when they frequent places near the sea-coast, they descend to the shores, and demolish the tenderer shell-fish in very great numbers. Their general places of rest are among the thickest bushes that can be found; and they are not easily induced to break cover, but will stand at bay a long time. In April and May they sleep

more soundly than at any other time of the year; and this is therefore the successful time for taking them in the toils. When a boar is roused out of the thicket, he always leaves it, if possible, by the same way which he entered it; and when he is once up, he will never stop until he reaches some place of greater security. If a saunder of them be found together, and any of their number break away, the rest follow in the same track. When the boar is hunted in the wood where he has been bred, he can scarcely ever be brought to quit it; sometimes indeed he makes towards the sides to listen to the noise of the dogs, but he retires into the middle again, and usually dies or escapes there. When a boar happens to run a-head, he will not be stopped or put off his way by man or beast, as long as he has any strength left. He makes no doubles or crossings when chased; and, if old, utters no sound when killed, though the sows and pigs will squeak when wounded. At his full strength he is one of the most resolute and courageous of animals. His prevailing impulse is to close with his antagonist. When fairly at bay he never shrinks from any contest, however unequal; and, although mortally wounded, he will nevertheless maintain the combat with the most unflinching bravery to the last.

The hinder claws of a boar are called *guards*. In the corn he is said to *feed*; in the meadows or fallow-fields, to *rout*, *worm*, or *fern*; in a close, to *graze*. The boar is farrowed with his full complement of teeth, which afterwards increase in size, but not in number. Amongst these there are four called *tushes* or *tusks*, the two largest of which do not hurt when he strikes, but serve only to whet the other two, with which the beast defends himself, and frequently kills his assailant.

BOAT, a small open vessel, propelled on the water by oars or sails. The construction, machinery, and even the names of boats, are very different, according to the various purposes for which they are intended, and the services on which they are to be employed. Thus they are occasionally slight or strong, sharp or flat-bottomed, open or decked, plain or ornamented; as they may be designed for swiftness or burden, for deep or shallow water, for sailing in a harbour or at sea, and for convenience or pleasure. The largest boat that usually accompanies a ship is the *long-boat*, which is generally furnished with a mast and sails. Long-boats fitted for men-of-war are occasionally decked, armed, and equipped, for cruising short distances against merchant ships of the enemy, or smugglers, for impressing seamen, and other services. The *barges*, which are next in order, are longer, slighter, and narrower. They are employed to carry the principal sea-officers, as admirals and captains of ships of war, and are unfit for the open sea. *Pinnaces* exactly resemble barges, but are somewhat smaller, and have never more than eight oars; whereas a barge properly never rows less than ten. The *cutters* of a ship are broader, deeper, and shorter, than the barges and pinnaces: they are fitter for sailing, and are commonly employed in carrying stores, provisions, passengers, and the like, to and from the ship. In the structure of this sort of boat the lower edge of every plank in the side overlays the upper edge of the plank below, which is called by ship-wrights clinker-build. *Yawls* are somewhat less than cutters, nearly of the same form, and used for similar services. They are generally rowed with six oars. The above boats more particularly belong to men-of-war. Merchant-vessels above 150 tons have at least two, a long-boat and yawl. Merchant-ships employed in the Mediterranean find it more convenient to use a *launch*, which is longer, flatter in the bottom, and better adapted every way to the harbours of that sea, than a long-boat. A *wherry* is a light, sharp boat, used in a river or harbour for carrying passengers from place to place. *Punts* are a sort of oblong flat-bottomed boats, nearly resembling floating stages. They are used by ship-wrights and caulkers, for breaming, caulking, or repairing a ship's bottom. It is also the name for the smallest boat of yachts, &c. A *moses* is a very flat, broad boat, used by merchant-ships among the Caribbee Islands, to bring hogsheads of sugar off from the sea-beach to the shipping anchored in the roads. A *felucca* is a strong passage-boat used in the Mediterranean, and propelled with oars and lateen sails. The *pirogue* of the southern and eastern seas is a kind of canoe made of the trunk of a tree hollowed out. It is generally worked with paddles, but sometimes it is decked and furnished with sails and an outrigger. The *proa*, so much used by pirates in the Eastern Archipelago, is sharp at both ends, in order to sail either way. Its lee-side is rounded, but the weather-side is flat, and provided with an outrigger to secure its stability.

BOAT-BILL. See ORNITHOLOGY, *Index*.

BOATSWAIN, the officer in a ship who has the charge of the boats, sails, rigging, colours, anchors, cables, and cordage. It is also the duty of this officer to summon the crew to their duty; to assist with his mates in the necessary business of the ship; and to relieve the watch when its time expires.

He has a mate who has the charge of the long-boat, for setting forth anchors, weighing or fetching home an anchor, warping, towing, or mooring.

BOBBIN, a small cylinder of wood, with a little border or head at each end, and bored through to receive an iron pivot. It is used in spinning, to wind thread, worsted, hair, cotton, silk, gold, and silver.

BOBBING, among fishermen, a method of catching eels, different from sniggling. To bob for eels, a number of large lobs are well scoured, and a twisted silk thread is run through them from end to end with a needle: they are then tied fast with the two ends of the silk thread, that they may hang in so many hanks; after which the whole mass is attached to a strong cord, with a plummet fixed a little above the worms to sink the bait, and the cord is made fast to a strong pole. This apparatus is thrown into muddy water: the eels tug lustily at the bait; the rope is then to be drawn in gently, and the eels are brought ashore.

BOBLINGEN, a town of Wirtemberg, in the circle of Neckar, and capital of a bailiwick of the same name. It is situated upon the declivity of a hill, 11 miles S.W. of Stuttgardt. Pop. 3300, engaged in the manufacture of woollen goods, vinegar, beer, aquafortis, and chemicals.

BOBSTAYS, the ropes which secure the bowsprit of a ship against the upward strain.

BOCA-CHICA, the strait or entrance into the harbour of Carthagena in South America. It is defended by several forts belonging to the Spaniards, all of which were taken in 1741 by the English; who were obliged, however, to raise the siege of Carthagena a short time after.

BOCAYRENT, a town of the province of Valencia, in Spain. It contains 4074 inhabitants, who are remarkable for their industry in the manufacture of linen and woollens, of cordage, soap, paper, and brandy.

BOCCACIO, or BOCCAGE, GIOVANNI, one of the most gifted and learned writers of his age, whose name alone, according to Mazzuchelli, is worth a thousand eulogiums, was born in 1313. His father was a merchant at Florence, where the pursuits of commerce were held in the highest estimation. His family came originally from Certaldo, a village situated about 20 miles from the capital of Tuscany; for which reason he generally subjoined to his name the words *da Certaldo*. Boccacio was not, therefore, the son of a peasant, as has been asserted in the *Dictionnaire Historique*. He appears to have been the illegitimate offspring of a connection which his father had formed while at Paris, having been called thither by some commercial affairs; and it was in the French capital that the illustrious author of the *Decameron* first saw the light. Conveyed at an early period to Florence, he commenced his studies, and, from his tenderest years, evinced a decided taste for poetry; but he had scarcely attained

 the age of ten when his father placed him in the house of another merchant, with the view of training him up to commerce. Several years afterwards this merchant took him to Paris, and kept him in all six years in his house; but failing to inspire his charge with a taste for the mercantile profession, to which the latter gave only a reluctant and compulsory attention, he sent the youth back to his father. At Florence, as at Paris, Boccacio was divided between occupations for which he felt nothing but repugnance, and a taste for letters which went on increasing daily. And this taste received a fresh stimulus at Naples, to which he had been sent with the view of withdrawing him from such pursuits, and attaching him definitively to the mercantile profession. He remained there eight years, and instead of associating only with merchants, he established an intimacy with several learned men, Florentine as well as Neapolitan, whom the favour of King Robert, the friend and patron of letters, had drawn to his capital. There is no evidence whatever of Boccacio having personally experienced the kindness of Robert; but he appears to have excited a tender interest in the bosom of the king's natural daughter, for whom he composed several works both in prose and verse, and whom he often designates by the name of Fiammetta. Endowed with all exterior advantages, of a lively and joyous disposition, possessing an amiable and yielding character, and the favoured lover of the daughter of a king, it is not surprising that he should have then felt less inclination than ever for mercantile occupations and pursuits. The sprightly taste of the princess, the intimate companionship of men of letters, the impression made upon him in a walk near Naples by the tomb of Virgil, the presence of Petrarch, who was treated with the most marked distinction by the court, being then about to proceed to Rome, there to receive the laurel crown, and probably, also, his first intercourse with this celebrated man, whose intimate friend and associate he was afterwards to become,—all contributed to strengthen his natural inclination, and to decide his vocation as a literary man and a poet.

After a residence of two years with his father at Florence, he returned to Naples, and was favourably received by the queen, Jane; and it is believed that it was as much to gratify the young queen as his dear Fiammetta, that he began the Decameron, or collection of a hundred tales, which places him, without a rival, in the first rank of Italian prose-writers. Having lost his father, and being thus at liberty to follow his own inclination, he went to settle at Florence, where his studies suffered no interruption except what was occasioned by pleasure, and some honourable missions with which he was charged by his fellow-citizens. Among other offices of this kind, he was the person selected to go to Padua, and carry to Petrarch the intelligence of his recall, and of the restitution that had been made of the property of his father, who, formerly banished from Florence, had since died in exile; and it was in the execution of this mission that he formed with his illustrious contemporary that close and intimate friendship which only ceased with their lives. Some years afterwards, having involved himself in embarrassments by his expenditure in the purchase of books and his taste for pleasure, he was generously relieved by Petrarch, who not only afforded him pecuniary aid, but gave him good counsel both as to his works and his conduct, and was mainly instrumental in bringing about the change which subsequently took place in his habits and character. A course of pleasure or dissipation is sure, sooner or later, to terminate in satiety, ennui, heart-sickness, and remorse; and when this crisis actually comes on, the presence and counsels of a tender and judicious friend may not only serve to check the moral re-action before it proceeds too far, but may also give a new and salutary direction to the mind and feelings of the penitent. Petrarch performed this important office to his friend. The exhortations of a Carthusian monk had at first inspired the latter with an extravagant scheme of reform, being nothing less than an entire renunciation of the world, and of those studies which are denominated profane; but Petrarch brought him back to better views, and kept him steadily in that just medium which is the position recommended by true wisdom.

Some new troubles having about this time broken out in Florence, Boccacio withdrew to Certaldo, where he possessed a small estate, in order to continue his pursuits in tranquillity. Hitherto he had only written in the vulgar tongue, and produced works of mere amusement; but now he composed several, which he wrote in Latin, on subjects of erudition and history; and one of these treatises is the first modern work in which a collection was made of all the mythological notions which are scattered throughout the writings of the ancients. He knew Greek very well, having brought, at his own expense, from Venice to Florence, Leontius Pilatus of Thessalonica, and entertained him for three years, in order to learn of him that language, to read with the learned refugee the Iliad and the Odyssey, and to translate both from beginning to end into Latin. He had also the glory of procuring from Greece, at his own expense, copies of these immortal works; nor did his zeal in the cause of classical learning stop here; for he spared neither pains nor expense in order to obtain good Greek and Latin manuscripts, and employed all his influence to induce his contemporaries to learn Greek, and to substitute the study of antiquity for that of the scholastic sciences, which alone had hitherto been encouraged. Auspicious for the cause of true learning, these efforts added to the reputation and authority of Boccacio. He was twice charged with important embassies from the republic of Florence to Pope Urban V., and executed them in a manner creditable to himself and satisfactory to his countrymen. He then returned to Certaldo, and resumed his favourite studies; but a long and grievous malady, with which he was now attacked, reduced him to a state of languor and depression more painful than even the disease itself. On recovering somewhat, he undertook a difficult, but to him most agreeable, task. He had always been an ardent admirer of Dante; he knew by heart nearly the whole of his poem, and had copied it several times with his own hand. The Florentines, who had persecuted and exiled this great poet, wishing now to honour and vindicate his memory, instituted, by a decree of the senate, a public chair for the explication of this poem, which, although it contained many sublime things, was nevertheless filled with obscurities and difficulties, certain to increase with the progress of time, and in proportion as we are removed from the period in which the author wrote; and it was on Boccacio that they conferred the new professorship. But the efforts which he made to fulfil the expectations of his countrymen retarded his convalescence; the death of Petrarch, his master and friend, which took place at this time, and was suddenly communicated to him, proved a stunning blow; he became daily weaker and weaker; and in little more than a year he died at Certaldo, on the 21st December 1375, in the sixty-second year of his age.

Boccacio was indeed born a poet; he was so in all his works of imagination, at least in invention if not in style. All that he has written in verse is mediocre; several of his Italian works in prose are also poor enough. He is only superior and inimitable in his novels, of which nevertheless he made small account. Like his master Petrarch, he believed that his serious works, written in Latin, formed his best title to fame; yet his reputation rests exclu-

Boccacio. sively on a simple collection of tales, as that of Petrarch does on his amatory verses. Every thing he has written in Latin bears a character of crude precipitation, which, however, is less the effect of negligence in the author, than of those difficulties and obstacles which were then opposed to the composition of such works. In his youth he had flattered himself with the idea of obtaining the second place in poetry by his verses; his admiration of Dante did not allow him to aspire to the first; and the Italian poems of Petrarch were as yet unknown to him. But as soon as he became acquainted with the latter, he threw into the fire the greater part of his lyric verses, sonnets, canzoni, and other amatory poems; and those which have since been published are merely such as, in spite of himself, escaped this act of severity. But the fortunate result of his disgust with his poetical productions was to induce Boccacio to write with greater care in prose, and to give to his language a perfection, rhythm, harmony, and elegance in the *tournure* of expression, which it had hitherto wanted, and which Italian, with all its capabilities, has never attained to the same degree in the hands of any other writer. His style may be characterized in two words; it is *simplex munditiis;* grace, elegance, and simplicity combined are its peculiar attributes; and so skilfully is the art of the writer concealed in the very perfection of his work, that while the charm diffused over it proves irresistible to readers of every class, it seems a spontaneous emanation of his mind, the result of mere volition, without labour, without effort, and without premeditation. The following is a tolerably correct list of the works of Boccacio:

1. *De Genealogia Deorum libri* xv. *De Montium, Sylvarum, Lacuum, Fluviorum, et Marium nominibus, liber.* The first edition of these two works united is in folio, without date, but it is supposed to have been printed at Venice prior to 1472, which is the date of the second edition. A third was printed the following year, and there have since been several at Venice, Paris, and Basel. The treatise on the *Genealogy of the Gods* was the fruit of immense reading; and as there existed at that time no similar work in which information might be obtained respecting the mythology of the ancients, its success was prodigious. In this production Boccacio cites several authors no longer extant, and derives from them particulars which are only to be found in his book. This work, translated into Italian by Joseph Betusi, has gone through twelve or thirteen editions, the first being that of Venice, 1574, in 4to. There are also two French translations; the first at Paris in 1498, in folio, reprinted in 1531, also in folio, and the second at Paris in 1578, in 8vo. The little *Treatise on Mountains, Forests, Lakes, Rivers, and Seas,* has also been translated into Italian; it is in quarto, but without date or name of place.

2. *De Casibus Virorum et Fœminarum Illustrium, libri* ix. The Paris edition of this treatise is in folio, and dated 1535, 1544. It was translated into Italian by Betusi, Venice, 1545, 8vo; into English by John Ludgate, London, 1494, folio, reprinted in the same form in 1527; into Spanish by D. Pedro Lopez de Ayala, and D. Juan de Zamora, Seville, 1495, Toledo, 1511, folio; into German by Jerome Ziegler, Augsburg, 1545, folio; and several times into French, first by an anonymous translator, Bruges, 1476, folio; next by Laurens du Premier-fait, Paris, 1483, folio, and at Lyons the same year; and, lastly, by Claude Witard, Paris, 1578, 8vo.

3. *De Claris Mulieribus.* The first edition is without date or name of place; the second was published at Ulm in 1473, and, like the first, is in folio. The work was translated into Italian by Vincent Bagli, a Florentine, Venice, 1506, 4to, and by Joseph Betusi, who made several additions, and prefixed a life of Boccacio, Venice, 1545 and 1547, 8vo. There are also Spanish, French, and German versions. Boccacio.

4. *Eclogæ.* These eclogues, sixteen in number, were printed, along with those of Virgil, Calphurnius, Nemesianus, Petrarch, and Gauricus, at Florence in 1504, and again at Basel in 1546, in the *Bucolicorum Autores.*

5. *La Teseide,* the first Italian poem which presents a specimen of the epopee. It is written in the *ottava rima,* of which Boccacio is usually considered as the inventor. Ferrara, 1475, folio; Venice, 1528, 4to; Paris, 1597, 12mo, a French translation.

6. *Amorosa Visione,* Milan 1520 and 1521, in 4to, with grammatical observations, and a defence of Boccacio by Claricio d'Imola, Venice, 1531, 8vo.

7. *Il Filostrato,* a romantic poem in *ottava rima,* the hero of which is the young Troilus, son of Priam, and the subject his amours with Chryseis, whom the poet makes the daughter of Chalcas, Bologna, 1498, 4to; Milan, 1499, 4to; Venice, 1501 and 1528, 4to.

8. *Nimfale Fiesolano,* a poem also in the *ottava rima,* in which, under the veil of pastoral fiction, Boccacio is supposed to give an account of a gallant adventure which occurred at Florence in his time. Venice, 1477, 4to; Paris, Molini, 1778, 8vo.

9. *Rime,* or poems on various subjects, being such as escaped the flames when the author resolved to burn all his verses. They have been several times collected; but Baldelli's edition, printed at Leghorn in 1802, is the best.

10. *Il Filocopo, ovvero Amorosa Fatica,* &c. a romance, written by the author when very young, and wholly devoid of interest. It is unconscionably long, and desperately tedious; and the style, which is sometimes flat and at other times bombastical, gives no promise of that purity of diction which Boccacio afterwards attained. Venice, 1472, folio; Milan, 1476 and 1478, folio; Venice, 1514, 4to; Paris, 1542, folio, and 1555, 8vo.

11. *L'Amorosa Fiammetta,* another romance, in no degree superior to *Il Filostrato.* Padua, 1472, 4to; Venice, 1481, 4to; Paris, 1585, 1609, 12mo.

12. *L'Urbano,* Florence, 1598, 8vo; translated into French under the title of *Urbain le Mescogneu,* Lyons, without date.

13. *Ameto* or *Nimfale d'Ameto,* a work written in prose, intermixed with verse, and the earliest specimen of this kind of composition. Rome and Venice, 1478, 4to; Treviso, 1479, 4to; Venice, 1503, folio; Florence, 1521, 8vo.

14. *Il Corbaccio, o sia Laberinto d'Amore,* a bitter and coarse invective against some female who had displeased him after his return to Florence. The indecency of this production is abominable, but the purity and beauty of the style have caused it to be sought after. Florence, 1487, 4to; Venice, 1516, 24to, and 1528, 8vo; Paris, 1569, 8vo.

15. *Origine, Vita et Costumi di Dante Alighieri,* Rome, 1544, 8vo; Florence, 1576, 8vo. In this life of Dante Boccacio shows himself more of a romancer than a biographer; but it is nevertheless interesting on account of several curious anecdotes it contains, and also by reason of the style, which is every way worthy of Boccacio.

16. *Commento sopra la Commedia di Dante Alighieri,* an invaluable work, containing a great number of explications of difficult passages in Dante, although almost suffocated by a multitude of details foreign to the intelligence of the text. This commentary, which embodies the lessons delivered publicly by Boccacio at Florence, when he was attacked with the malady of which he died, was not printed till the eighteenth century. It extends only to the 17th chapter of the *Inferno,* and occupies the two last volumes of the collection of Boccacio's works in Italian prose, published at Naples, with the false imprint of Florence, in 6 vols. 8vo, 1724.

Boccale ‖ Boccalini.

17. Lastly, *Il Decamerone*, Boccacio's principal title to immortality, and of all works extant, that, perhaps, of which it is the most difficult to convey a tolerably accurate idea in few words. To regard it merely as a collection of gallant and licentious tales, is to entertain a very false notion indeed of this extraordinary work. The greater part of the poets, it is true, who have borrowed from this source, have indeed taken little else from it than licentiousness; but it is their fault more than that of the author, if their draughts have been so confined. In the Decameron, Boccacio has painted, as on an immense canvass, men of all conditions, of all characters, of all ages; and described events of every kind, from the freest and the gayest to the most touching and the most tragical. He has also given models of all sorts of eloquence, and carried his language to a pitch of perfection unknown before his time, and unrivalled since. For three centuries after it appeared it was constantly reprinted, and more than a hundred different editions might be enumerated, to say nothing of translations into every language of Europe which is connected with an independent literature. At the same time it has experienced singular vicissitudes. From the date of the first edition in 1470, liberties of every kind were taken with the text, particularly in the more licentious parts, which led to its prohibition by two popes, Paul IV. and Pius IV.; some academicians also undertook to reform the Decameron; important corrections as well as suppressions were made; and several editions, thus amended, appeared. But in order to judge of the work as it proceeded from the hand of Boccacio, we must revert to the older editions, or to those which have followed them. The rarest and dearest is that of Florence, 1527, in 4to. Of this, however, an exact copy was printed at Venice in 1729, but bearing at the end the name of Florence and the date of 1527. It is nevertheless easily distinguishable by those marks which are known to bibliographers. The curious ought to have, also, for comparison, the edition amended by the Florentine academicians, conformably to the orders of the grand duke of Tuscany, and approved by Gregory XIII. It will show, on the one hand, to what a state the masterpiece of Boccacio had been reduced; and, on the other, excite surprise at the remnants of the old interpolations which are preserved, and invested with the pontifical sanction. This edition was printed at Florence in 1573, in 4to. The edition of Salviati, who undertook a new reform, appeared at Venice in 1584, in 4to. In both these reformed editions, the portion of the text respected and left untouched is of extreme purity. It would be endless to attempt an enumeration of other editions, or of the translations which have been made into different languages. (*Biographie Universelle, Crescembeni.*) (J. B—E.)

BOCCALE, or BOCAL, a liquid measure used at Rome, equivalent to about an English quart.

BOCCALINI, TRAJAN, born at Loretto A.D. 1556, a celebrated satirical writer who obtained the admiration of all Italy by his refined and delicate criticisms. His profession was architecture; and it appears that he commenced rather late in life to supply the deficiencies of a neglected education. Pursuing his studies at Rome, he there acquired the friendship of several distinguished persons, and through their influence was appointed governor of a small town in the Papal States; from which, however, he was soon recalled for mal-administration. Returning to Rome, he wrote his celebrated *Ragguagli di Parnaso*, in which Apollo is represented as holding his court on Parnassus, receiving the complaints of the whole world, and distributing justice according to the exigencies of each particular case. This work, which was a satire on the lives, actions, and writings, of eminent individuals, was published at Venice, whither the author had retired, to escape, it is said, from the hostility of those whom he had abused. Here, on the 16th November 1613, Boccalini died of colic accompanied with fever, according to the register of the parochial church of Sta. Maria Formosa. His end has by some writers been related differently. They assert that as he lay in bed some ruffians, employed by the court of Spain, assailed him with small bags filled with sand, and beat him so violently that he died soon after. Mazzuchelli, however, in his *Scrittori d'Italia*, has contradicted this story. The freedom with which Boccalini had attacked the tyrannical government of Spain in his *Pietra del Paragone*, was supposed to be the cause of this outrage; but this work did not appear until two years after his death. That entitled *La Segretaria d'Apollo*, which was published as a continuation of the *Ragguagli di Parnaso*, has generally been attributed to Boccalini; but its authenticity is denied by the best critics. The titles of his works are as follows:—*Ragguagli di Parnaso*, in two centuries, Venice, 1612 and 1613, 4to; 2. *Pietra del Paragone Politico*, Cosmopoli (Amsterdam) 1615, 4to; 3. *Commentarj sopra Cornelio Tacito*, Geneva, 1669, and Amsterdam, 1677, 4to.

Boccarella ‖ Bochart.

BOCCARELLA, in the glass manufacture, a small round aperture in the furnace, beside the bocca, and almost horizontal with it. Out of this and another similar aperture the servitors take coloured or finer metal from the piling pot.

BOCCONE, PAOLO (afterwards SYLVIO), a celebrated Sicilian naturalist, born at Palermo A.D. 1633. After he had gone through the usual course of study, he was ordained priest, and entered into the Cistercian order. For the sake of improving his knowledge in natural history, he travelled over Sicily, Malta, Italy, the Low Countries, England, France, Germany, Poland, and several other countries; and in 1696 was admitted a member of the Academ. Curiosor. Naturæ, in Germany. Upon his return to Sicily, he retired to the convent of Sta. Maria d'Altifonte, near Palermo, where he died in 1704. He left many curious works, some of which have gone through several editions. The following in particular may be mentioned, 1. *Recherches et Observations Naturelles touchant le Corail, la Pierre Etoilée, et l'Embrâsement du Mont Etna*; 2. *Museo di Fisica e di Esperienza*; 3. *Osservazioni Naturali*; 4. *Della Pietra Belzuar minerale Siciliana*; 5. *Appendix ad Museum de Plantis Siculis.*

BOCHART, SAMUEL, one of the most learned men of the seventeenth century, was born at Rouen in Normandy, May 30. 1599. He early made great progress in learning, and became a proficient in the oriental languages. He was many years pastor of a Protestant church at Caen, and became tutor to Wentworth Dillon, Earl of Roscommon, author of the essay on Translated Verse. While at Caen, he particularly distinguished himself by his public disputations with Father Veron, a Jesuit, and celebrated as a polemic. The dispute was held in the castle of Caen, in the presence of a great number of Catholics and Protestants, including among the former the Duke of Longueville. In 1646, Bochart published his *Phaleg* and *Chanaan*, which are the titles of the two parts of his *Geographia Sacra*. His *Hierozoicon*, which treats of the sacred animals of Scripture, was printed at London in 1675. In 1652, Christina, queen of Sweden, invited him to Stockholm: whither he repaired accompanied by Huet. On his return to Caen he resumed his duties as a minister of the gospel, married, and was received into the academy of that city. Bochart was a man of profound erudition; he possessed a thorough knowledge of the principal oriental languages, including the Hebrew, Syriac, Chaldaic, and Arabic; and such was his zeal for extending his acquirements, that at an advanced age he wished to learn Ethiopic. He was remarkable for modesty and candour; but so absorbed was he in his favourite study, that he saw Phœnician, and nothing but Phœnician, in everything, even in the words of the Celtic; and hence the prodigious number of chimerical etymologies which swarm in his works. He died at Caen, May 16. 1667. A complete edition of his works was published at Leyden, under the title of *Sam. Bochart Opera Omnia: hoc est; Phaleg,*

Bochius || Bodin.

Chanaan, seu Geographia Sacra, et Hierozoicon, seu de Animalibus sacris Sacræ Scripturæ, et Dissertationes Variæ, 1675, 2 vols. folio; 1692, 1712, 3 vols. folio.

BOCHIUS, or BOCH, JOHN, a Latin poet, born at Brussels A.D. 1555. He travelled into Italy, Germany, Poland, and Muscovy, and at his return became secretary to the Duke of Parma. He died January 13. 1609. The critics in the Netherlands honoured him with the title of the Belgic Virgil.

BOCHNIA, the capital of a circle of the same name in the Austrian province of Galicia, is situated on the river Raba, in Long. 20. 25. E. Lat. 49. 57. 15. N. It has a gymnasium and other schools, and extensive salt mines producing annually about 200,000 cwt. of salt. Pop. 5590. This circle contains 3 cities, 9 market-towns, and 49 villages, with 204,578 inhabitants.

BOCHUM, the capital of a circle of the same name in the Prussian province of Westphalia, and government of Arnsberg, with 4877 inhabitants, engaged chiefly in the manufacture of cassimeres and hardware. The circle contains three cities, 2 market-towns, 84 villages, and 55,874 inhabitants.

BOCKING, a town and parish in the hundred of Hinckford, county of Essex, 40 miles from London. It was formerly celebrated for the manufacture of a particular description of baize, which found a ready sale in the markets of Spain; but its chief manufactures now are silk and crape. It has an old church, hospital, and flour mills. Pop. (1851) 3846.

BOCK-LAND (*book* and *land*), in ancient English law, is the same as the modern *freehold land*, held by charter or deed in writing; by which name it was distinguished from *folk-land* or copyhold land, which was holden by the common people without writing.

BODE, JOHANN ELERT, a celebrated German astronomer, born January 19. 1747, at Hamburg, where his father kept a commercial academy. From his earliest years he was devoted to the mathematical sciences, especially astronomy. In the garret of his father's house, with the aid of a telescope constructed by himself, he eagerly made observations of the heavens; and at eighteen years of age had acquired so great a knowledge of astronomy, that when Dr Reimarus visited his father, young Bode was found occupied in calculating an eclipse of the sun. This incident was the means of introducing him to the notice of Professor Büsch, who at once afforded him every facility for prosecuting his labours with success. Shortly afterwards Bode gave the first public proof of his knowledge by a short work on the solar eclipse of August 5. 1766; and this was followed by his *Anleitung zur Kenntniss des gestirnten Himmels*, an elementary treatise on astronomy, which was eminently successful, and has since gone through numerous editions. In 1772, being called to Berlin by Frederic II., he was made astronomer to the Academy of Sciences, and afterwards a member of that institution. The well-known periodical work entitled *Astronomische Jahrbücher*, which is continued to the present day, was commenced by Bode in 1774; but that on which his fame chiefly rests is the *Uranographia*, published in 1801, in which the industrious author has given observations of 17,240 stars, or 12,000 more than are to be found in any older charts. This veteran observer, who may justly be said to have been the first to diffuse a general taste for astronomy in Germany, died at Berlin, Nov. 23. 1826.

BODERIA, or BODOTRIA, the ancient name of the Firth of Forth, Scotland.

BODIN, JEAN, characterized by Bayle as "one of the ablest men that appeared in France in the sixteenth century," and famous as the author of *The Republic*, and the *Methodus ad Facilem Historiarum Cognitionem*, was born at Angers about the year 1530. He was at one time in great favour with Henry III., but this was not of long continuance. The Duke of Alençon, however, gave him several employments, and took him to England as one of his suite, where he had the pleasure of finding his *Republic* in use as a text-book in the university of Cambridge. In the *Ragguaglia* of Boccalini he is condemned to the fire as an atheist, for maintaining liberty of conscience. He declared himself with much freedom against those who asserted that the authority of monarchs is unlimited; and yet he displeased the republicans. Upon the death of the Duke of Alençon, Bodin retired to Laon, where he married; and in the time of Charles IX. he was the king's solicitor, with a commission for the forests of Normandy. He died of the plague, at Laon, in 1596. Besides his *Methodus*, and *Six Livres de la Republique*, which Laharpe has described as containing the germ of the *Spirit of Laws*, Bodin wrote *Commentaire sur les Livres de la Chasse d'Oppien*, Paris, 1555, in 4to; *Démonomanie*, Paris, 1581, in 4to; *Fléau des Démons et Sorciers*, 1616, in 8vo; *Universæ Naturæ Theatrum*, Lyons, 1596, in 8vo; *Paradoxes, doctes et excellents Discours de la Vertu touchant la Fin et Souverain Bien de l'Homme*, Paris, 1604; and *Colloquium Heptaplomeron sive de abditis Rerum sublimium Arcanis*, printed for the first time in 1841, at Berlin. For some further particulars regarding Bodin, and a general estimate of his merits as a writer, see *Prelim. Dissert.* I.

Bodkin || Bodley.

BODKIN, a small instrument of steel, bone, ivory, &c., used for making holes by piercing: also a similar instrument with an eye, for drawing tape or thread through a loop, &c.

BODLE, an old Scottish copper coin, of the value of two pennies Scots, or the sixth part of an English penny.

BODLEY, SIR THOMAS, founder of the Bodleian library at Oxford, was born at Exeter A.D. 1544. When he was about twelve years of age, his father, John Bodley, on account of his Protestant principles, was obliged to leave the kingdom. He settled with his family at Geneva, and continued there till the death of Queen Mary. In that university, then in its infancy, young Bodley studied under several eminent professors. On the accession of Queen Elizabeth, he returned with his father to England, and was soon after entered of Magdalen College, Oxford. In 1563 he took the degree of bachelor of arts, and the year following was admitted a fellow of Merton College. In 1565 he read a Greek lecture in the hall of that college; took the degree of master of arts the year after; and read natural philosophy in the public schools. In 1569 he was one of the proctors of the university, and for some time after officiated as public orator. Quitting Oxford in 1576, he made the tour of Europe; and on returning to his college after four years absence, he applied himself to historical and political studies. He became gentleman-usher to Queen Elizabeth; and in 1585 he married Anne Ball, a widow lady of considerable fortune, whose father, named Carew, was of Bristol. He was soon after sent as ambassador to the king of Denmark, and several German princes. He was next despatched on a secret mission to France; and in 1588 he went as ambassador to the United Provinces. On his return to England in 1597, finding his preferment obstructed by the jarring interests of Burleigh and Essex, he retired from court, and could never afterwards be prevailed on to accept of any public employment. He now began the foundation of the Bodleian library; and soon after the accession of King James I. he received the honour of knighthood. He died at his house in London, January 28. 1612, and was buried in the choir of Merton College chapel, where a monument of black and white marble was erected to him, on which stands his effigy in a scholar's gown, surrounded with books. Sir Thomas wrote his own life to the year 1609; which, with the first draught of the Statutes, and his Letters, have been published from the originals in the Bodleian library, by Hearn, under the title of "*Reliquiæ Bodleianæ*, or Authentic Remains of Sir Thomas Bodley;" London,

Bodmin || Boehm.

1793, 8vo. For a particular account of the *Bodleian Library*, see LIBRARIES.

BODMIN, a parliamentary and municipal borough and market-town in the county of Cornwall, 235 miles from London. It is situated between two hills, and consists of one narrow and ill-paved street, nearly a mile in length. It is one of the county towns; the assizes and quarter-sessions being held here alternately with Launceston. It is also a stannary town. It has a spacious church, town-hall, lunatic asylum, county jail and a grammar-school founded by Queen Elizabeth. The principal manufacture is shoes. Its municipal affairs are conducted by a mayor, four aldermen, and twelve councillors, and it returns two members to parliament. Market-day, Saturday. Pop. (1851) of municipal borough, 4327, of parliamentary borough, 6337.

BODONI, GIAMBATISTA, superintendent of the royal press at Parma, chief printer to his Catholic Majesty, member of various academies in Italy, and knight of several orders, was born in 1740, at Saluzzo in Piedmont, where his father owned a printing establishment. While yet a boy, he began to engrave on wood. He at length went to Rome, where he became a compositor for the press of the Propaganda. He made himself acquainted with the oriental languages, and thus was enabled to render essential service to the Propaganda press, by restoring and accurately distributing the types of several oriental alphabets which had fallen into disorder. The Infante Don Ferdinand having established at Parma, about 1760, a printing-house on the model of those in Paris, Madrid, and Turin, Bodoni was placed at the head of this establishment, which he soon rendered the first of the kind in Europe. The beauty of his typography, &c., leaves nothing further to be desired; but the intrinsic value of his editions is seldom equal to their outward splendour. His Homer, however, is a truly magnificent work; and, indeed, his Greek letters are faultless imitations of the best Greek manuscript. His editions of the Greek, Latin, Italian, and French classics, are all highly prized for their typographical elegance, and some of them are not less remarkable for their accuracy. Bodoni died at Padua in 1813, aged seventy-three. Some years after his death appeared a magnificent work in two volumes quarto, entitled *Manuale Tipografico*, containing specimens of the vast collection of types which had belonged to this celebrated typographer.

BOECE, or BOETHIUS, HECTOR. See BOYCE, HECTOR.

BOEDROMIA (Βοηδρόμια), a festival celebrated at Athens in memory of the succour brought by Ion to the Athenians, when invaded by Eumolpus in the reign of Erectheus. Various accounts of its origin are given. Plutarch (*Thes.* 27) says that it was held in commemoration of the victory obtained by Theseus over the Amazons, in the month of Boëdromion, which was the third month of the Athenian year, corresponding to our September.

BOEHM, or BEHMEN, JACOB, founder of the sect of Boehmists, and called by his disciples the Teutonic Theosophist, was born in 1575, near Goerlitz in Upper Lausatia. He was bred a shoemaker, and for some time supported a large family by this occupation; but having dabbled in chemistry, his mind, heated by sermons and German divinity, became subject to raptures, mystical ecstacies, and notions of divine illumination. To these he first gave vent in 1612, in a treatise entitled *Aurora, or the Rising of the Sun*, a mixture of astrological, philosophical, chemical, and theological extravagances, written in a quaint and obscure style. This work was censured by the magistrates of Goerlitz, who at the instigation of the clergy endeavoured to suppress it; yet Boehm continued to dream and to scribble, and in 1619 published his treatise *De Tribus Principiis*, inculcating a species of Spinozism, namely, that the operations of grace are subjected to laws analogous to those which nature has imposed in the purification of metals, and that God is to be regarded as the substance of the universe, which has produced everything by way of emanation. He afterwards went to Dresden, where he was examined by some theologians more indulgent than those of Goerlitz, and found irreproachable. He died at Goerlitz in 1624, leaving a great number of treatises *On the Celestial and Terrestrial Mystery, and on the Intellectual Life.* "It is not possible," says Mosheim, "to find greater obscurity than there is in these pitiable writings, which exhibit an incongruous mixture of chemical terms, mystical jargon, and absurd visions." Nevertheless, in the last century, Boehm found a zealous apologist in William Law, the pious author of *Christian Perfection*, who published an English translation of his work, in two vols. 4to. Boehm had a great many disciples, some of whom, like Kuhlmann, who was burned at Moscow in 1684, were wild and dangerous fanatics. All his works were collected and reprinted at Amsterdam in 1682, and again in 1730, under the title of *Theosophia Revelata.*

Bœotia.

BŒOTIA (Βοιωτία), a country of central Greece, bounded in the south by the Gulf of Corinth, by Magaris and Attica; in the east by Attica and the Euripus; in the north by the Locri Opuntii; and in the west by Phocis. Its surface is calculated to amount to about 1119 English square miles. The country, surrounded nearly on all sides by mountains, divides itself naturally into three parts, the low country of and about Lake Copais, the valley of the river Asopus, and the coast district between mount Helicon and the Corinthian gulf. The country about Lake Copais is a large valley, so completely surrounded by hills that it is connected with the Euboean Sea only by subterraneous passages. The extensive Lake Copais in this hollow is fed by the Cephisus, the principal river of the country. The natural subterraneous passages not being sufficient to carry off the great masses of water accumulating at times in the valley, the early inhabitants often suffered severely from inundations; whence at a very remote period cloacæ were built, probably by the Minyans of Orchomenos, to carry off the waters. Remains of these works, as great and stupendous as any that were executed in antiquity, still excite the admiration of the traveller, and for thousands of years they made that part of Bœotia one of the most fertile districts of Greece. For several centuries, however, these drains have been neglected, in consequence of which the country has been changed into a pestilential marsh. Between this valley and the basin of the Asopus is situated the Theban plain, which is still distinguished for its fertility. The lowlands and valleys of Bœotia were notorious in antiquity for their moist and thick atmosphere, which was believed to exercise a peculiar influence upon the character of the inhabitants, for they are often spoken of as remarkable for dulness, and a kind of intellectual insensibility. The dialect spoken by the Bœotians was a broad Æolic.

In the earliest times Bœotia was inhabited by several tribes, such as Aonians, Temmices, Hyantes, Thracians, Leleges, Phlegyans, and the Minyans of Orchomenos, the last of whom appear to have formed a great centre of civilization at a very remote period. But all these tribes were gradually either expelled by the Bœotian Æolians immigrating from Thessaly, or absorbed by them, so that in later times they wholly disappear. The country which before had had no common name, henceforth is always spoken of as Bœotia, and the several towns and cities, with Thebes at their head, formed a sort of confederation; in which, however, the Thebans and Bœotians frequently came into hostile collision, Thebes claiming the supremacy of the whole country, and the Bœotian towns insisting upon their independence. The political history of the country is inseparably connected with the history of ORCHOMENOS, THEBES, PLATÆÆ, and THESPIÆ, to which the reader must be referred for details. The Bœotian confederacy continued its nominal existence even under the Roman emperors, although the country was so reduced, that about the time of

Boerhaave.

Augustus, Tanagra and Thespiæ alone could be considered as towns, the others having been either entirely destroyed, or existing only as villages. (Compare the Travels of Clarke, Wheler, Dodwell, Sir W. Gell, Hobhouse, and Thiersch, *Etat actuel de la Grèce*, vol. i. p. 280, vol. ii. p. 23; Forchhammer, *Hellenika*, p. 143, fol.) (L. S.)

BOERHAAVE, HERMANN, one of the most celebrated physicians of modern times, was born at Woorhout near Leyden, December 31. 1668. Destined for the clerical profession, to which his father belonged, he received a liberal education, and early displayed unusual abilities. At the age of sixteen he entered the university of Leyden, where he studied under Gronovius, Ryckius, Trigland, and other distinguished men, and obtained the highest academical honours. In 1690 he took his degree in philosophy; on which occasion he delivered an inaugural dissertation *De distinctione mentis à corpore*, in which he attacked the doctrines of Epicurus, Hobbs, and Spinosa. Being left, on the death of his father, without any provision, he was compelled to support himself by teaching mathematics. By the advice of Vandenberg, the burgomaster of Leyden, Boerhaave now applied himself with ardour to the study of medicine, to which indeed he had early manifested a decided inclination. The works of Hippocrates among the ancients, and those of Sydenham among the moderns, were the especial objects of his study; but his reading was by no means confined to these authors. In 1693 he took his degree of M.D. at Harderwyck in Guelderland, and immediately entered on the duties of his profession. His merits soon became conspicuous; and in 1701 he was appointed by the university of Leyden to supply the place of Drelincourt as lecturer on the institutes of medicine. His inaugural discourse on this occasion was entitled *De commendando Hippocratis studio*, in which he recommended to his pupils that great physician as their model. In 1709, the university rewarded his distinguished merit by appointing him successor to Hotton in the chair of botany and medicine, in which capacity Boerhaave did great service, not only to his own university, but also to botanical science, by his improvements and additions to the botanic garden of Leyden, and by the publication of numerous works descriptive of new species of plants. He was appointed in 1714 rector of the university. In the same year he succeeded Bidloo in the chair of practical medicine, and in this capacity he had the merit of introducing into modern practice the system of clinical instruction. Four years later he was appointed to the chair of chemistry, and delivered an inaugural discourse, which contains the germs of his celebrated *Elements of Chemistry*. In 1728 he was elected into the Royal Academy of Sciences of Paris, and two years later into the Royal Society of London; to both of which he communicated his chemical researches. In 1729 declining health obliged him to resign the chairs of chemistry and botany; and in 1731 he resigned the rectorship of the university, to which office he had been re-elected. On this occasion he delivered a discourse *De Honore Medici Servitute*. This great and good man died, after a lingering and painful illness, which he bore with Christian patience and firmness, on the morning of the 23d September 1738. His funeral oration was delivered by his pious and learned friend the Rev. Mr Schultens.

From the time of Hippocrates, no physician had more justly merited the esteem of his contemporaries, and the admiration of posterity, than Boerhaave. To uncommon intellectual abilities he united those amiable qualities of the heart which give them so great a value to society. His personal appearance was simple and venerable. He taught very methodically, and with great precision: his style was eloquent, and his delivery dignified and graceful. He sometimes also gave his lectures a lively turn; but his raillery was never coarse or satirical. He possessed remarkable powers of memory, and was an accomplished linguist. A declared foe to all excess, he considered decent mirth as the salt of life. He was fond of music, with which he had a scientific acquaintance; and during winter he had a weekly concert in his house. It was his daily practice throughout life, as soon as he rose in the morning, which was generally very early, to retire for an hour to private prayer, and meditation on some part of the Scriptures. He often told his friends, when they asked him how it was possible for him to go through so much fatigue, that it was this practice which gave him spirit and vigour in the business of the day.

Boerhaave.

Of his sagacity, and the wonderful penetration with which he often discovered and described, at first sight, such distempers as betray themselves by no symptoms to common eyes, very surprising accounts have been transmitted to us. Yet so far was he from having presumptuous confidence in his own abilities, or from being puffed up by prosperity, that he was condescending to all, and remarkably diligent in his profession: he used often to observe that the life of a patient, if trifled with or neglected, would one day be required at the hand of the physician. He used to say that the poor were his best patients, because God was their paymaster. His benevolence, however, was exercised with discrimination. The activity of his mind sparkled visibly in his eyes. He was always cheerful, and desirous of promoting every valuable end of conversation, of which the excellency of the Christian religion was frequently the subject. He never regarded calumny nor detraction,—for even he had his enemies,—nor in any instance thought it necessary to confute them. "They are sparks," said he, "which, if you do not blow them, will go out of themselves. The surest remedy against scandal, is to live it down by a perseverance in well-doing; and by praying to God that he would cure the distempered minds of those who traduce and injure us." His great skill and celebrity as a physician brought him a large fortune. He left his only surviving daughter two millions of florins.

The genius of Boerhaave raised the fame of the university of Leyden, especially as a school of medicine, so as to make it a resort of strangers from every part of Europe. All the princes of Europe sent him disciples, who found in this skilful professor not only an indefatigable teacher, but an affectionate guardian. When Peter the Great went to Holland in 1715, to instruct himself in maritime affairs, he also took lessons from Boerhaave. The reputation of this eminent man was not confined to Europe: a Chinese mandarin wrote him a letter directed "To the illustrious Boerhaave, physician in Europe;" and it reached him in due course. The city of Leyden raised a splendid monument to his memory in the church of St Peter, inscribed "To the salutary genius of Boerhaave," SALUTIFERO BOERHAAVII GENIO SACRUM.

When Boerhaave first directed his attention to medicine, the philosophical reform inaugurated by Bacon had given a powerful impulse to the physical sciences; and these, accordingly, occupied all minds, whilst the healing art had but little profited in consequence. It was overlooked or forgotten that, from its very origin, Hippocrates had applied to it the experimental philosophy with which the learned were now everywhere so enthusiastically occupied. His theory, however, still continued to fluctuate between several dogmas equally remote from the truth. The chemists who, at the revival of learning in Europe, had overturned the authority of Galen, had to defend themselves against the sects of the mechanicians, and of Bellini, which divided the dominion of medicine between them. In a small portion of Germany alone Stahl brought back men's minds to the judicious doctrine of Hippocrates, attributing all the movements in the animal economy to a force inherent in itself, and different from the general forces of matter; but in adopting a word, the meaning of which was by no means precise, he rendered less general and less salutary the influence which he would otherwise have produced. The first perusal of Hippocrates

Boëthius. appeared to have carried away Boerhaave; but this physician, endowed by nature with a mind fitted for analysis, comparison, and combination, rather than with a creative and inventive genius, was unable to resist the influence of his age, and above all, the effect of his early studies. Having been a mathematician and natural philosopher before he became physician, he was constantly carried away by the first objects of his labour and research; and being more capable than any one else of detecting the accessory affinities between these sciences and that of man, he ran greater risk of being seduced by them. But as every system, however vicious, has always, along with the facts which it arranges and offers to explain, a point of accordance more or less remote, he thought that the best medical system would be that which should unite and combine all opinions. Forgetting that living bodies are free during their life from those movements to which other bodies are imperiously constrained, or at least counterbalance them, and that all the acts which they perform are the result of an activity which is peculiar to them; overlooking, also, that those movements of the living economy which most easily admit an application of the laws of physics and mechanics, have, nevertheless, as a *primum mobile*, the force of life, and only receive from the forces of dead matter an accessory impulse; Boerhaave wished to combine in one and the same theory the vital philosophy of Hippocrates, the chemical principles of Sylvius, the mechanism of Bellini, and many other incongruities besides: attributing more, however, to the mechanical and chemical forces, which can never be but accessory, than to the more profound and secret powers of life, which are the principal. Thus the calibre of the vessels adjusted to the dimensions of the globules composing the liquids of the body, formed, according to him, the hydraulic relation on which depended the circulation of the humours, their separation from the blood in the different secretory organs, the morbific congestion of the blood in various fluxions, in humours, inflammations, and such like; and hence he concluded that all the efforts of the physician should be directed to establish this relation, or rather mechanical equilibrium. Nor did he stop even here. To the mechanical hypotheses just mentioned he added others founded on chemical principles, when, in attempting to explain the causes and the phenomena of diseases, he admitted the formation of pretended acrimonies in the blood, which the physician ought, according to him, to have constantly in view in order to neutralize them; acrimonies which were long famous in the language of the schools, and which are still found in that of ordinary life. The whole phenomena of diseases, with the spontaneous evacuations by which they are terminated, and which constitute the crises, find a ready explanation on this vicious system, which seems to offer a reason, when it only mystifies with a word, involving a gratuitous hypothesis. In practice, however, theory receives many modifications; and there can be little doubt, that in prescribing for patients, Boerhaave was more guided by experience and good sense than by the strangely eclectic doctrine to which we have here cursorily alluded.

The principal works of this illustrious physician are, 1. *Institutiones Medicæ*, Lugd. Bat., 1708; 2. *Aphorismi de cognoscendis et curandis Morbis*, Lugd. Bat., 1709. On this work, which was the text book of Boerhaave's lectures, Van Swieten published a commentary in 5 vols. 4to; 3. *Libellus de Materia Medica, et Remediorum Formulis quæ serviunt Aphorismus*, Lugd. Bat., 1719. 4. *Institutiones et Experimenta Chemiæ*, Paris, 1724.

BOËTHIUS, or BOËTIUS, ANICIUS MANLIUS TORQUATUS SEVERINUS, a Roman statesman and philosopher, born of an illustrious patrician family, between A.D. 470 and 475. It is conjectured that he was the grandson of Flavius Boëthius, the prefect of the prætorium, who was murdered by Valentinian III., and that his father was the consul of A.D. 487. Being left an orphan at a very early age, the care of his education devolved on his relations, who sent him, it has been said, to Athens, where he resided eighteen years, and was a pupil of Proclus. This statement, however, rests only on the very questionable authority of Thomas Brabantinus (*De Disciplina Scholarium*), and is in effect contradicted by Cassiodorus (i. 45). However this may be, he was early distinguished at Rome for the extent and variety of his acquirements, and his intimate acquaintance with the literature of Greece. Boëthius occupies a remarkable place in literary history, as standing on the confines between the ancient and scholastic philosophy; being, says Gibbon, the last of the Romans whom Cicero would have acknowledged for his countryman. He lived at Rome in great splendour and affluence, and was not more distinguished for his learning than for his virtue and great liberality to the poor. Rising rapidly in the public esteem, he was successively appointed to various high offices in the state, and at length was made consul A.D. 510. That public affairs, however, did not entirely engross his attention, is testified by his great literary industry, and in particular by his voluminous translations from the Greek philosophers. As a statesman he was pre-eminent for integrity, as well as for his unremitting diligence in the detection of fraud and the suppression of violence, to which his countrymen were continually exposed from the rapacity of their Gothic invaders. The talents and virtues of Boëthius were duly appreciated by Theodoric, who made him *magister officiorum* in his court, and consulted him upon all affairs of importance. By that king he was employed to regulate the coinage with a view to the prevention of forgery; and he was engaged in some important negotiations with Gundebald, king of the Burgundians, and with Clovis, king of the Franks. He also appears to have paid some attention to practical mechanics, as among other specimens of his skill he constructed for Gundebald a clepsydra and a gnomon, which greatly delighted that prince. Boëthius.

Boëthius married Rusticiana, the daughter of Symmachus, and by her he had two sons, who were made consuls A.D. 522; upon which occasion, after pronouncing a panegyric on Theodoric, he distributed among the populace a large sum of money. The consulships of his sons, and that of his father, have erroneously been ascribed to himself. The story also of his previous marriage with Elpis of Sicily appears to be a fable, as the two sons of that lady were consuls in the year 500, at which time Boëthius was certainly not above thirty years of age.

His unflinching integrity, and the zeal he displayed in defending his countrymen against the extortion and excesses of their Gothic masters, rendered Boëthius highly obnoxious to the courtiers; and they resolved to accomplish his ruin. Theodoric, now grown through old age morose and fretful, lent a ready ear to their insinuations against his noble minister; and of this disposition in the king, three men of profligate lives and desperate fortunes, Gaudentius, Opilio, and Basilius, took advantage in order to gratify private revenge. The boldness with which Boëthius defended Albinus when accused of treason, was made the plea on which they charged him with a design to dethrone the king and throw off the barbarian yoke; to which was added the crime of sacrilege or sorcery. Boëthius was at this time at a distance from Rome; yet Theodoric transmitted the complaint to the senate, who, partly perhaps through fear, condemned him to death without summoning him to his defence. Accordingly he was imprisoned at Ticinum (Pavia), in the baptistery of the church; and here, during his captivity, he composed his celebrated treatise *De Consolatione Philosophiæ*. The manner of his death is uncertain: it has been said that his eyes were forced from their sockets by a cord drawn tightly round his head, and that he was beaten with clubs till he expired; but it is more probable that he suffered decapitation, A.D. 524–526. Two centuries afterwards, a cenotaph was erected to his memory in the church of S. Pietro Cielo d'Oro, by Luitprand king of

Bog ‖ Bogotá.

the Lombards; and in 990 Otho III. honoured his memory with a magnificent mausoleum, which was inscribed with an epitaph by Pope Sylvester II.

It was for ages the custom to regard Boëthius as a Christian saint and martyr, but without any sufficient foundation; for unless the theological works sometimes ascribed to him be really his (which seems more than doubtful), there is no evidence of his having professed Christianity; nor is the name ever mentioned in the *Consolatio Philosophiæ*, though the high moral tone, and the belief in prayer and a superintending Providence, might naturally lead to such an inference. This work is written in alternate prose and verse (the latter chiefly borrowed from Seneca), and is a dialogue between the author and Philosophy personified.

During the middle ages this work had many translators as well as imitators. For centuries the Peripatetic philosophy was studied only through the commentaries of Boëthius; but on the introduction of Aristotle's writings into Europe in the thirteenth century, the fame of Boëthius, whose works had in some measure supplied the void during 800 years, gradually began to decline, and sunk at length into comparative obscurity.

The learning and eloquence of Boëthius are conspicuous in his works, which were first published in a collected form at Venice, in folio, 1491 (or 1492); and an improved edition, in folio, appeared at Basle in 1570. It is worthy of notice that Boëthius is one of the principal Latin writers on music, and that his treatise *De Musica* supplied for some centuries the want of those Greek manuscripts which were supposed to be lost. It may also be observed, as an interesting fact in literary history, that Alfred the Great translated the *Consolatio Philosophiæ* into Anglo-Saxon, with large original additions. The best edition of this work is by J. S. Cardale, with notes and a translation, 1828.

BOG, or Bog of Gight, a small town of Scotland, seated near the mouth of the river Spey, in Long. 2. 23. W. Lat. 57. 48. N.

BOGALCUND. See Rewah.

BOGNOR, a rising market and maritime town of Sussex, in the rape, and six miles S.E. of the town of Chichester. Previous to 1785, when the proprietor, Sir R. Hotham, began its improvement, it consisted of only a few huts inhabited by fishermen. It has now become a favourite watering-place, and has many handsome villas, a market-place, mechanics' institute, hotels, baths, assembly rooms, and the other accessaries of a watering-place. Pop. (1851) 1913.

BOGODUCHOW, the capital of a circle of the same name, in the European government of Charkow, on the river Merle. It contains four churches and about 7000 inhabitants. Long. 35. 45. E. Lat. 50. 10. N.

BOGOMILI, or Bogarmitæ, in *Ecclesiastical History*, a sect of heretics which sprung up about the year 1179. Their founder was one Basil, a monk, who was burnt alive at Constantinople by the Emperor Alexius Comnenus. Their system was nearly allied to that of the ancient Gnostics and Manichæans. (See Anna Comnena, *Alex.* xv.; Wolf, *Hist. Bogomilorum.*)

BOGOTÁ, formerly called Santa Fé de Bogotá, the capital of the republic of New Granada, is situated in the province of the same name, in 4. 6. N. Lat. and 78. 30. W. Long., in an elevated plain or table-land forming part of the eastern ridge of the cordillera of the Andes, which separates the extensive valley crossed by the river Magdalena from those immense plains that are watered by the Meta, the Casanare, and many other rivers flowing eastward, which increase the waters of the majestic Orinoco.

Physical aspect of the country.

The plain of Bogotá occupies a space of about 60 miles from south to north in length, and 30 miles east to west in breadth. It is surrounded by lofty mountains, but more especially to the eastward, where the summits of Chingaso and the Paramo de la Suma Paz are conspicuous for their elevation. No part of this chain, however, has been found to exceed in height 14,000 feet above the level of the sea, and consequently in these latitudes it does not reach the limits of perpetual snow. The mountains which bound it in other directions are much less elevated; and over those to the westward may be seen, in the distance, the snowy summits of the more elevated mountains which constitute the central ridge of the cordillera. Throughout its whole extent this plain exhibits evident marks, in the perfect level of its surface, the alluvial nature of the soil, and the appearance of the insulated rocks which rise up in some parts of its extent, of having formerly been the site of an extensive lake. It is traversed by the river Funza or Bogotá, which, collecting into one channel the numerous mountain-streams that water the valley, bends its course to the south-western extremity of the plain, and enters a narrow channel, from which it is precipitated over a perpendicular precipice of 600 feet in height, into the valley of the Magdalena, forming the magnificent fall of Tequendama. This splendid cataract is an object of wonder and admiration to all beholders. The fall forms one continued sheet of water, interrupted only a little at its upper part by a projecting ledge of rocks. So great is the diffusion of water in the surrounding atmosphere, in the form of rain or haze, that a perpetual humidity prevails; and the vegetation in the immediate vicinity exhibits an uncommon degree of vigour and luxuriance. The contrast of the vegetation at the summit, where oaks, elms, and other trees of temperate climes are found, with that at the bottom, where the graceful palm-tree flourishes, is very remarkable, and cannot be altogether accounted for merely by the difference of level. The evaporation at the fall must be very great, as the volume of water which issues from the bottom of the valley towards the Magdalena is much smaller than at the summit, where the river leaves the plain of Bogotá. In various parts of the plain, from the great equality of its surface, the banks of the river are to a considerable extent inundated, and so marshy, that, especially in the rainy season, they cannot be passed without difficulty. These situations abound in ducks and other water fowl, in the capture of which an ingenious device is resorted to by the Indians. His head concealed by a cap made of rushes, while the rest of his body is under water, the fowler stealthily moves towards the game, which he seizes by the feet and secures to his girdle.

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Could the opening at Tequendama, through which the river Bogotá now escapes, be closed up by artificial means, the whole extent of the plain would be converted into one continuous lake, as appears to have been the case in former times; for the change which has been produced, and which has rendered so great an extent of soil useful to man, has without doubt been occasioned by the agency of the river, whose waters, by constant attrition during a series of ages, have eventually been able to overcome the rocky barrier opposed to their progress, and have hollowed out the deep channel through which the river now precipitates itself into the abyss beneath; and, from our knowledge of the laws which regulate the economy of nature, we may anticipate that the same causes will in time to come still more effectually drain the plain of Bogotá. The traditions of the aborigines tend to confirm the view which is now taken of the ancient condition of this plain; but, ignorant of the extensive operation of those natural causes which are known to us, they ascribed the whole to supernatural agency, and have handed down a legend, setting forth, that an aged man of great power and wisdom, named Bochica, broke down, by means of his powerful arm, a passage through the rocks which inclose the valley at Tequendama, and formed the outlet by which he drained the adjacent plain; and that having accomplished this, he taught the inhabitants of the country to build cities and villages, and introduced among them those habits of industry, civilization, and religion, which were found to exist at the time when the country was discovered by Europeans.

This extensive plain is exceedingly fertile, and susceptible of the highest cultivation. It produces abundant crops of wheat, barley, and the leguminous plants cultivated in Europe. Of the former the average produce is five quarters per acre; and of all these, owing to the regular succession of the rainy and dry seasons, two crops may be obtained from the same field in one year; a practice, however, which is not usually followed with the cereals, as these require the alternation of green crops, to prevent the fertility of the soil becoming too much exhausted. Lucerne is also cultivated to a great extent, and affords ample sustenance to numerous flocks of sheep and herds of cattle

Bogotá. and horses, which are reared and maintained on this plain for the supply of the capital. Before the conquest of the Spaniards, the plain of Bogotá maintained a numerous population; but the inhabitants who at present reside on it, and are occupied in agricultural pursuits, are far too few in number to give full development to its fertility and resources. Its immediate vicinity to a populous city, where there is a ready market for all its produce, presents very powerful inducements to the establishment of industrious and intelligent agriculturists; and, doubtless, many such, from Europe and elsewhere, will ere long find their way to so inviting a situation.

Climate. The plain of Bogotá, according to the observations of Humboldt, has an elevation of 8694 feet above the level of the sea; and consequently, although so near the equator, it enjoys a mild and equable climate, the inhabitants experiencing a kind of perpetual spring. In consequence of the sun being twice perpendicular at nearly equidistant periods during the year, there are two winter or rainy seasons, and two summer or dry seasons every year, each of about three months continuance; the rainy season commencing about the equinoxes, and continuing during the months of March, April, and May, and again during September, October, and November; and the dry seasons beginning with the solstices, and continuing during the intermediate months. Even during the winter months the rains are not continuous, but generally the mornings are cool and exceedingly agreeable, the rain usually commencing towards the afternoon. The range of the thermometer averages at this season from 58° to 63°, but sometimes descends as low as 47° of Fahrenheit. During the summer months, however, there is almost constantly a serene and unclouded sky, with so little dew during the night that it scarcely incommodes the inhabitants who then venture out into the open air. At this season the average height of the thermometer is from 68° to 70° in the shade. A climate so delicious is found very conducive to the preservation of health, and few spots within the tropics present so desirable a place of residence. Here those insects and venomous reptiles which occasion so much annoyance in the neighbouring districts of less elevation are altogether unknown; and the females who inhabit this plain possess a freshness of complexion unknown to those who dwell in less favoured parts of the country. Yet, with all these advantages, the period of human existence does not appear to be in general so long protracted in this country as in more rigorous climates; old age comes on at a less advanced period of life; and females, who reach maturity at an early age, exhibit the symptoms of decay at a period when women in England are in the full enjoyment of all their physical and intellectual faculties.

Owing to its great elevation, the rarefaction of the atmosphere is so considerable, that strangers, on their first arrival at Bogotá, are generally affected with a degree of oppression and difficulty of breathing; but this, in most instances, gradually disappears with a protracted residence. Here epidemic diseases are altogether unknown. Travellers, however, who proceed to Bogotá by the Magdalena are not unfrequently attacked, on their arrival, with intermittent fevers; but there is every reason to believe that the causes which give rise to this complaint have been in operation during the period of their navigating that river.

Minerals. The mountains which surround the table-land or plain of Bogotá, and those that extend towards the provinces of Casanare, Velez, Mariquita, and Antioquia, abound in rich mines of iron, copper, lead, silver, gold, sulphur, precious stones, and coal. Towards the north, in the province of Velez, are situated the celebrated Monriquira copper mines, which for more than a century have supplied all the interior of New Granada with that metal. As they have not yet been scientifically worked, the yield has hitherto been much smaller than it ought to have been. They are very extensive, and in the immediate vicinity are abundant coal mines, which hitherto have not been worked by the proprietors, as the abundance of other fuel has hitherto obviated the want of them. The copper mines of Monriquira are situated at a distance of 45 miles from the river Carare, which is one of the navigable streams flowing into the Magdalena; and the authorities of Velez are occupied in opening a road leading to that river by which to export the rich produce of their province. The copper mineral of Monriquira assayed at Swansea, produced 31 per cent. of pure copper, and a small quantity of silver. When science shall be applied to the working of these mines, and a sufficient number of workmen employed, they will be able to supply not only the whole of New Granada, but also contribute a considerable quantity for exportation. In Villete, a hamlet situated halfway between Bogotá and the river Magdalena, there are also some rich copper mines not yet worked: the most noted of these are those of Poyandé, on the left bank of the river Magdalena to the south-east of Bogotá. These mines, from their proximity to the river Magdalena, which is the principal source of communication in New Granada, offer the greatest advantages for working, and have been lately undertaken by a New Granadian house. Bogotá.

Westward of Bogotá is the province of Mariquita, and on the left bank of the Magdalena are the silver mines of Santa Anna, now worked by an English company called the Mariquita and New Granada Company. The hilly range in which these mines are situated abounds in gold mines as they approach the province of Antioquia, which comprises auriferous grounds of extraordinary richness, and have lately attracted the attention of Europe. Several companies for working the mines have been formed in consequence. In the auriferous parts of Antioquia, works have lately been constructed by the New Granada Company, formed in this country, and possessing the rich mines of Frontino, Bolivia, and Juan Creollo; as also by a French company working the mines of Curazao on the right bank of the river Nare, and by a multitude of national companies, who are daily making new discoveries.

The produce of the gold mines of Antioquia at the present time is calculated at five millions of dollars annually, although only a small part of the population work them, as the inhabitants generally prefer agriculture to mining.

Thus it is that although the population of Antioquia, at present divided in three provinces, is 230,000, it is calculated that not more than 7000 work in the mines.

In the vicinity of Bogotá are the abundant salt mines of Zipaquira, Enemocon, and Tauza. From these and from the salt pits of Cheta, Recetor, Pajarito, and Cumaral, the whole of the interior of New Granada is supplied.

These salt mines were worked by the Spanish and Columbian governments by the primitive method which they found in use among the Indians. But the government of New Granada has established a perfect administration for scientific and economical working, by which they produce considerable quantities.

At the present time these salt mines yield to the government an income of half a million dollars annually. As the population increases the revenue to the government will be augmented, as the produce of these mines will provide for centuries a population of ten times the present number. Close to Bogotá are also situated the celebrated emerald mines of Muzo, which for many years have supplied the great demand for this precious stone in Europe. These mines belong to the government, who have rented them to a company composed of natives and foreigners.

City. The city of Santa Fé de Bogotá was founded in 1538, by Gonzalez Ximenes de Quesada. It stands at the base of two mountains, which are known by the names of La Guadalupe and Monteserrato. At first it consisted of only twelve houses, in honour of the twelve apostles, and contained but sixty inhabitants; but, from its favourable situation, it increased rapidly, and became a place of considerable extent; two years afterwards was raised to the rank of a city; and eventually became the seat of government for the kingdom of New Granada. Its population in 1800 consisted of 21,464, exclusive of strangers and temporary residents; and in that year the number of births exceeded that of

Bogotá. deaths by 247. Its population was estimated at 30,000 in 1821, when, on the union of New Granada and Venezuela, to form the republic of Columbia, it became the capital and the seat of government.

Since the dissolution of Columbia, and its division into three independent republics, Bogotá has continued to be the capital of one of them, namely of New Granada. Its population is estimated at present at 60,000.

The rapid increase of the population has greatly enhanced the value of houses and other property in the city and its vicinity. Nature indeed seems to have pointed out the plain of Bogotá as the most eligible situation which can well be imagined for the formation of a great and opulent city, the seat of government of a powerful nation. It enjoys a genial and salubrious climate, in the midst of a fertile and abundant district; and it forms the centre from which diverge to the north and to the east the two most extensive lines of internal navigation to be found in Columbia.

The communication with the coast is easily effected by means of a carraigeway from Bogotá to El Roble, a distance of 9 leagues, and one for mules from El Roble to Honda, 13 leagues; and between Honda and the coast by the steamers of the Santa Marta, Carthagena and Barranquilla Companies, and lately by those of the Magdalena Steam Company, established in London.

These various steamers scarcely suffice for the increasing traffic, both export and import, of this improving country. The steamers ascend the river in eight or ten days, loaded with foreign merchandize for the consumption of the provinces of the interior, and descend loaded with the tobacco of Ambalema, Penalisa, Geron, Socerro, and the different districts in which this article is produced in excellent quality in New Granada; as also with the bark of Fusagazuga, Pitayo, and other districts, where it is as good as that of Calisaya.

On approaching Bogotá from the Magdalena, the city is seen at a considerable distance, the cathedral and the convents of Guadulupe and Monteserrato being the most conspicuous objects in view. These stand on the summits of two mountains about 2500 feet above the city, which is built at their base. The ascent is steep and difficult; but the labour of the traveller is amply repaid by the magnificent view which he obtains of the city, its convents and gardens, and the whole extent of the plain, with its villages, its hamlets, and cultivated fields. The city itself is somewhat in the form of an amphitheatre, and occupies a larger space than might seem requisite for the number of its inhabitants. The convents, with their extensive gardens, comprise a considerable portion of it; and the houses, on account of the earthquakes, are generally of but one story. The cathedral, built in 1814, possesses very little external beauty; but its interior is fitted up with considerable taste and elegance; its ornaments are rich and valuable; and the statue of the Virgin, who is the patron saint, is covered with a profusion of diamonds and other precious stones. The convents, formerly numerous (about 33), and many of them richly endowed, have of late years fallen into decay, and been devoted chiefly to the service of government, their revenues being mostly applied to educational purposes. There are still, however, about nine convents and three nunneries occupied by religious persons, of which the most wealthy and prosperous are those of Santo Domingo and San Juan de Dios, to which latter there is attached a hospital for the reception of the sick and wounded, affording accommodation to several hundred inmates, who are carefully attended by the friars, and plentifully supplied with everything requisite; besides which, food is here daily distributed to the poor. The convent of San Francisco is of great extent, and under good management. It contains many valuable paintings, the productions of Vasquez, a native artist of considerable merit; one of which, in particular, a Madonna with an infant Jesus, has been mentioned in terms of high commendation. Bogotá.

The university of Bogotá was founded in 1610, since which time two colleges have been endowed with large revenues for the purposes of education. The colleges are now three in number, and in them are educated nearly all the youth of these countries. Formerly the course of study was confined to Latin, mathematics, natural and moral philosophy, and theology; and even then the university produced some men of great eminence for their attainments in the natural sciences; among whom Mutis, Caldas, and Zea hold a distinguished place. Education.

In accordance with the new constitution signed on the 21st May 1853, and which has merited the applause of the liberal portion of the English and United States press, religion and education are completely free, and no forced contributions can be levied at any time or place to support any kind of worship. Foreigners and natives can practise their religion with every liberty, and keep their schools for the education of their children in the manner they may think best.

A military school is supported out of the public funds, which has produced some good engineers; and in some private colleges literature is taught along with the physical sciences, mathematics, and moral philosophy. The scientific and professional degrees have been abolished, and the personal accomplishments of each person alone determine his standing in society.

The mint is a large and handsome building, with coining machinery of great strength and solidity. All the departments are regulated with much precision and minuteness. This is the only mint in the republic of New Granada, with the exception of that of Popayan. We are informed by Humboldt, that from 1789 to 1795, 8,161,862 dollars were coined at Santa Fé de Bogotá, and, from 1788 to 1794, 6,502,542 dollars in Popayan. During the four years 1801–4 inclusive, the amount coined at Bogotá was 5,214,199 dollars, at Popayan, 3,554,878. After this period the coinage seems to have increased in amount, since in Santa Fé de Bogotá alone no less than 3,499,489, dollars were issued in 1806 and 1807. At present the coinage in Bogotá and Popayan is not considerable, because the precious metals are exported in bars or in dust since the duties on their exportation were abolished. The French decimal system in the monies has been adopted since 1847, and in all transactions French silver and other coins of a similar standard are used indiscriminately with the national coinage. These monies are received in exchange for tobacco, coffee, cocoa, gold, and other produce of the country. The gold coinage consists of ten, five, and two-dollar pieces, the ten-dollar piece weighs 16 grains, 409 milligrains, and contains 900 parts of pure gold, and 100 alloy. The doubloons of 16 dollars have been abolished. In public business transactions the French decimal system is universally adopted. Mint.

The square round the cathedral is beautified with a statue of Bolivar in bronze by Teneroni, and a large building constructed on the spot formerly occupied by the palace of the viceroys, and the town hall. In this building are held the sittings of the legislative assembly; also the offices of the ministry of finance, home department, municipality, and the local authorities, are in this building. There also are held the sittings of the provincial government, which, in a country enjoying perfect municipal institutions, is a very considerable body, as it issues laws on all subjects concerning the provinces without the government being able to interfere under any circumstances. The palace of the president is an old Jesuit college repaired and fitted up. The private houses are generally good, and the great influx of foreigners has improved the style of building. The streets, as in almost all cities built by the Spaniards in South America, are formed at right angles to each other; and all those extending from east to west have a small stream of water flowing along them, a convenience which might tend greatly to increase the comfort and cleanliness of the inhabitants, under an improved system of police. Only a few of the principal streets are provided with side pavements. There are four public squares or plazas provided with fountains, and five handsome bridges over two small rivulets which traverse the city.

A public market is held every Friday in the great square, where abundant supplies of all kinds of provisions are exposed for sale, and where may be seen an assemblage of all the varied

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classes which inhabit this country—the Creole, the Mulatto, the Mestizo, the Indian, and the Negro. The supplies of beef, mutton, pork, poultry, and game, are abundant, and moderate in price. Vegetables and fruit are also plentiful, and in the utmost variety; the vegetable productions of the tropical, the temperate, and even cold regions, being all easily attainable, in consequence of the diversified elevation of the surrounding country. One part of the market-place is appropriated to the sale of articles of native manufacture, which consist principally of coarse cotton and woollen fabrics. In the vicinity of the river Funza or Bogotá, which is here an inconsiderable stream, and runs close to the city, is situated the alameda or public promenade, which is inclosed on each side by gardens, and shaded by rows of stately poplars. This forms the favourite resort of the inhabitants during the delightful evenings of summer; and the surrounding gardens afford a place of resort to such parties as desire to solace themselves with the silver tones of their favourite guitar.

Inhabitants.

The society of Bogotá is very agreeable, the inhabitants being mild, polite, and cheerful. They are naturally fond of gaiety and amusements, as is evinced by the frequency of their *tertulias* or evening parties, their balls and concerts. The ladies are remarkably lively and pleasing in their manners: they are generally low in stature, but delicately formed, their feet and ankles being particularly small and handsome, which they set off to great advantage by the neatness of their shoes and silk stockings. The morning dress, in which they usually attend their devotions, consists of the *saya* and *mantilla*. The *saya* or skirt of black kersymere or silk, variously ornamented, fits closely to the body, and is well calculated to show off a fine figure: the *mantilla* covers the neck and shoulders, and sometimes the head, and is kept close to the body by the folded arms. The evening promenade dresses of the ladies are much more showy and diversified, both in form and texture, than those which are worn in the early part of the day, partaking a good deal of the fashions of Europe, which daily become more prevalent; and at their balls and *tertulias* they frequently display the additional ornaments of a profusion of rich and valuable jewels. They dance with much grace and elegance; and among the favourite dances of the country may be noticed the Spanish *contra-danza*, which, by its slow and graceful movements, is peculiarly well calculated to exhibit to advantage the fine figures which they possess in common with most other women of Spanish origin. The females of the inferior classes usually go without shoes or stockings, a practice which often forms a striking contrast with the rest of their attire, which in many cases is both showy and expensive.

Moral condition of the people.

The moral condition of the inhabitants of Bogotá has been variously estimated, and perhaps in most instances incorrectly. The political state of the country before the revolution was such as to afford little scope for the display of striking character. But the eventful scenes of the revolution have given rise to a development of character which shows that they possess in a high degree those qualities which are calculated, with the aid of an improved system of education, to raise them in the scale of civilized communities. Previous to the revolution, the men, besides their ordinary occupations or religious observances, had scarcely any other means of employing their leisure time than by devoting themselves to gambling, cock-fighting, and bull-baiting. The women, brought up in the most profound ignorance and superstition, devoted much of their time to religious matters, and in attendance on the numerous festivals and processions of the church. The want of a good and efficient education, the demoralizing influence of some of the religious practices there prevalent, and the comparatively little estimation in which virtuous conduct in females has hitherto been held, have tended materially to lower the tone of morals in the country. But a new epoch has at length dawned upon them; efficient means have been adopted to promote education and intelligence among all classes; and a purer system of ethics seems to be gradually introducing itself into the country, as has been shown, among other things, by the establishment of a Bible Society in Bogotá, under the able auspices of some of the most influential men of the country, and even aided by the Catholic clergy themselves. (Humboldt, *Essai Politique*: Humboldt, *Vue des Cordillères; Relation Historique des Voyages de MM. Humboldt et Bonpland*; Hall's *Present State of Colombia*; Mollien's *Travels in Colombia*, translated from the French; *Present State of Colombia*; Hamilton's *Travels in Colombia; Campaigns and Cruises in Venezuela, New Grenada, and the Pacific.*) (J. G.) (A. B.)

Bohaddin.

BOHADDIN, or, more properly, Boh-a-Eddyn, an eminent Arabian writer and statesman, better known in the East under the appellation of Ibn-Sjeddad. He was born at Mossul A.D. 1145 (A.H. 539), and early became eminent in the study of the Koran, as well as in jurisprudence. At the age of twenty-seven he obtained the place of lecturer at Baghdad, and, soon after, a professor's chair at Mossul. In 1187 he made the pilgrimage to Mecca, and then proceeded to visit Jerusalem and Hebron. In passing through Damascus he was sent for by Saladin, who was then employed in the siege of Kancab. Bohaddin observed, as he himself mentions (*Vita Saladini*, ch. v.), that the whole soul of the monarch was engrossed by the war which he was then waging against the enemies of the faith; and that the only mode of acquiring his favour was by urging him to its vigorous prosecution. With this view he composed a treatise on the *Laws and Discipline of Sacred War*; and this work, on his return, he presented to Saladin, who received it with peculiar favour. Bohaddin, from this time, remained constantly attached to the person of the sultan, and was employed in various important embassies and departments of civil government. That prince seems also to have sought, by the friendship of so eminent a doctor, to exalt his reputation for sanctity. Often, while riding through the ranks, Bohaddin rode by his side, and read to him passages out of the Koran. Bohaddin was now appointed judge of the army, and judge of Jerusalem. In this latter capacity an incident occurred which proves the impartial justice exercised by the sultan. A merchant presented himself at the tribunal of Bohaddin, and complained that he had been unjustly deprived of a large sum of money. On being asked to name the author of the injury, he replied "the sultan himself." Saladin, on learning the circumstances, denied the truth of the charge; but said that the man should have justice. Accordingly he was introduced into his presence; and the sultan, descending from his throne, pleaded his own cause before Bohaddin. The latter decided in favour of Saladin, and even hinted that the plaintiff merited chastisement. The sultan, however, dismissed the person not only unpunished, but with handsome presents.

Bohaddin continued in favour with Saladin during the whole of that monarch's life; and after his death, he was active in securing the throne to his son Melik-al-Dhaker. That prince created him kadi of Aleppo, which gave Bohaddin an opportunity of founding in that city a college, of which he himself was the principal professor. Under his auspices, the sciences, which had greatly declined in Aleppo, soon rose to more than their former lustre. When Melik-al-Dhaker died, his son Melik-al-Aziz was a minor, and Bohaddin obtained the principal sway in the regency. This gave him an opportunity of introducing learned men at court, and loading them with honours. As the prince, however, approached to manhood, Bohaddin, though he still retained his offices, found it expedient to retire from court. Even after he was unable to go to college, he continued to give lectures in his own house; and he persevered in these learned labours till the age of ninety, when he died A.D. 1235 (A.H. 633).

Bohaddin wrote on jurisprudence and Moslem divinity; but his principal work is his *Life of Saladin*; which, with several other pieces connected with the same subject, was published by Schultens, at Leyden, in 1732, accompanied by a Latin translation, with notes and a geographical index. This work affords a favourable specimen of the historical compositions of the Arabs. It is written with some spirit, and yet is free from that inflation which so frequently disfigures oriental composition. Whatever relates to Saladin, breathes the highest tone of panegyric; yet the enthusiasm with which everything concerning him is narrated, and the

Bohea || Bohemian Brethren.

anecdotes which the author, from his personal knowledge, is able to communicate respecting that extraordinary character, give his work a great degree of interest. (H. M.)

BOHEA, the name given in commerce to black teas, comprehending Souchong, Campo, Pekoe, Congo, and common Bohea. See TEA.

BOHEMIA. See AUSTRIA.

BOHEMIAN or MORAVIAN BRETHREN. Christianity was originally introduced into the Slavonian provinces lying between Germany and Turkey, not from Rome but from Constantinople, in the ninth century, under their native princes. In the tenth century Bohemia and Moravia were conquered by Otho I. of Austria, when, with imperial despotism, ecclesiastical domination was attempted to be enforced upon the inhabitants. Arms could subdue the land, and the law of the strongest compel the submission of an enslaved people, but neither violence nor priestcraft could subjugate or ensnare the conscience of the true converts to the gospel. These ever maintained the doctrines and the ordinances of their primitive church; and never relinquished the Scriptures in their own language, the holy communion in both kinds, and the right of their clergy to marriage. Though popery gradually gained ascendency among the multitude, with whom religion was a profession, those with whom it was a reality clave to that which they had received from their fathers, who had received it from the earliest age of the church on earth, whose teachers had been the apostles and evangelists, and Jesus Christ himself their "*One Master*."

In the thirteenth century, King Richard II. of England married a Bohemian princess, who had became acquainted with the disciples of our Wickliffe, "the morning star of the Reformation" both in England and Germany, as he has been worthily styled. The writings of this great light shining in a dark world, by the queen's correspondence with her native country, were transmitted thither, translated, and eagerly approved by the faithful in Bohemia and Moravia. Among these, in the fifteenth century, John Huss, for maintaining the Scriptural doctrines which they promulgated, was burned by the popish council of Constance. After his death a schism arose among his followers,—many taking the sword to fight for their faith, and a few choosing rather to perish by the sword than defend that faith with carnal weapons.

Out of the small peace party sprang "the United Brethren," as a distinct denomination, under episcopal government, having received the rite of ordination from the Waldenses. This little flock during the two next centuries, like their forerunners in all ages, were persecuted with unrelenting malignity by the bigoted priesthood; while, at the instigation of the latter, on sundry occasions war was waged against them by the Austrian tyrants under whose yoke they had been born. At length, about 1660, the remnant were either scattered through the adjacent provinces of Germany and Poland, or were compelled to hide themselves among the fastnesses of their native forests and precipitous mountains. Their last bishop, Amos Comenius, took refuge in England; and thinking that his people were about to cease from the earth, he commended their cause while they did yet exist to their pious brethren of the church of England, for the preservation of their memory and their name.

In the year 1650, was published in London, by certain refugees from Bohemia, for the information of Christians in England, *The History of the Bohemian Persecution, from the beginning of their conversion to Christianity, in the year* 894, *to the year* 1632, *Ferdinand the Second of Austria reigning, in which the unheard of secrets of policy, councils, arts, and dreadful judgments, are exhibited.* Printed by B. A. for John Walker, at the Star in Pope's Head Alley, M.D.C.L." This volume, which has now become very rare, was avowedly compiled as supplementary to Foxe's *Book of Martyrs*, to show in this country how much had been suffered on the Continent in "the dark places of the earth," which, as well as here, were "full of the habitations of cruelty and wickedness," during the death-pangs of expiring error, and the birth-pains of regenerating truth in the nominally Christian world. Bohemian Brethren.

The following specimen of the style and contents of this remarkable chronicle may suffice:—"New edicts were published in the name of the king and the consistory, that these pernicious men should nowhere be suffered either in Bohemia or Moravia. Hence it came to pass, that many, especially the chiefest among them, being dispersed among the woods and mountains, did dwell in caves where they were scarce secure enough; wherefore they dressed not their meat, nor made any fire but in the night only, for fear the smoke ascending should betray them; and in the extremity of the cold in winter nights, sitting near the fire, they gave themselves to reading of the Bible and holy discourses. When, in the depth of the snow they went forth to provide themselves necessaries, they went close together lest they should be discovered by their footsteps, and the hindermost did draw behind him a great bough of beech, to cover the print which their feet had made in the snow, that nothing might be seen but the impression of some country lad drawing a bush behind him."

About this period some of the persecuted refugees obtained protection and privileges from the English government; and the Church of Austin Friars, in the centre of London, was granted to one of the ministers of the Brethren, John de Lazco, with the distinct superintendence over the members of Protestant congregations from Bohemia, Moravia, Poland, and Hungary. Again, in the reigns of Charles II. and George I., the case of these sufferers was recommended by briefs read, and monies to be collected for their aid, in the churches throughout the kingdom; with the express sanction of two successive archbishops of Canterbury, who, with the Lord Chancellor, the Archbishop of York, and Bishops of London, Carlisle, Sarum, Norwich, and Bristol, were appointed trustees for the advancement of the charity. On both these occasions, the credentials of these foreigners, after rigid scrutiny, were avouched as follows:—"The Bohemian Church has been free from her infancy, and for almost 700 years, from the encroachment of the Roman See; crushed at length by its prevailing powers, she brought forth a progeny, which, growing up in Bohemia, obtained the name of UNITAS FRATRUM. This fraternity, the heir of the truly ancient faith, spread its boughs as far as Poland, renounced the errors of Popery, and preserved the succession of episcopal orders."

Amidst all their tribulations the Brethren *laboured* incessantly as well as *suffered* patiently, and in them were literally exemplified the declarations of the apostle concerning the ancient worthies:—they "had trial of cruel mockings and scourgings, yea, moreover, of bonds and imprisonments; they were stoned, they were tempted, were slain by the sword, being destitute, afflicted, tormented,—of whom the world was not worthy." From their origin till their apparent extinction towards the close of the seventeenth century, they were merely *a church of martyrs and confessors.* During the lucid intervals from persecution, they were the first people who employed the newly invented art of printing for the publication of *the Bible* in a living tongue, and three editions of the Bohemian Scriptures were issued by them before the Reformation. When Luther, Melancthon, Calvin, and Bucer, at length arose to testify the truth more successfully than they had been able to do, to each of these illustrious men the Brethren submitted their doctrinal tenets, their church discipline, and the records of their affairs; and from each, in return, they received assurances of cordial approbation and the kindest encouragement.

Sixty years after the suspended animation which followed the flight of Comenius from Moravia, the church of the United Brethren was raised from the dead. "*A remnant*

Bohol

was saved." A few individuals and their families gradually, and by stealth as it were, emigrated from their own country and found refuge on the estates of Count Zinzendorf, in Lusatia, where they built a humble village, and named it *Herrnhut*. This is still the principal settlement of the society, which has at this day affiliated stations, *Home* and *Missionary*, to the ends of the earth.

The United Brethren first appeared in England as a body before the middle of the last century, where (although the most malignant slanders were circulated against them), with the simplicity of conscious innocence, they laid their case before parliament, their doctrines, discipline, history, and character. These were scrupulously investigated by committees of both houses; and two bills, exempting them from taking oaths, and bearing arms in certain cases, were carried with the unanimous consent of all the bishops; indeed all opposition was abandoned after the final test of their claims; and they were thus fully acknowledged by the British legislature to be "*An Ancient Protestant Episcopal Church, which had been countenanced and relieved by the kings of England, his Majesty's predecessors.*" (See acts 20th Geo. II. cap. 44, and 22d Geo. II. cap. 30, passed in 1747 and 1748; also a Congratulatory Letter from Archbishop Potter to Count Nicholas Lewis Zinzendorf, one of their bishops, on his consecration; including this testimony: "I should be entirely unworthy of that high station in which Divine Providence has placed me, were I not to show myself very ready to use every exertion for the assistance of the universal church of God; but to love even preferably your Church, united with us in the bond of love; having hitherto, as we have been informed, invariably maintained both the pure and primitive faith and discipline of the first Church; being neither intimidated by dangers, nor seduced by the manifold temptations of Satan."

The revived Church of the United Brethren, on the estates of Count Zinzendorf, in Lusatia, including their expatriated countrymen and pious persons from other quarters, gradually multiplied through Germany, Denmark, Russia, Holland, and North America. But, when their number at Herrnhut scarcely amounted to 600 persons, when they had only rested from suffering, and were beginning to build their first church, and lay out their first burying-ground,—the missionary spirit was sent down upon them with such constraining influence, that in the short period of eight years, they had messengers of peace in Greenland, Lapland, North and South America.

At present (1853) the church of the Brethren numbers about 20,000 Europeans, and has 293 missionaries and 70 stations in Greenland, Labrador, and South America, the West Indies, South Africa, and Australia. The number of converts and heathen receiving instruction is as follows:—

British Subjects...	Negroes	30,741	
	Indians	205	
	Hottentots	6,191	
	Esquimaux	1,321	
			38,458
Danish	Negroes	10,252	
	Greenlanders	2,102	
			12,354
Dutch	Negroes		18,972
United States	Indians		286
		Total,	70,070

The annual expenses of carrying on this great work little exceed L.12,000, and of this sum about one-half is contributed by Christian friends of various other denominations,—a glorious example of that "*Charity which never faileth;*" and showing that it may still be said, as of old, "*See how these Christians love one another!*" (J. M—Y.)

BOHOL, or Bool, one of the Philippine Islands between Mindanao and Leyte, discovered by Magellan in 1521. It is in Long. 124. 15. E. Lat. 10. N., and is about 40 miles in length, and 32 in breadth. It produces some gold.

Boiardo.

BOIARDO, Count Matteo Maria, of a noble and illustrious house established at Ferrara, but originally from Reggio, was born at Scandiano, one of the seignoral estates of his family, near Reggio di Modena, about the year 1434, according to Tiraboschi, or 1420 according to Mazzuchelli. At an early age he entered the university of Ferrara, where he applied to his studies as regularly as if he had not been a person of quality, nor belonged to the privileged class He acquired the Greek and Latin, and even the oriental languages, and was in due time admitted doctor in philosophy and in law. At the court of Ferrara, where he enjoyed the favour of Duke Borso d'Este and his successor Hercules, he was invested with several honourable employments, and in particular named governor of Reggio, an appointment which he held in the year 1478. Three years afterwards he was elected captain of Modena, and re-appointed governor of the town and citadel of Reggio, where he died in the year 1494, though in what month is uncertain. Almost all of his works, and especially his great poem of the *Orlando Inamorato*, were composed for the amusement of Duke Hercules and his court, though not written within its precincts. His practice, it is said, was to retire to Scandiano or some other of his estates, and there to devote himself to composition; and Castelvetro, Vallisnieri, Mazzuchelli, and Tiraboschi, all unite in stating that he took care to insert in the descriptions of his poem those of the agreeable environs of his chateau, and that the greater part of the names of his heroes, as Mandricar, Gradasse, Sacripant, Agramant, and others, were merely the names of some of his peasants, which, from their uncouthness, appeared to him proper to be given to Saracen warriors. But be this as it may, the *Orlando Inamorato* deserves to be considered as one of the most important poems in Italian literature, since it forms the first example of the romantic epic worthy to serve as a model, and, as such, undoubtedly produced the *Orlando Furioso*. Gravina and Mazzuchelli have said, and succeeding writers have repeated on their authority, that Boiardo proposed to himself as his model the Iliad of Homer; that Paris is besieged like the city of Troy, that Angelica holds the place of Helen, and that, in short, the one poem is a sort of reflex image of the other. In point of fact, however, the subject-matter of the poem is derived from the *Fabulous Chronicle* of Turpin; and with the exception of the names of Charlemagne, Roland, Oliver, and some other principal warriors, who necessarily figure as important characters in the scene, there is not the least resemblance or analogy between the fable of the one and that of the other. This poem, which Boiardo did not live to finish, was printed at Scandiano the year after his death, under the superintendence of his son Count Camile. The title of the book is without date; but a Latin letter from Antonio Caraffa di Reggio, prefixed to the poem, is dated the kalends of June 1495. A second edition, also without date, but which must have been printed before the year 1500, appeared at Venice; and the poem was there twice reprinted during the first twenty years of the sixteenth century. These editions are the more curious and valuable, that they contain nothing but the text of the author, which is comprised in three books, divided into cantos, the third book being incomplete. But Niccolo degli Agostini, a mediocre poet, had the courage to continue the work commenced by Boiardo, adding to it three books, which were printed at Venice in 1526–1531, in 4to; and since this time no edition of the Orlando has been printed without the continuation of Agostini, wretched as it unquestionably is. Nor is this all. Successive rifacciamenti were executed by Domenichi and Berni, who took prodigious liberties, especially with the style, which they chose to consider as feeble, and ill suited to the high qualities of the poem in other respects; and the consequence has been, that the original composition has

Boileau-Despreaux.

been nearly overlaid by these innovations, and that the romantic epic invented by Boiardo is now almost universally read as remodelled by Berni. The other works of Boiardo are, 1. *Il Timone*, a comedy, Scandiano, 1500, 4to; 2. *Sonnetti e Canzoni*, Reggio, 1499, 4to; 3. *Carmen Bucolicon*, Reggio, 1500, 4to; 4. *Cinque Capitoli in terza rima*, Venice, 1523 or 1533; 5. *Apulejo dell' Asino d'oro*, Venice, 1516, 1518; 6. *Asino d'oro de Luciano, tradotto in volgare*, Venice, 1523, 8vo; 7. *Erodoto Alicarnasseo istorico, tradotto di Greco in Lingua Italiana*, Venice, 1533 and 1538, 8vo; 8. *Rerum Italicarum Scriptores*. (*Biographie Universelle;* Tiraboschi, *Storia della Letterat. Ital.* lib. c. 3. sect. 26, 33; Crescembeni, tom. i. and iii.) (J. B—E.)

BOILEAU-DESPREAUX, Nicolas, a celebrated French poet, born at Paris, or at Crosne, November 1. 1636. After he had gone through a course of literature and philosophy, his relations induced him to study the law, and he was admitted advocate at the age of twenty-one. But though he had all the talents necessary for the bar, he could not adapt himself to a science which turns upon continual equivocations, and often obliges those who follow it to clothe falsehood in the garb of truth; and it may be imagined that the dreamy tomes of Accursius and of Alciat afforded no congenial nourishment to the disciple of Horace and Juvenal. He accordingly deserted what his biographers call "l'antre de la chicane," and determined to study theology. He soon found, however, that scholastic divinity had its tricks and quirks as well as law; and imagined, that in order to allure him the more cunningly, chicanery, which he thought to avoid, had only changed her habit. Renouncing, therefore, the Sorbonne, he applied himself entirely to the study of the belles-lettres, and soon occupied one of the most distinguished places on the French Parnassus. The public gave his works the reception they deserved; and Louis XIV. not only had Boileau's works read to him as they were composed, but settled a yearly pension of 2000 livres upon him, and gave him the privilege of printing all his works. He was afterwards chosen a member of the French academy, and also of the academy of inscriptions. This great man, who was as remarkable for his integrity, his innocence, and diffusive benevolence, as for the keenness of his satire, died of a dropsy in the chest on the 13th of March 1711, in the seventy-fifth year of his age. The *Lutrin* of Boileau, still considered by some French critics as one of the best poems to which France has given birth, was first published in 1674. But it is with great reason and justice that Voltaire confesses it inferior to the *Rape of the Lock*. There are two actions recorded of Boileau, which sufficiently prove that the inexorable satirist had a most generous and friendly heart. When Patru, the celebrated advocate who was ruined by his passion for literature, found himself under the painful necessity of selling his extensive library, and had almost agreed to part with it for a moderate sum, Boileau tendered him a higher price, and, after paying the money, added this condition to the purchase, that Patru should retain, during his life, the possession of the books. Another instance of the poet's generosity is of a yet nobler character. When it was rumoured at court that the king intended to retrench the pension of Corneille, Boileau hastened to Madame de Montespan, and represented that his sovereign, equitable as he was, could not, without injustice, grant a pension to an author like himself, just ascending Parnassus, and withdraw it from Corneille, who had so long been seated on the summit; he entreated her, for the honour of the king, to prevail on his Majesty rather to strike off *his* pension than to withdraw that of a man whose title to that which he enjoyed was incomparably greater; and he declared that he could more easily console himself under the loss of that distinction, than under the affliction of seeing a just reward taken away from such a poet as Corneille. This magnanimous application had the success which it deserved; and it appears the more noble, that the rival of Corneille was the intimate friend of Boileau. The long and unreserved intercourse which subsisted between Boileau and Racine was highly beneficial and honourable to both. The dying farewell of the latter is the most expressive eulogy on the private character of Boileau: "*Je regarde comme un bonheur pour moi de mourir avant vous,*" said the tender Racine, in taking a final leave of his faithful and generous friend. As a satirist Boileau is inferior to Horace; but in his Epistles he almost equals his illustrious model; whilst in regularity of plan, felicity of transition, and a firm, sustained elegance of style, his *Art Poetique* will stand a comparison with the celebrated *Epistle to the Pisos*.

Boii || Boissard.

The works of Boileau consist of his *Satires;* his *Epistles;* his *Art of Poetry*, including his Epigrams, and some other pieces of French and Latin poetry; his *Dialogue on Poetry and Music;* a *Dialogue on the Heroes of Romance;* a *Translation of Longinus's Treatise on the Sublime*, with *Critical Reflections* on that author. The best edition of them, perhaps, is that with the notes and commentaries of M. Daunou, printed at Paris in 1809, in 3 vols. 8vo; but the edition of 1747 by Lefevre de Saint-Marc, in 5 vols. 8vo, with cuts, and accompanied with the remarks of Brossette, is the most *recherchée*. His life has been written by Desmaizeaux, Amst. 1712, 12mo.

BOII, a people of ancient Gaul, who made immigrations into Germany and Italy, and appear to have given their name to Bohemia and to Bologna. (*Niebuhr*).

BOILING, the effect produced on liquids by the application of heat sufficient to convert them rapidly into vapour, with the phenomena of ebullition. The boiling point varies greatly in different liquids, and is also affected by the degree of atmospheric pressure, being higher when the pressure is increased, and lower when it is diminished. When the barometer stands at 30 inches, the boiling point of water is 212° Fahr., and it is found to vary 0·88 of a degree for each half inch of barometric variation: consequently, for every variation of one-tenth of an inch in the barometer, the boiling point of water is altered 0·176 of a degree. Hence water will boil sooner at the top of a mountain than at its base; and thus a method is afforded for determining its height. Water boils *in vacuo* at 98° Fahr. Under a uniform barometric pressure of 30 inches, mercury boils at 662°; alcohol at 176°; ether at 96°; and oil of turpentine at 316° Fahr.

Boiling Springs. See Iceland; Physical Geography.

BOIS-LE-DUC, or Hertogenbosch, a city of Holland, capital of the province of North Brabant, 28 miles S.S.E. of Utrecht. It stands at the confluence of the Dommel and the Aa, and is strongly fortified, being defended by a citadel and two forts. The city is handsome and well built, and is intersected by several canals. It contains seven churches, among which is that of St John, founded in the beginning of the fourteenth century, and one of the finest ecclesiastical edifices in Holland. It has also a handsome town-hall, surmounted by a tower containing a fine set of chimes, an orphan asylum, grammar-school (once attended by Erasmus), prison, two hospitals, an arsenal, and barracks for 3000 troops. The trade of Bois-le-Duc is very considerable: it has several distilleries and glass-works, and manufactures of linen, needles, cutlery, &c. It is the seat of a vicar-general, and has tribunals of primary instance and commerce. Pop. 21,000.

BOISSARD, Jean Jacques, a classical antiquary and Latin poet, born at Besançon in 1528. He studied at Louvain; but, disgusted by the severity of his master, he secretly left that seminary, and after traversing a great part of Germany reached Italy, where he remained several years, and was often reduced to great straits. His residence in Italy developed in his mind a taste for antiquities, and he soon formed a collection of the most curious monuments of Rome and its vicinity. He then visited the islands of the Archipelago, with the intention of travelling through Greece, but a severe illness obliged him to return to Rome. Here he resumed his favourite pursuits with great ardour; and

Bojador || Bolingbroke.

having completed his collection, returned to his native country. But not being permitted to profess publicly the Protestant religion, which he had embraced some time before, he withdrew to Metz, where he died, Oct. 30. 1602, aged seventy-four. His works are:—

1. *Poemata, Epigrammatum libri tres, Elegiæ libri tres, Epistolarum libri tres*, Basle, 1574; 2. *Emblemata*, Latin and French, Metz, 1584; 3. *Emblemata*, Latin, Francfort, 1595; 4. *Vitæ et Icones Sultanorum Turcicorum*, &c., Francfort, 1596; 5. *Theatrum Vitæ Humanæ*, Metz, 1596; 6. *Romanæ Urbis Topographiæ et Antiquitatum, quibus succincte et breviter describuntur omnia quæ tum publice quum privatim videntur animadversione digna, partes vi.*, Francfort, 1597, 1598, 1600, and 1602, folio, six tomes in three, with plates, and now very rare; 7. *Icones et Vitæ Virorum Illustrium*, Francfort, 1592 to 1599; 8. *Parnassus Biceps*, Francfort, 1601; 9. *De Divinatione et Magicis præstigiis*, Oppenheim and Hanau, rare and curious; and, 10. *Habitus Variarum Gentium*, Metz, 1581, ornamented with seventy illuminated figures.

BOJADOR, a cape of Western Africa, which projects considerably into the sea, and presents a very rugged and dangerous aspect. The Portuguese were long deterred by it from prosecuting their career of discovery in this direction. It was at length passed by Gellaney; and vessels navigating the Atlantic now stand too far out to sea to be exposed to any danger. Lat. 26. 7. N. Long. 14. 29. W.

BOKHARA. See Bukharia.

BOL, Ferdinand, a Dutch painter, born at Dordrecht about 1610, was one of Rembrandt's most distinguished pupils. His works are chiefly found at Amsterdam, where he died in 1681 or 1686.

BOLABOLA, or Borabora, one of the Society Islands, in the South Pacific Ocean. It is about twenty-four miles in circumference, and is surrounded by a reef of rocks and islets. A very lofty double-peaked mountain rises in the centre. There is a border of low land along the coast, which is very fertile, and covered with cocoa-nut and bread-fruit trees. The island is populous, and the inhabitants are of a more warlike disposition than their neighbours, some of whom they have subdued. Long. 151. 52. W. Lat. 16. 32. N.

BOLBEC, a town of France, capital of a canton of the same name, in the department of Lower Seine, on the Bolbec, and on the railway from Paris to Havre, 18 miles E.N.E. of the latter. It is a handsome and flourishing manufacturing town; the streets are wide and well laid out, and the suburbs contain many neat houses. The principal manufacture is cotton; besides which it has woollen and linen factories, dye-works, and tanneries. Pop. 9000.

BOLE, an opaque, earthy mineral, occurring in solid amorphous masses, of a yellow, red, or brownish colour. It yields to the nail, and cuts easily, has a conchoidal fracture, with a shining streak, and adheres to the tongue. Its specific gravity is between 1·60 and 2·00, and when thrown into water it emits a crackling noise, and falls to pieces. It occurs in wacké and basalt at Striegau in Silesia, at Habichtswald in Hessia, near Sienna in Tuscany, and among the cliffs of the Giant's Causeway, Ireland. Armenian bole is used as a coarse red pigment.

BOLEYN, Anne. See Anne Boleyn.

BOLI, a town of Asiatic Turkey, in Natolia, 85 miles N.W. of Angora. It is the capital of a district, and the residence of a governor, and contains numerous public edifices, though nowise remarkable in their structure. In the vicinity are the ruins of the ancient Hadrianopolis, and many marble fragments with Greek inscriptions. The country around is fertile; and in the neighbourhood is an extensive forest, which supplies Constantinople with a great quantity of wood. Long. 31. 19. E. Lat. 40. 35. N.

BOLINGBROKE (Henry St John) Viscount, was the only son of Sir Henry St John, a baronet of ancient family, and was born on the 1st of October 1678, at the family seat at Battersea. During the early years of his life he was intrusted to the care of his grandmother, a rigid and somewhat fanatical Presbyterian, from whose religious adviser, Daniel Burgess, the future orator received the rudiments of his education. Burgess, like his patroness, was somewhat of a fanatic, and was more desirous to indoctrinate his pupil in the principles of the Presbyterians, than in the languages of ancient Greece and Rome. To the injudicious rigour of his discipline may be traced that prejudice against religion which taints the most elaborate of St John's compositions. The time came at length when the pupil was delivered from the jurisdiction of both his grandmother and tutor, and to his great joy he was sent to Eton. Nothing is known of his history at that college, save that he made the acquaintance of Robert Walpole. The future statesmen were even at this early period rivals, and the bitter malignity with which Bolingbroke in after life assailed the great minister is said to have arisen out of the quarrels of their school days. From Eton he went to Christ Church, Oxford, where he astonished his tutors by the extraordinary quickness of his apprehension and the strength of his memory; while he dazzled his fellow-students by the splendour of his appearance and the wit and brilliancy of his conversation. From Oxford he removed to London, where he persisted for a time in his career of debauchery with such success that he came to be regarded by the most licentious men of the age as an irreclaimable libertine, and by such of them as remembered the days of Charles II., was likened to the infamous Rochester. Even Swift does not attempt to defend this period of his life, but expresses his belief that he lived long enough to regret and repent of it. The intervals of his excesses he employed in writing poetry; and when Dryden published his translation of Virgil, he recommended it in a copy of verses prefixed to the first edition of that work. His next public appearance was made in 1700, when he gave to the world an ode entitled *Almahide*, which was so bad that it did not elicit even a hostile criticism. A few other pieces which he wrote at this time have not been preserved. About this time he went abroad and travelled on the Continent for two years, spending the most of his time in France and Italy. The knowledge of French which he was in this way enabled to acquire was of signal service to him in after life. In 1700 he married the daughter of Sir Henry Winchescomb, with whom he received a handsome fortune; but so incompatible was his temper with that of his bride, that in a short time they were formally separated. In the following year he began his political career, by representing in parliament the borough of Wootten Basset. The family to which he belonged had been known for several generations as firm supporters of the Whig faction; but the young member consulted at once his interests and his inclination by siding with the Tory party, then promising to become dominant in England. Harley was at this time speaker in the House of Commons; and his dexterity was such as to make him respected alike by his own friends and the Opposition. To Harley St John attached himself, and so effectually did he assist him in difficult conjunctures with the whole weight of his personal and family interest, and the fire of his splendid eloquence, that when Harley was made secretary of state in 1704, St John, as a reward for services, was appointed secretary at war. In 1707, after a long series of court intrigues, the queen was induced to dismiss her secretary, and St John, hitherto consistent, immediately gave in his resignation. He retired not only from office but from parliament, and for the next two years devoted himself wholly to study. These two years he repeatedly mentions as the happiest of his life. It was not long, however, before he was called upon to quit his retirement and direct his attention once more to public affairs. While St John was thinking and writing in the solitude of the country, Harley, after the manner of these days, had been busily intriguing at court. The result of his machinations was that the Whigs were in their turn ousted, and the Tory administration once more reinstated. Harley

Bolingbroke.

Boling-broke.

became chancellor of the exchequer. St John took office as secretary of state in 1710, and was soon acknowledged ministerial leader in the House of Commons. Circumstances, however, soon transpired which made it apparent that these two men, hitherto so true to each other, could no longer act in concert. For when in 1712, Harley, now Lord Oxford, refused to secure for his late coadjutor a rank in the peerage equal to his own, St John's indignation knew no bounds. He resolved, however, for the ultimate advancement of his interests, to maintain at least the appearance of friendship with the successful minister. Mr St John was therefore in the meantime obliged to content himself with the title of Viscount Bolingbroke. His ambition, however, was far from being satisfied even with so honourable a distinction, and he now determined to turn against his ancient friend and ally the very weapons by means of which that friend had cleared his way to power. He was no less skilful in the conduct of a court intrigue than Oxford himself had been, and at length, through the influence of Mrs Masham the queen's favourite, whose good graces he had cultivated assiduously for two years, he obtained the dismissal of the lord treasurer in 1714. Two years before this consummation he had been sent as ambassador to the French court, and his conduct while there was such as to justify his enemies in the clamorous outcry which they raised against him. It was suspected, and not without reason, that Bolingbroke's object in visiting Paris was not so much to negotiate the details of a general peace, as to make arrangements for the restoration of the exiled royal family. It was reported in England that he had had at least one interview with the Pretender; it is now clearly ascertained that he had two. His conduct, which had long been most suspicious, was now openly canvassed with the utmost freedom. His useless and wanton treachery in the matter of the peace of Utrecht was remembered against him; the readiness with which he had deserted his party and his old patron Oxford, when the opposition was once more in the ascendant, was not forgotten; and even the follies and vices of his early manhood were cast up to him. These circumstances all marked him out as a man eminently unscrupulous, and reckless of the national honour, when it interfered with the prospects of his personal advancement. The airy fabric of his ambition, however, was overthrown by a circumstance of which he had never contemplated the possibility, and which he could not prevent. The queen died; George I. was quietly proclaimed; and the ambitious secretary was deprived of the seals. Harley laboured under the same suspicions with himself: each was suspected of favouring the cause of the Pretender, though from different motives. It was now resolved that both of them should be impeached. Bolingbroke received notice of his impending danger and fled to France, where he was warmly welcomed by the Pretender and his party, and pressed to accept the office of secretary. This office he held for a very short time. He failed as completely to secure the confidence of his new master as of his old partizans in England, and in 1716 was dismissed. In 1718 his wife died. Two years after he married the Marquise de Villette, the niece of Madame Maintenon, a widow of large fortune. He resided for some years upon his wife's property, devoting his time entirely to literary pursuits, and the entertainment of literary men. Amongst others who visited him in his retreat was the young Voltaire, who submitted to him the manuscript of the *Henriade*, which he had just completed. It was now that he composed his *Reflections upon Exile*. In 1723 he was informed that he was at liberty to return to England. He accordingly returned to his native country, where he remained, however, for a very short time. He soon returned to France, and removed thence to Aix-la-Chapelle. In 1724 he once more revisited England, and had the satisfaction of learning in the following year that the bill of attainder against him was reversed, and that he was now at liberty to resume his title and his fortune. Provision, however, had been expressly made that he should never again cross the threshold of the House of Lords. This qualified pardon Bolingbroke attributed to the influence and intrigues of Sir Robert Walpole. His old hostility against that minister revived, and for ten years he opposed his policy with all the bitterness and malignity of which he was capable. His invectives he published in the form of letters, under the title of *The Occasional Writer*. The success which attended these letters, and another series that appeared in a paper called the *Craftsman*, was so great as to place their author above all the political pamphleteers of the day, Swift alone excepted. Some of these contributions were afterwards republished, and have descended to us as the *Letters on the History of England*. So great was the impression they produced that the government prosecuted the publisher, and menaced the author in a manner that elicited from him one of the most brilliant and witty of all his compositions. Finding at length that, on the accession of George II. his hopes of political preferment were blighted for ever, he resolved to retire to France, and devote the remainder of his days to the study of history and philosophy. He set out for the Continent with his wife early in 1735, and did not again visit England till summoned by the death of his father in 1742. Bad health once more drove him to France, and shortly after to the baths of Aix-la-Chapelle. In 1744 he bade a last farewell to the Continent. He returned to England only to find that all the friends of his early years had passed away. Gay, Prior, Atterbury, and Windham were gone; Swift had recently died; and Pope did not survive him long. By his will the great poet appointed Bolingbroke his literary executor, and made over to him all his manuscripts "to preserve or to destroy." None of these documents were allowed to see the light, and the statesman ever persecuted the memory of the poet with a rancour that has not yet been satisfactorily explained. From this time till his death he devoted all his time and energies to correcting and arranging his works for posthumous publication. Lady Bolingbroke, whose health had been for a long time declining, died in 1750, and on the 15th December 1751, her husband closed his stormy career. He was buried beside his wife in the family vaults at Battersea, where a long epitaph, written by himself, records his history, his virtues, and his misfortunes.

Boling-broke.

Bolingbroke's fame with posterity will rest chiefly on his oratory. No specimen of his oratorical powers has descended to our times, save a small fragment, of which the finest passage is avowedly borrowed from Demosthenes. When we recollect, however, the great natural advantages he possessed, the splendour of his personal appearance, his clear and powerful voice, and his action unsurpassed for ease and grace; when we remember, moreover, his great natural endowments, which he had taken care to improve by long and severe study, his great acquaintance with history, his brilliant wit, and the copious felicity of his diction, we cannot but believe that he takes rank as on the whole the greatest of British orators. Such was the opinion of Pitt, who, on one occasion discoursing on the lost treasures of the past, and hearing his friends lament, one the lost books of Livy, another those of Tacitus, declared that for his part he regretted most of all the speeches of Bolingbroke. Such, too, is the opinion of Lord Brougham, the greatest orator of our own day. As a writer his influence has long since passed away—a circumstance which made Burke ask "Who now reads Bolingbroke?" As a speculator he merits little gratitude from posterity. When Dr Johnson was asked his opinion of Bolingbroke's ethical works, he replied "Bolingbroke, sir, was a scoundrel and a coward; he loaded a blunderbuss against Christianity, which he had not the courage to fire during his lifetime; but left half-a-crown to a hungry Scotsman to draw the trigger after he was dead." The "hungry Scotsman" here alluded to was David Mallet, to

Bolivar. whom Bolingbroke intrusted the publication of his works. They appeared, in a handsome edition in 5 vols. 4to, Lond., 1754. They were afterwards reprinted, with a life by Goldsmith, in 8 vols. 8vo, 1809.

BOLIVAR, SIMON, the hero of South American independence, was born in the city of Caraccas, on the 24th July 1783. His father was Don Juan Vicente Bolivar y Ponte, and his mother Dona Maria Concepcion Palacios y Sojo, both descended of noble families in Venezuela. After acquiring the elements of a liberal education at home, Bolivar was sent to Europe to prosecute his studies, and with this view repaired to Madrid, where he appears to have resided for several years. Having completed his education, he spent some time in travelling, chiefly in the south of Europe, and visited the French capital, where he was an eye witness of some of the last scenes of the revolution. Returning to Madrid, he married the daughter of Don N. Toro, uncle of the marquis of Toro in Caraccas, and embarked with her for America, intending, it is said, to dedicate himself to domestic life and the improvement of his large estate. But this plan was frustrated by the premature death of his lady, who fell a victim to yellow fever; and Bolivar again visited Europe, in order, by change of scene, to alleviate the sorrow occasioned by this bereavement.

On his return home he passed through the United States, where, for the first time, he had an opportunity of observing the working of free institutions; and soon after his arrival in Venezuela he appears to have embarked in the schemes of the patriots, and pledged himself to the cause of independence. Being one of the promoters of the movement at Caraccas in April 1810, he received a colonel's commission from the supreme junta then established, and was associated with Don Luis Lopez Mendez in a mission for communicating intelligence of the change of government to Great Britain. He took part in the first military operations of the Venezuelan patriots, after the declaration of independence on the 5th of July 1811; and in 1812, when the war commenced in earnest, by the advance of Monteverde with the Spanish troops, he was intrusted with the command of the important post of Puerto Cabello. But the castle of San Felipe, which commanded the town, having been treacherously surrendered to the Spaniards, Bolivar was compelled to evacuate the place; and Miranda having soon afterwards made his peace with the government, Venezuela submitted to Monteverde, while those who had been most deeply committed in the revolution consulted their safety by quitting the country. On this occasion Bolivar succeeded in obtaining a passport under a fictitious name, and made his escape to Curaçoa.

But as important events were passing on the continent, he repaired to Carthagena in September 1812, and, with other refugees from Caraccas, joined the patriots of New Grenada, who gave him a command in the small town of Baranca, under the orders of Labatut, the republican governor of Santa Martha. Not content, however, with the obscure part of a subaltern at Baranca, Bolivar undertook an expedition against Teneriffe, a town higher up on the Magdalena; and having made himself master of the place, proceeded to Mompox, driving the Spaniards before him from all their posts on the Upper Magdalena, and finally entering Ocaña in triumph amidst the acclamations of the inhabitants. He then marched upon Cucuta; defeated a Spanish division commanded by Correa; and, emboldened by success, conceived the design of invading Venezuela, and expelling Monteverde. The congress of New Grenada approved of the project, and gave him a commission as brigadier; but from the jealousy of some, the lukewarmness of others, and the procrastination of all, many disheartening obstacles were thrown in his way. By zeal and Bolivar. perseverance, however, he at length surmounted every difficulty, and commenced his march for Venezuela with little more than 500 men. At the head of this handful of troops he boldly entered the province of Merida; made himself master of the provincial capital, where, on learning the news of his approach, the inhabitants rose upon the Spaniards; re-established the republican authorities there; then pushed his vanguard under Jirardot upon Trujillo, where a corps of royalists under Cañas was defeated; and finally expelled the Spaniards from the provinces of Merida and Trujillo. While he was thus carrying every thing before him, Bolivar obtained intelligence of the cruelty and oppression exercised by Monteverde and his subordinate officers in Venezuela; and, exasperated at their barbarity, as well as desirous to give a check to their excesses, he issued the famous decree of *guerra a muerte*, condemning to death all Spanish prisoners who might fall into his hands.

Bolivar's army increasing daily, he now formed it into two divisions, one of which he committed to the charge of Rivas, and advanced rapidly on Caraccas through the provinces of Trujillo and Varinas. After a variety of encounters, which generally terminated in favour of the patriots, a decisive battle was fought at Lastoguanes, where the flower of Monteverde's troops sustained a total defeat, and the road to Caraccas was in consequence left uncovered. Monteverde threw himself into Puerto Cabello, and Bolivar lost no time in marching on the capital, which being evacuated by the Spaniards, he entered in triumph on the 4th of August 1813. While this operation was in progress, Mariño effected the liberation of the eastern provinces of Venezuela, of which, excepting the fortress of Puerto Cabello, the patriots regained entire possession. At this period the whole authority in Venezuela centred in Bolivar as commander of the liberating army; and a convention of the principal civil and military officers, held at Caraccas on the 2d of January 1814, confirmed the dictatorial power which circumstances had placed in his hands. Misfortune, however, was at hand.

The contest, which had hitherto been confined to a species of partisan warfare, now assumed a more serious character. The royalists, effectually roused by the reverses they had sustained, concentrated all their means; and a number of sanguinary encounters ensued. At length, after various vicissitudes of fortune, Bolivar was defeated by Boves near Cura, in the plains of La Puerta, and compelled to embark for Cumana with the shattered remains of his forces. Caraccas was also retaken by the Spaniards in July; and before the end of the year 1814 the royalists were again the undisputed masters of Venezuela. From Cumana Bolivar repaired to Carthagena, where he once more appeared as a fugitive, and thence proceeded to Tunja, where the congress of New Grenada was sitting, in order to render an account of his operations. He had been unfortunate, which generally exposes a commander to misconstruction and obloquy; and his expedition, as brilliant in its outset as it proved disastrous in the issue, was severely criticised. But notwithstanding his misfortunes, and the efforts of his personal enemies, he was received and treated with great consideration; and as the congress were then organizing an expedition against Bogota, for the purpose of compelling Cundinamarca to accede to the general coalition of the provinces, Bolivar was intrusted with the command of the forces of the union on this occasion. Accordingly, in December 1814 he marched against Santa Fe at the head of 2000 troops. All attempts at negociation having failed, he invested the city, drove in the out-posts, carried the suburbs by storm, and was preparing to assault the grand plaza or square, where Alvarez and the troops of Cundinamarca were posted,

Bolivar. when the latter capitulated and acknowledged the general government of New Grenada, which was now transferred to Bogota. For this important service Bolivar received the thanks of the congress; and even the inhabitants of the city against which he had been sent expressed their approbation of his conduct.

In the meanwhile Santa Martha had fallen into the hands of the royalists, through the incapacity of Labatut; and as the general government appreciated the importance of recovering possession of that place, Bolivar was employed on this service, with orders to receive the necessary supplies and munitions of war from the citadel of Carthagena. But the preposterous jealousy of Castillo, the military commandant, defeated all his plans. The season for action was wasted in disgraceful altercations and ruinous delays; and while Bolivar was investing Carthagena, in the hope of intimidating Castillo into submission, Morillo landed on the island of Margarita at the head of an overwhelming force of Spaniards, and put an end to dispute. Finding a check thus effectually given to any movement against Santa Martha, and satisfied that he could not be usefully employed at Carthagena, Bolivar resigned his command, and embarked for Jamaica in May 1815. He remained at Kingston during the greater part of the year, whilst Morillo was reducing Carthagena and overrunning New Grenada almost without opposition; and in the interim narrowly escaped assassination by a Spaniard who had been hired to make an attempt on his life.

From Kingston Bolivar repaired to Aux Cayes in Hayti, where, assisted by private individuals, and furnished with a small force by Petion, he organized an expedition, in order to join Arismendi, who had raised anew the standard of independence in the island of Margarita. In May 1816 he reached Margarita, and sailing thence, landed on the continent near Cumana; but being attacked at Ocumare by the Spaniards under Morales, he was compelled to re-embark. Nothing disheartened by this failure, he obtained fresh reinforcements at Aux Cayes, and in December landed again in Margarita, where he issued a proclamation convoking the representatives of Venezuela in a general congress. He then proceeded to Barcelona, where he organized a provisional government, and assembled troops to resist Morillo, who was then advancing at the head of a strong division. The hostile forces encountered each other on the 16th of February 1817, when a desperate conflict ensued, which lasted during that and the two following days, and ended in the defeat of the royalists. Morillo retired in disorder, and being met on his retreat by Paez with his llaneros, experienced a new and more complete overthrow. Being now recognised as commander-in-chief, Bolivar proceeded in his career of victory, and before the close of the year had fixed his head-quarters at Angostura. But as the military operations of this and the following year belong rather to the history of Colombia than to the biography of Bolivar, the reader is referred to that head for an account of them. He presided at the opening of the congress of Angostura on the 15th of February 1819, when he submitted an elaborate exposition of his views on government, and also surrendered his authority into the hands of congress. Being, however, required to resume his power, and retain it until the independence of the country should be completely established, he re-organized his troops, and set out from Angostura, in order to cross the Cordilleras, effect a junction with General Santander, commanding the republican forces in New Grenada, and bring their united means into action against the common enemy. This bold and original design was crowned with complete success. In July 1819 he reached Tunja, which he entered, after a sharp action on the adjoining heights; and on the 7th of August he gained the victory of Bojaca, which gave him immediate possession of Santa Fe and all New Grenada. Nor was this all. By the resources of men, money, and munitions of war, which he found at Bogota, he was enabled to augment the effective strength of his army, and to return to Venezuela with a force sufficient to insure the expulsion of the Spaniards. Bolivar.

The campaign of New Grenada is unquestionably Bolivar's most brilliant achievement, and deserves much of the praise which has been lavished on it. His return to Angostura was a sort of national festival. He was hailed as the deliverer and father of his country, and all manner of distinctions and congratulations were heaped upon him. He availed himself of this favourable moment to obtain the enactment of the fundamental law of the 17th December 1819, by which the republics of Venezuela and New Grenada were henceforth united in a single state, under his presidency, by the title of the republic of Colombia. The seat of government was also transferred provisionally to Rosario de Cucuta, and Bolivar again took the field. Being now at the head of the most numerous and best appointed army the patriots had yet assembled, he gained important advantages over the Spaniards under Morillo, and on the 25th November 1820 concluded at Trujillo an armistice of six months, probably in the hope that the Spaniards would now come to terms, and that the further effusion of blood might be spared. If such were his views, however, they were disappointed. Morillo was recalled; Torre assumed the command; and the armistice was allowed to expire without any pacific overture being made. As a renewal of the contest was therefore inevitable, Bolivar resolved, if possible, to strike a decisive blow; and this accordingly he did at Carabolo, where he vanquished Torre, and so completely destroyed the Spaniards, that the shattered remains of their army were forced to take refuge in Puerto Cabello, where two years after they surrendered to Paez.

The battle of Carabolo may be considered as having put an end to the war in Venezuela. On the 29th June 1820 Bolivar entered Caraccas, and by the close of the year the Spaniards were driven from every part of the country except Puerto Cabello and Quito. The next step was to secure, by permanent political institutions, the independence which had now been conquered; and accordingly, on the 30th of August 1821, the present constitution of Colombia was adopted with general approbation, Bolivar himself being president, and Santander vice-president.

Having thus achieved the independence of his own country, Bolivar next placed himself at the head of the army destined to act against the Spaniards in Quito and Peru. The fate of Quito was decided by the battle of Pichincha, which was fought in June 1822, and gained by the conduct and prowess of Sucre. Bolivar then marched upon Lima, which the royalists evacuated at his approach; and entering the capital in triumph, he was invested with absolute power as dictator, and authorized to call into action all the resources of the country. But being violently opposed by some of the factions which then distracted Peru, and unable to make head against their intrigues, he was obliged to withdraw to Trujillo, leaving the capital to the mercy of the Spaniards under Canterac, by whom it was immediately occupied. This success, however, proved only temporary. By June 1824 the liberating army was completely organized; and taking the field soon after, it routed the vanguard of the enemy. Improving his advantage, Bolivar pressed forward, and on the 6th of August defeated Canterac on the plains of Junin; after which he returned to Lima, leaving Sucre to follow the royalists in their retreat to Upper Peru; an exploit which the latter executed with equal abi-

Bolivar. lity and success, gaining a decisive victory at Ayacucho, and thus completing the dispersion of the Spanish force. The possessions of the Spaniards in Peru were now confined to the castles of Callao, which Rodil maintained for upwards of a year, in spite of all the means that could be employed for their reduction. In June 1825 Bolivar visited Upper Peru, which having detached itself from the government of Buenos Ayres, was formed into a separate state, called Bolivia, in honour of the liberator. The first congress of the new republic assembled in August 1825, when Bolivar was declared perpetual protector, and requested to prepare for it a constitution of government.

We now come to what may be considered as the second part in the biography of Bolivar. Hitherto we have been almost exclusively occupied in tracing his military career; at first uncertain, and marked by great reverses, but afterwards illustrated by a series of victories which, although fortune frequently favoured his enterprises, were principally owing to his own courage and constancy, aided by very considerable military genius. But from the period at which we have arrived, he appears before us in the capacity of a lawgiver; and imputations on the purity of his political views, whether well founded or the reverse, seem to have been contemporaneous with his attempts to consolidate the governments which owed their existence to his military prowess. Our present business, however, is with facts. In December 1824 he convoked a constituent congress for the February ensuing, and this body assembled accordingly; but, owing to the unsettled state of the country, the dictatorial power was vested in Bolivar for another year, and a grant of a million of dollars was offered him, which, however, he declined. The congress soon adjourned, and the dictator remained absolute governor of Peru. There is no evidence that he abused the power thus intrusted to him. Residing partly at Lima and partly at Magdalena, he directed the acts of the government, and also proposed the celebrated congress at Panama for establishing an alliance between all the independent states of America. His project of a constitution for Bolivia was presented to the congress of that state on the 25th May 1826, accompanied with an address, in which he embodied his opinions respecting the form of government which he conceived most expedient for the newly-established republics. Of this code some account will be found in the article Bolivia; but its most extraordinary feature consisted in the provision for lodging the executive authority in the hands of a president for life, without responsibility, and with power to nominate his successor. This alarmed the friends of liberty, and excited lively apprehensions amongst the republicans of Buenos Ayres and Chili; whilst, in Peru, Bolivar was accused of a design to unite into one state Colombia, Peru, and Bolivia, and to render himself perpetual dictator of the confederacy.

And it must be confessed that the conduct of the liberator gave some colour to these imputations. By the surrender of the castles of Callao, Peru was completely freed from the Spaniards, and the object which Bolivar professed to have had in view was accomplished. Yet he manifested no intention of resigning his authority, and departing from the country. On the contrary, when the deputies for the constituent congress of 1826 assembled, they were induced to decline acting in their legislative capacity; whilst a majority of their number published an address, urging Bolivar to continue at the head of affairs for another year, and, in the meanwhile, requesting him to consult the provinces individually respecting the form of government which they would prefer, and the person who should be placed at its head. He complied with this request, which he had probably suggested; circular letters were addressed to the prefects of departments, commanding them to assemble the electoral colleges, and to submit for the sanction of these bodies a constitution similar in all respects to the Bolivian code; and this constitution was adopted by the colleges, which, with an unanimity perfectly extraordinary, nominated Bolivar president for life. We are too distant from the scene of these events, and too near the time of their occurrence, to be able to judge accurately as to the means by which this unanimity was produced in a country which, above all others, was distracted by factions, and a prey to intestine commotions. Bolivar.

In the meanwhile the affairs of Colombia had taken a turn which demanded the presence of Bolivar in his own country. During his absence Santander had administered the government ably and uprightly; its independence had been recognised by other countries; and its territory had been subdivided into departments, defined by geographical boundaries analogously to that of France. But Paez, who commanded in Venezuela, having been accused of arbitrary conduct in the enrolment of the citizens of Caraccas in the militia, refused obedience to the summons of the senate, and placed himself in a state of open rebellion against the general government; whilst the disaffected party, taking advantage of this collision, united with the refractory commander, and encouraged him in his opposition, by which means the northern departments became virtually separated from the rest of the republic. All, however, professed a willingness to submit their grievances to the decision of Bolivar, and equally required his return to Colombia. But the factious jarrings to which we have adverted did not rest here. Whilst these movements were taking place in Venezuela, various municipalities of the southern departments, which had originally constituted the presidency of Quito, held public meetings, at which the Bolivian code was adopted, and the supreme authority lodged in Bolivar as dictator. Whether these proceedings were in accordance with the wishes of Bolivar or not, it is impossible to affirm with any degree of certainty. It has been generally believed, indeed, that the meetings in question were summoned, and the resolutions suggested, by Leocadio Guzman, an emissary of Bolivar's; and some have even alleged that Paez was incited and encouraged by hints from the same quarter. But be this as it may, the actual state of affairs, however produced, was such as demanded the presence of Bolivar.

Accordingly, having intrusted the government to a council nominated by himself, with General Santa-Cruz at its head, he set out from Lima in September 1826, and hastened to Bogota, where he arrived on the 14th November, and immediately assumed the extraordinary powers which by the constitution the president was authorized to exercise in case of rebellion. He remained only a few days in the capital, and then pressed forward to stop the effusion of blood in Venezuela, where matters had gone on much farther than he could ever have contemplated, even supposing him to have been the main-spring of the intrigues to which we have already adverted. On the 31st December he reached Puerto Cabello, and the following day issued a decree offering a general amnesty. He had then a friendly meeting with Paez, and soon afterwards entered Caraccas, where he fixed his head-quarters, in order to check the northern departments, which had been the principal theatre of the disturbances. In the meanwhile Bolivar and Santander were re-elected to the respective offices of president and vice-president, and by law should have qualified as such in January 1827. In February, however, Bolivar formally resigned the presidency of the republic, at the same time expressing a determination to refute the imputations of ambition which had been so freely cast upon him, by retiring to private life, and spending the remainder of his days on his patrimonial estate. Santander

Bolivar. combated this resolution, urging him to resume his station as constitutional president, and declaring his own conviction, that the troubles and agitations of the country could only be appeased by the authority and personal influence of the liberator himself. But distrust and suspicion of Bolivar's conduct and intentions now filled all the friends of republican institutions. The anti-republican code of Bolivia was considered as a record of his political faith, and he was believed to be anxious for its introduction into Colombia. He was also accused of being in concert with Paez, and of having secretly fomented discord in the nation, in order to create an impression of the necessity of appointing him dictator. What truth there may be in these charges, or whether there be any at all, we shall not at present take it upon us to say. That they were generally believed at the time is unquestionable; nor is it easy, upon any other supposition, to account for the private intimacy which subsisted betwixt Bolivar and Paez, whilst publicly they were at open war, and fiercely denouncing each other. Another proof of the belief which then prevailed is the large minority in congress who voted for accepting his resignation of the presidency. But as a majority were of a contrary opinion, and insisted on his retaining the presidency, he repaired to Bogota to take the oaths and resume his functions. Before his arrival, however, he issued simultaneously three separate decrees; one granting a general amnesty of all past offences; another, convoking a national convention at Ocaña; and a third for establishing constitutional order throughout Colombia.

His arrival was accelerated by the occurrence of events in Peru and the southern departments, which struck at the very foundation of his power. Not long after his departure from Lima, the Bolivian code had been adopted as the constitution of Peru, and Bolivar had been declared president for life. This took place on the 9th of December 1826, the anniversary of the battle of Ayacucho; at which time the Colombian auxiliary army was cantoned in three divisions, one in Upper, and two in Lower Peru, at Arequipa and Lima. The third division, stationed at Lima, consisted of veteran troops, commanded by generals Lara and Sands, personal friends of the liberator. But notwithstanding their known attachment to Bolivar personally, his recent conduct in Colombia had rendered them distrustful of his designs; and although they had originally no disposition to thwart his views on Peru, had his ambition been confined to that state alone, they resolved to strike a blow against his power when they conceived it employed for the subjugation of their own country. Accordingly, in about six weeks after the adoption of the new constitution, a counter-revolution in the government of Peru was effected by this body of dissatisfied veterans. They had taken their measures so well that they arrested their general officers without opposition; placed them under the orders of Bustamente, one of their colonels; and announced to the inhabitants of Lima that their sole object was to relieve the Peruvians from oppression, and to return home to protect their own country against any attack on its liberties. Availing themselves of the opportunity thus unexpectedly afforded them, the Peruvians abjured the Bolivian code, deposed the council of ministers appointed by the liberator, and proceeded to organize a provisional government for themselves. After this bloodless revolution, the third division embarked at Callao on the 17th March 1827, and landed in the southern department of Colombia in April; part proceeding to Guayaquil, and part to Cuença and Quito, but all declaring that their only object in the step they had taken was the restoration of constitutional order, the preservation of republican institutions, and opposition to the designs entertained by Bolivar against the general liberty.

Intelligence of these events reached Bolivar while in the north of Colombia. He had long remained in a state of comparative inactivity; but the news of the counter-revolution in Peru, effected by the very troops in whom he had most implicitly confided, called forth all his energy, and he lost no time in preparing to march to the south, in order to reduce the refractory division. But he was spared the necessity of coming to blows with these troops, who, finding the government in the hands of the national executive, had peaceably submitted to General Ovando. In the meanwhile Bolivar had accepted the presidency, and resumed the functions belonging to his official station. But although Colombia was, to all external appearance, restored to tranquillity, the nation was divided into two parties, and agitated by their opposite views and incessant collisions. Bolivar had regained the personal confidence of the officers and soldiers of the third division; but the republican party, with Santander at their head, continued to regard with undisguised apprehension his ascendency over the army, and the political movements in which he was continually engaged, accusing or suspecting him of a desire to imitate the career of Napoleon. In the meanwhile all parties looked anxiously to the convention of Ocaña, which was to assemble in March 1828, for a decided expression of the national will. The republicans hoped that the issue of its deliberations would be favourable to their views; whilst the military, on the other hand, did not conceal their conviction that a stronger and more permanent form of government was essential to the public welfare, that the people were unprepared for republican institutions, and that Bolivar should be intrusted with discretionary power to administer the affairs of Colombia. Bolivar.

And the latter view seems to have prevailed. In virtue of a decree, dated Bogota, the 27th August 1828, Bolivar assumed the supreme power in Colombia, and continued to exercise it until his death, which took place at San Pedro, near Santa Martha, on the 17th December 1830. By this decree he was authorized to maintain peace at home, and to defend the country against foreign invasion, to command the forces of the state by land and sea, to negociate with foreign powers, to make peace and declare war, to enter into treaties, to appoint all civil and military officers, to issue decrees and ordinances of every description, to regulate the administration of justice, and in short to exercise all the functions and prerogatives of sovereign, not to say absolute power. The decree, indeed, provided that he was to be assisted in the exercise of the executive power by the council of ministers; but it is obvious, from the terms of this document, and above all, from the nature of the powers it conferred on the president, that, although the council might advise, it could never control him; and that, with the army at his back, he was sovereign of Colombia under a new denomination. Still his position was, in many respects, far from being an enviable one. Suspicion and distrust were excited by all his actions, and his life seems to have been embittered, if not shortened, by the incessant attacks made on his character and conduct. This seems evident from an address to the Colombian nation, which he dictated only a few days before his death; and in which, after alluding to his efforts in the cause of liberty, and asserting his disinterestedness, he complains that his enemies had abused the credulity of the people, and violated what to him was most sacred, his reputation; that he was the victim of his persecutors, who had brought him to the brink of the grave; that he had aspired to no other glory than the consolidation of Colombia; and that if his death should contribute to pacify all factions, and to strengthen the union, he would descend with tranquillity to the tomb.

Bolivia.

The time has not yet arrived when it would be either safe or just to attempt an estimate of Bolivar's real views and character. But there are some facts in his history which, as they seem to be well established, it is due to his memory to bring prominently forward. He expended nine-tenths of a splendid patrimony in the service of his country; and although he had for a considerable period unlimited control over the revenues of three countries, Colombia, Peru, and Bolivia, he died without a shilling of the public money in his possession. The value of his military services can best be estimated by their results. He conquered the independence of three states, which he also organized; and he called forth a spirit in the southern portion of the New World, which can never be extinguished. He purified the administration of justice; he encouraged the arts and sciences; he fostered national interests; and he induced other countries to recognise that independence which was in a great measure the fruit of his own exertions. (Restrepo's *Colombia*, vol. iii.; *American Annual Register*, vols. i. and ii.; *Encyclop. Americ.* v. Bolivar; *Memoirs of General Miller*, vol. ii.; Ducoudray Holstein's *Memoirs of Simon Bolivar.*) (J. B—E.)

Bolivia.

BOLIVIA.

This name was given in 1825 to a new state or republic in South America, formed from the provinces of Upper Peru, which formerly constituted part of the viceroyalty of Buenos Ayres, and were well known by the names of Charcas, Potosi, La Paz, Cochabamba, and Santa Cruz de la Sierra. These provinces, on securing their independence, soon after the battle of Ayacucho, 9th December 1824, found it necessary to come to a determination as to their future political state and institutions; and therefore it became a question with the inhabitants of Upper Peru, whether they should continue their former connection with the Buenos Ayrean or Argentine provinces, attach themselves to the republic of Peru, or form their country into a separate and independent republic. But the existing government of Buenos Ayres having with equal judgment and generosity divested itself of the claim which it had on the provinces of Upper Peru, the inhabitants of the latter were left at perfect liberty to decide on the future political government of their country. Deputies from all the provinces were in consequence nominated; and having assembled in Chuquisaca, the capital of the republic, in August 1825, the result of their deliberations was, that the provinces of Upper Peru should in future constitute a separate and independent nation. This assembly, continuing its sessions, issued a declaration of national independence; and in the exuberance of their gratitude to General Bolivar for the important influence he had exercised in accomplishing the liberation of their country, they determined on giving the name of Bolivia to the whole country.

Boundaries and divisions.

Bolivia extends from 9. 30. to 25. 40. of S. Lat., and from 58. to 71. of W. Long. from London, and it is bounded on the north by Peru and Brazil, on the east by Brazil and Paraguay, on the south by the Argentine provinces and Chili, and on the west by the Pacific Ocean and Peru. It has been divided by the constituent congress of Bolivia into six departments, viz. Potosi, Chuquisaca, La Paz, Santa Cruz, Cochabamba, and Oruro; and these have been subdivided into provinces and cantons. Thus each department includes in its jurisdiction certain provinces of the ancient regime. The department of Potosi contains Atacama, Lipez, Potosi, Porco, Chayanta, and Chichas; Chuquisaca contains Charcas or Chuquisaca, Cinti, Yamparaes, and Tomina; La Paz, the provinces of La Paz, Pacajes, Sicasica, Chulumani, Omasuyos, Larecaja, and Apolobamba; Santa Cruz, the provinces of Santa Cruz, Mojos, Chiquitos, Vallegrande, Pampas, and Baures; Cochabamba contains Cochabamba, Sacaba, Tapacari, Arque, Palca, Clissa, and Misque; and the department of Oruro, the provinces of Paria, Oruro, and Carangas.

Physical aspect of the country.

The province of Atacama, which belongs geographically either to Chili or Peru, forms the only part of Bolivia which comes into contact with the Pacific Ocean, and is situated between the Andes and the ocean. It is almost entirely desert and destitute of population. At its northern extremity is situated the small port of Cobija, which has been recently denominated Puerto la Mar, and has acquired additional importance from its being now the only avenue by which foreign articles of commerce can enter the Bolivian republic without the payment of transit duties; having obtained peculiar and valuable privileges, as an encouragement to the introduction of merchandise by this route, in preference to the more convenient routes by the Puertos Intermedios, belonging to the republic of Peru. But the arid nature of the surrounding country, and the great scarcity of water, must greatly retard its advancement, as the inhabitants are not only scantily supplied with this very essential necessary of life, but the mules employed in the transportation of goods into the interior are exposed to great privations and hardships from the want of water and pasture.

The provinces of Lipez, Porco, Potosi, Chichas, Oruro, Paria, Carangas, and some others, are very elevated districts, and principally valuable on account of their mineral riches. The climate is so cold that scarcely any vegetable productions present themselves, except a species of coarse grass, which serves as pasture to the numerous herds of *llamas*, *guanacos*, *alpacas*, and *vicuñas*, which abound in these elevated situations. Cinti, Yamparaes, Tomina, some parts of Chichas, and other places, enjoy a milder climate, and the vegetation is more abundant and varied; while from these the mining districts are principally supplied with provisions and other necessaries. In the provinces of Chayanta, Larecaja, Sicasica, Chuquisaca, and other places in the department of La Paz, there are also numerous and valuable mines of gold and silver; but the nature of the country being more diversified and less elevated in many places, the inhabitants are less dependent on the neighbouring provinces for their supplies. The greater number of the eastern provinces, which belong to the departments of Cochabamba and Santa Cruz, are of less elevation, and consequently possess many of the productions peculiar to tropical regions. The province of Tarija, which is situated at the south-eastern extremity of the department of Chuquisaca, and which belongs politically to the Argentine republic, forms geographically a part of the Bolivian republic, and was at one period claimed and taken possession of by them as such. This quarter has always been described as possessing a delightful climate, with a rich and fertile soil.

Mountains.

The greater part of the republic of Bolivia is situated in a mountainous and elevated country, more particularly at its western and central parts; but towards the east it becomes much less so, and at length terminates in extensive plains, which are bounded on the east by the Brazils. That part of the Andes which is situated in Bolivia is divided into two separate chains, of great elevation, running in a northerly direction, and nearly parallel to each other. Their separation commences near Potosi, in the province of Porco, between 19° and 20° of south

Bolivia. latitude, and they continue apart from each other, forming the eastern and western Cordilleras of Bolivia, and terminate by their union, between 14° and 15° of south latitude, to the south of the city of Cusco. These lofty ranges inclose an extensive valley or table-land, which has no visible outlet for the discharge of its waters; in this respect resembling the valley of Mexico before the formation of the artificial outlet denominated the Desagua de Huehuetoca. The former, however, greatly exceeds the latter in extent, as well as in elevation. From Carangas at its southern extremity, in 19° 45′, to Lampa, in 15° S., its extent has been estimated at about 3500 square leagues; and the barometrical observations of Mr Pentland give it an elevation above the level of the sea, at Oruro, the lowest point of observation, of no less than 12,441 feet. The mountains of the western Cordillera vary in elevation from 13,605 feet, which has been observed at El Paso del Alto de los Huesos, to that of 18,898 feet, which is attained by the Cerro de Tacora or Chipicani. In this chain are found several active volcanoes, amongst which may be enumerated those of Shama and of Arequipa, the latter of which presents to the observer the most perfect natural cone which has yet been observed in any country. The eastern Cordillera, which is entirely confined to Bolivia, has been ascertained, by the trigonometrical observations of the same gentleman, to possess an elevation greatly exceeding that of Chimborazo, or of any other mountain in the New World. Thus he has found that the summit of the Cerro Nevado de Sorata has an elevation of 25,250 feet, and that of the Cerro Nevado de Illimani, situated to the eastward of the city of La Paz, an elevation of 24,350 feet above the level of the sea.

From that part of the eastern Cordillera which is situated between Oruro and La Paz, in about 18° of south latitude, there branches off a chain, which proceeds from west to east, constitutes the mountains of Cochabamba and Santa Cruz de la Sierra, and is called, in the different parts of its course, the Cordillera de Chiriguanaes, de los Sauces, and de Yuracarees, each rising to the region of perpetual snow. Their eastern declivity is very rapid, and their loftiest summits are situated, not in the centre, but in the northern part of the group. This lateral ridge, where it terminates, forms the point of partition between the basin of the Amazons and that of the Rio de la Plata. The Cachimayo and the Pilcomayo, which rise between Potosi, Talavera de la Puna, and Chuquisaca, flow to the south-east to unite with the Parana; while the Parapiti and the Guapey or Rio de Misque pour their waters into the Mamori towards the north-east, and thence into the Amazons. But the ridge of partition being placed near Chayanta, between 19° and 20° south latitude, and south of Misque, Tomina, and Pomabamba, the river Guapey, which flows through these provinces, is forced to sweep round the whole group or chain of Cochabamba in order to reach the plains of the Amazons. From that part where this chain of mountains closes the ridge of partition of Cochabamba, it proceeds towards the north-east to 16° of south latitude, and forms, by the intersection of two plains slightly inclined, a kind of wall in the midst of the savannahs, which separates the waters of the Guapore, flowing into the Madeira, from those of the Aguapehy and Jauru, tributary streams of the Rio Paraguay, and thus forms a line of junction between the lateral Cordillera or counterfort of Cochabamba and the mountains of Brazil. This level strait, which divides the sources of the Mamori and the Pilcomayo, and crosses the provinces of Mojos and Chiquitos, displays bare and grassy steppes, like the plains of Casanare and Buenos Ayres.

Lakes. The valley or table-land which is occupied by the lake of Titicaca and the Rio Desaguadero forms the most elevated table-land in the globe, with the exception of that of Thibet, which presents only mountain pastures, Bolivia. covered with sheep; while this table-land of the New World presents towns and populous cities,—affords support to numerous herds of cattle, *llamas*, *guanacos*, and sheep,—and is covered with harvests of maize, rye, barley, and wheat, at an elevation which has nothing to equal it in any other part of the world. The lake of Titicaca or Chuquito, which occupies its northern extremity, is 12,703 feet above the level of the sea, and its extent is equal to twenty times that of the lake of Geneva, or 448 square marine leagues. It is surrounded by numerous towns and villages, with a rich and fertile country, and contains several islands, the largest of which is called Titicaca, and was long held in great veneration by the Peruvian Indians, in consequence of its having been the place from whence Manco Capac and his consort Manco Oello Huaco, the great founders of the empire of the Incas, issued, to spread civilization, industry, and good government among the surrounding nations; in memory of whom, and as a testimony of gratitude for so many benefits conferred upon the country, the Incas afterwards erected in this island a magnificent temple to the sun, in which were accumulated great riches in silver and gold, being offerings of the Peruvians, all of which were afterwards thrown into the lake, to prevent their falling into the hands of the Spaniards. This island has in latter times fallen sadly from its former high destinies; since, during the revolutionary war, it served the purpose of a secure prison, in which were confined the patriot prisoners who had had the misfortune to fall into the hands of the royalists. The lake of Titicaca is very irregular in its form, but it has been estimated at about 240 miles in circumference; in many places it has a depth of seventy or eighty fathoms, and admits of extensive navigation for ships and smaller vessels, though not unattended with danger, as it is subject to sudden storms and violent gusts of wind from the neighbouring mountains. This forms the most elevated scene of navigation perhaps in the universe. This lake communicates with the smaller lake of Paria, situated at the southern extremity of the valley, by means of the Rio Desaguadero, which flows out of the lake of Titicaca, and has a breadth of from eighty to a hundred yards. This river and lake form part of the western boundaries between the republics of Bolivia and Peru. Over this river was formed, in the time of the Incas, a suspension bridge, composed of cables and cords made of the grass and rushes which grow on its borders; and the work was constantly renewed from time to time, to obviate the effects of decay, as it constituted the only line of communication between the opposite sides of the valley. These lakes, with the Desaguadero, form the only recipients for the water of those rivers and streams which arise from the surrounding mountains and enter into this extensive plain, which has no visible outlet, by which any portion of its contents can escape, otherwise than by means of evaporation.

Rivers. Those rivers which take their rise from the western declivity of the western Cordillera, and flow into the Pacific, are so inconsiderable in magnitude, and so short in their course, as scarcely to merit observation, and are only useful in supplying the means of a partial irrigation to the arid plains which separate these mountains from the Pacific. But those numerous rivers taking their origin on the eastern declivity of the more elevated or eastern Cordillera, which is distinguished in the different parts of its extent, as the Cordillera of La Paz, of Palca, of Ancuma, and of Pelechuco, present a very different aspect, and are of much greater importance, since they communicate with large navigable rivers, which terminate in the Atlantic Ocean.

The river Paro or Beni, which takes its origin in the

Bolivia. neighbourhood of the city of La Paz,—and the Guapey, which arises near Cochabamba, and, sweeping round the southern and eastern bases of the Cordillera of Cochabamba, unites itself to the Mamori,—flow to the north-east to mingle with the waters of the mighty Marañon or Amazons; while the Pilcomayo, which arises near Potosi and Chuquisaca, and the Vermejo, which has its origin in the valley of Tarija, bend their courses, at a considerable distance from each other, to the south-east, until they mingle their contents with those of the Paraguay, which terminates in the Rio de la Plata. All these rivers are navigable throughout their whole extent, until within a very inconsiderable distance of the important cities above mentioned; and not only afford the most convenient and extensive lines of river communication with the nations of Europe and all the countries which border on the Atlantic, but will likewise, in time, by means of steam navigation, open up the vegetable wealth of the intermediate districts.

Animals. The animals which distinguish the more elevated parts of Bolivia are the *guanaco*, the *llama*, the *alpaca*, and the *vicuña*, which are found in great abundance in such situations. These animals, in their structure and habits, are all closely allied to the camel of Africa. Thus, an examination of the structure of the stomach shows that they are capable of existing during a considerable time without any supply of water, and in fact they are seldom seen to drink from the streams of their native mountains. The camel seems peculiarly well calculated to live in the arid and burning deserts of the Old World, and the form of its feet is singularly adapted for traversing rapidly these extensive plains; whilst, on the other hand, the *guanaco* and the *llama* have their feet so constructed as to enable them with facility to ascend and descend the abrupt declivities, and to traverse the rugged and uneven passes, which abound in these mountains. They seem likewise to frequent particularly those parts of the Cordillera of the Andes which are the most dry and arid, and which are least clothed with dense forests and shrubbery. Thus, in the Cordillera which separates the Argentine republic from Chili, the *guanacos* are found in great numbers on the summits and eastern declivities, which are exceedingly arid and bare, when compared with the western or Chili side, where the Andes in their whole extent are clothed to a certain elevation with a broad belt of forest trees and evergreens, and where, at certain seasons of the year, there are heavy and continued rains. On this side the *guanaco* is of comparatively rare occurrence.

There has existed considerable diversity of opinion among naturalists whether the *guanaco*, *llama*, *alpaca*, and *vicuña*, are different, or only the same species: but it is now the prevailing opinion that they comprise two distinct species, the three former constituting one, the *Camelus Llama* of Linnæus, or *Auchenia Glama* of Illiger; and that the differences which have been observed are only the results of domestication,—the *guanaco* being the animal in its wild or native state, the *llama* the same animal after it has been modified by a long period of domestication, and the *alpaca* only differing from the *llama* in being covered with a more abundant fleece, and kept in flocks for the sake of the wool. The subject, however, of the identity of these animals requires some further investigation, as it has been asserted that the distinctive types of the different kinds may yet be discovered in a wild state. In their natural state, the *guanacos* are found in numerous herds on the more elevated parts of the Andes, Peru, and Bolivia, and of the Cordillera which separates Chili from the Argentine provinces, and extend even a great way along that chain as it approaches the Strait of Magalhaens, having been met with in considerable numbers, according to the testimony of Captain King, in various parts of the islands composing Tierra del Fuego, at a distance of only fifty miles from Cape Horn They are likewise found in the Andes of Colombia or New Grenada, but are there much less numerous. In the summer they usually frequent the most elevated parts of the mountains; but on the approach of winter, the snow and the inclemency of the season obliges them to seek shelter in the valleys and plains below. They are then in high condition, and at this season are most prized by the hunters. The young of the *guanaco* are easily tamed, and soon become remarkably gentle and attached to their keepers. Bolivia.

These were the only ruminating animals found in South America on its discovery by the Spaniards; and the *llamas* were then extensively employed as beasts of burthen by the Peruvian Indians;—a custom which is still continued to a considerable extent, in consequence of the greater facility and economy in feeding them. But, in many instances, the introduction of horses and mules has entirely superseded the use of them. They are capable of carrying a load of from 100 to 150 lbs., which they convey, at the rate of fifteen, and sometimes even of twenty, miles a day, over rocks and precipices where their attendants can sometimes with difficulty follow them; and they require very little care to direct them in their course. The larger species are capable of carrying a full-grown man, and will trot or run under him with great swiftness for several miles. The chief merit of the *llama*, next to its being sure-footed, seems to be its extreme docility, and the trifling expense of its maintenance. "They want neither bit, bridle, nor saddle," says Feuillée; "there is no need of oats to feed them; it is only necessary to unload them in the evening at the place where they are to rest for the night; they go abroad into the country to seek their own food, and in the morning they return to the same place; their baggage is replaced, and they continue their route." Their defects are, their comparative weakness, their slow rate of travelling, and their obstinacy. If their load is too heavy, if they are fatigued, or are urged forward too fast, they lie down and refuse to proceed. It is therefore requisite to have a number of spare *llamas* in readiness to supply the places of such as are fatigued or give in; for after four or five days' travelling they generally require to rest.

The *guanaco*, and the *llama*, which is considered as of the same species, but only in a domestic state, are exceedingly graceful and handsome animals; and their whole physiognomy indicates vivacity and intelligence. They usually march two and two when in troops, in a stately manner, with their heads erect; and it is a remarkable circumstance, that the *llamas*, in passing underneath an archway to which they are unaccustomed, always bow their heads, however high the arch may be. In their wild state, when disturbed by the approach of strangers, these animals seem to possess a considerable degree of curiosity, placing themselves on the summits of the neighbouring mountains, and gazing upon the intruders beneath, occasionally uttering a peculiar interrupted cry, after which they scamper off to a distance. They are remarkably gregarious, and may sometimes be seen in herds of from 300 to 500; and when disturbed, or when travelling in the mountains, they constantly follow a leader—a circumstance of which the hunters who lie in wait for them frequently take advantage. The *llamas* are so exceedingly tame and gentle in their manners, that in passing along the streets or roads they occasionally approach their heads towards the bystanders, as if requesting corn or some other article of food: when irritated, however, the *guanaco*, in its tame state, as well as the *llama*, squirts on the aggressor some saliva from a cleft in the upper lip; but our own experience has proved to us that this saliva is quite destitute of that acrid quality which some have attributed to it. On the arrival of the Spaniards in Peru these animals were killed in vast num-

Bolivia. bers for their flesh and skins. Gregorio de Bolivar estimates, that in his time 4,000,000 were annually killed to be eaten, and no less than 300,000 *llamas* were employed in the transport of the ores from the mines of Potosi alone. Even at the present day the *guanaco* or wild species exists in great numbers in those parts of the Andes which are least frequented; yet many are still annually destroyed and eaten by the Indians, and also by the *puma* or American lion, which is found in many parts of these mountains. Their flesh is savoury when young, but not very palatable when full grown; their wool, however, is very valuable to the Indians, who manufacture it into hats and various kinds of woollen stuffs; and their skins, when tanned, are useful in making shoes and harness.

The *vicuña* (*Camelus Vicugna*) is a smaller animal than the *guanaco* or *llama*, and only useful for its fleece. The wool is long and fine, and forms a valuable article of commerce; it is of a brownish colour, somewhat resembling that of a dried rose leaf; it has a soft, silky, and close texture, and is well calculated for the manufacture of hats and warm clothing. The *vicuña* very much resembles the *llama* and *guanaco* in its habits and dispositions, but cannot be usefully employed as a beast of burthen. It usually frequents the highest parts of the mountains, even where frost and snow prevail. It is extremely timid, but gregarious, and runs very swiftly. The *chinchilla* (*Chinchilla lanigera*) is also an inhabitant of the mountainous parts of Bolivia. The skins, however, are of an inferior quality, although larger than those obtained from the northern parts of Chili; but still they form a very valuable article of commerce, on account of the great fineness and delicacy of their furs. The eastern or more thickly wooded parts of Bolivia are inhabited by a variety of wild animals, which are more or less common in Brazil, and the other parts of intertropical America of inconsiderable elevation.

Vegetation. The vegetation of Bolivia is exceedingly various, depending principally upon the elevation of the district above the level of the sea. In many situations the mountains are covered with perennial snows, below which level we find those extensive plains or *paramos*, on the less elevated parts of which are situated the cities of Potosi, Oruro, and other towns in the district of Charcas. On these vegetation is very slight and scanty, consisting principally of a coarse wiry grass called *ichu*, and rushes, which only serve the purpose of food for the *llamas*, *guanacos*, *alpacas*, and *vicuñas*, which abound there; and during long journeys, as from Oruro to La Paz, scarcely a tree is to be seen. In the more sheltered spots may be found some stunted bushes of the carob tree, and another shrub called *tola*. Several species of the *cactus* tribe are also found in these elevated regions, and especially the *Cactus Peruvianus*, so general an inhabitant of South America, where it sometimes grows to the height of from twenty to thirty, or even forty feet, and is either in single stems or variously branched. It is used in many parts of Bolivia as a fence for inclosures; and the stems, when divested of their spines, are employed in the formation of rafters and door-posts for houses. Descending in level, as on the margins of the lake of Titicaca and at La Paz, the vegetation becomes more vigorous and varied, and the plains may be seen covered with abundant crops of grain; while in the neighbourhood of La Paz is cultivated to a great extent the coca plant (*Erythroxylum Coca*), in such general use, and so essential an article with the Indians, that its culture in the province of La Paz is productive of great wealth to the inhabitants of that part of the country. It is used by them as a masticatory in combination with a particular alkaline substance, called *llipta*, and on long and painful journeys serves the Indian in lieu of all other nourishment. In the neighbourhood of Chuquisaca and Cochabamba, which have respectively an elevation of 9331 and 8448 feet above the level of the sea, and in numerous other valleys, the vegetation is so rich and luxuriant, that they are considered as the gardens of Bolivia, and supply the more elevated mining districts with a great part of those necessaries and luxuries of life which their more rigorous climate denies them. As the country descends towards the east, the sides of the mountains become clothed with dense forests, and at length present all the exuberant richness and variety which characterize the vegetation of level districts within the tropics. Bolivia.

Geology. The geological structure of the colossal mountains situated in Bolivia has hitherto been very imperfectly examined. We learn from Humboldt, however, that the metalliferous mountains near Potosi are principally composed of trachytic porphyries; and Mr Pentland likewise discovered trachyte in the mountain of Pichu, one of the most elevated of the western Cordillera. In the same chain there likewise exist various volcanic mountains, some of which are in an active state. There is perhaps no part of the world which affords a more interesting field for the investigations of industrious and intelligent geologists than Bolivia, not only on account of the great elevation which it attains, but also from the exhibitions of internal structure presented by volcanic agency and otherwise; while powerful aid might be afforded by such inquiries in searching for mines, and in the prosecution of mining enterprises, and also in discovering beds of coal and other important auxiliaries, tending to lessen the difficulty and expense of such undertakings.

Minerals. The great variety, extent, and value, of the mineral productions of the mountainous districts of Bolivia have given to this part of America an importance and celebrity which it would not otherwise have obtained, and caused large and populous cities and towns to be built at elevations where the rigours of the climate and the deficient vegetation would otherwise have afforded very few inducements for fixing the abodes of industry.

Gold. Gold is found in considerable quantities in the mountainous parts of Bolivia; but, owing to the expense of extracting the metal from the ore, the mines which produce it have not been worked to the extent of which they are susceptible. In these it is usually found in the form of grains or nodules, or intermixed with antimony, silver, and other substances, and is separated by reducing the whole to a fine powder, and by amalgamation with quicksilver. The colossal mountain of Illimani is believed to contain great quantities of gold, in consequence of that metal having been found in a native state in considerable quantities in the lake of Illimani, situated at its base, and at an elevation of 15,780 feet above the level of the sea. In the seventeenth century, likewise, an Indian found near its base, at a short distance from the city of La Paz, a mass of native gold, which was said to have been detached from the mountain by the agency of lightning, and which, having been purchased for the sum of 11,269 dollars, was afterwards deposited in the cabinet of natural history at Madrid.

But by far the greater part of the gold procured in Bolivia is obtained by means of the *lavaderos* or gold washings, in the beds of rivulets, where it is found in the form of grains. The most productive of these are the celebrated *lavaderos* of Tipuani, consisting of streams descending from the snow-capped summits of the Cordillera of Ancuma, situated about sixty leagues to the north-east of the city of La Paz, in the province of Larecaja. The town of Zorata, which is the great resort of the miners and all others who are attracted by these gold washings, is at a considerable distance, and is reached by a road full of difficulties and dangers. The eastern sides of the mountains, when contrasted with the western declivities,

Bolivia. looking towards the lake of Titicaca, present a rich and vigorous vegetation, and the climate becomes sensibly milder as we descend. The waters rush with impetuosity from these lofty mountains, and, accumulating greatly in their progress, at the distance of fifteen miles from the summit called Amicarpa, form the river Tipuani, which runs with great rapidity, and, passing between two lofty mountains, emerges, after a course of about forty miles, near the village of Tipuani, where it loses its former rapidity, the country now consisting of only gentle undulations. This river terminates in the Beni, one of the tributaries of the Amazons; but before reaching the Beni its channel ceases to be productive of gold. From its inconsiderable elevation, the country where these *lavaderos* are situated is hot and moist, and subject to intermittents. The surrounding country is covered with a very luxuriant vegetation, and teems with all the animal and vegetable productions of tropical America.

The gold is found in the form of grains or *pepitas*, at the depth of ten or twelve yards below the surface, imbedded in a stratum of clay of several feet in thickness, and has the purity of 23½ *quilates*. All the operations are performed by manual labour, and the excavations are kept free from water by means of buckets, at an expense of labour which might easily be saved by the employment of pumps and other mechanical contrivances. An idea may be formed of the disadvantages of pursuing such a course by stating, that at the works of Isola alone, in the years 1819, 1820, and 1821, no less than from 300 to 400 labourers were constantly employed in emptying the water by means of hide buckets; yet the gold-washings were so productive as not only to cover the heavy expense thus incurred, but greatly to benefit the proprietor. The gold-washings at Tipuani were worked in the time of the Peruvian Incas, as is evinced by their tools, which are occasionally found imbedded in the alluvial soil, and almost invariably in such situations as prove the most productive.

Silver. Silver, however, has hitherto been the staple metallic production of Bolivia, and has given to it that celebrity which it has long possessed. In the rich mountain of Potosi alone, according to the records kept at Potosi of the *quintas* or royal duties from the year 1545 to the year 1800, no less than 823,950,509 dollars were coined during that period; and if to this be added the amount of the preceding years, not included, and that obtained in a clandestine manner, without the payment of the customary dues, not less than 1,647,901,018 dollars have been obtained from this source alone in the space of 255 years.

The Cerro de Potosi, or argentiferous mountain of Potosi, has somewhat of a conical form, resembling a colossal sugar-loaf; its base being about three leagues in circumference, and its summit 16,037 feet above the level of the sea, and 2723 above the level of the great square or *plaza* of the city of Potosi, which is situated at its base. At the foot of the *cerro* is a smaller mountain called Huayna Potosi, or the Younger Potosi, likewise containing silver, but in less abundance than the other, and less accessible, from the numerous springs which there impede the operations of mining. The principal mountain has been worked as high up as within 125 feet of its summit. The labours of the miners have hitherto been principally confined to the upper half of the mountain, which has been perforated by numerous excavations, with at least 5000 *bacas minas*, or opening of mines. This number, however, does not indicate the existence of so many mines, since each mine has often two or more openings. These operations have not been conducted with any regard to order or convenience. The upper part of the mountain is exhausted to a considerable extent of its valuable contents; but the lower part is still in a great measure untouched, as the springs are there more numerous, and the water accumulates in such quantities as Bolivia. materially to interrupt the further progress of the miners. Various works have been commenced and prosecuted, for carrying off these waters from the lower part of the mountain, but none of them have ever been carried to such an extent as fully to answer the purpose of their formation. The most extensive of these has been the *Socabon* or adit of San Juan Nepomuceno, in the formation of which the Spanish government expended no less a sum than 560,243 dollars. It is 2200 *varas* or yards in extent, six feet in height, and six in breadth at the base, and it is arched and lined with rough stones without cement. In various parts of the country near the mountain are numerous lakes or pools formed from the water of these springs and other sources in the mountains, which, being economized, give motion to the machinery employed in reducing the ore.

The mines of Potosi, according to Humboldt, rank next in importance to those of Guanaxuato in Mexico. The existence of silver in this place was first accidentally discovered by an Indian in the year 1545, and ever since that time its mines have been worked. A few years prior to the commencement of the revolution it was worked to a considerable extent, and no less than 40 *ingenios* or mills for grinding ore were in full operation; but the events which followed proved most destructive, not only to the machinery employed, but likewise to the capital embarked in mining operations. From fifty to sixty *bocas minas* were worked in 1825, when General Miller became prefect of the department; but Temple, when he visited it soon afterwards, found only about fifteen *ingenios* at work, affording on an average 1500 merks of silver weekly, or about L.125,000 sterling per annum. Pazo, in his *Letters on South America*, on visiting the mountain of Potosi, thus expresses himself: "The sublimity of the surrounding scenery did not so much interest my feelings as the celebrated mountain which has poured forth its *lavas* of silver upon the world, to animate enterprise and reward industry; to pamper the luxurious, and minister to the comforts of the sober and virtuous; to disseminate knowledge and religion, and to spread the desolations of war, marshalling armies in the field, and pointing the thunder of navies on the ocean; filling cities with monuments of taste and art, and overwhelming them with ruin; founding mighty empires, and levelling them with the dust; inciting, in short, to virtue and to crime, and being the source of much good, and the root of great evil, in the world."

The silver mines of Portugalete, in the province of Chichas, have acquired considerable celebrity on account of the richness as well as quantity of their ores, which yield from 60 to 80 merks of silver to the *caxon*, while those of Potosi only afford about 10 merks from the same quantity of ore. The silver mines of Choromo, near Tupiza, in the province of Chichas, were worked, until lately, on account of General Olañeta, the proprietor, and were considered as productive. Besides these there are various other silver mines in the province of Chichas, but their value is much diminished by the scarcity of water, and their being situated in an almost desert and unproductive country. At La Plata, Porco, and Lipes, there exist silver mines, especially one in the latter province, celebrated for the purity of its ores, which were formerly in great repute, but since eclipsed by the more important ones of Potosi and of other places. In Carangas there are rich mines, where the silver is found in its metallic state, disseminated in the rock, a kind of ore which is considered as very productive. At Oruro the silver mines were formerly very rich and productive, as the opulence of its inhabitants, of which there are some remarkable instances on record, sufficiently

Bolivia. evinced; but these, as well as the celebrated tin mines of the same place, have fallen into decay, principally in consequence of the disastrous events which attended the insurrection of Tupac Amaru. They are now filled with water, and the inhabitants being deficient in the requisite machinery, have no means of emptying them. Besides those already enumerated, many other gold and silver mines were worked to advantage; but in consequence of the diminished confidence and capital resulting from the long and disastrous war of independence, they have latterly been neglected.

Timber or coal for smelting is a great desideratum in Potosi and others mining districts, as, from the nature of the ores, in which the silver is principally associated with copper and lead, they are unsuited for the process of amalgamation, and can only be properly extracted by fusion, by which means the copper and lead are also preserved. The loss of mercury, in extracting the silver by the process of amalgamation from the ores produced in the mines of Bolivia and Peru, is from 15 to 25 per cent. on the value of the silver produced; while, by the process of smelting, all the silver might be obtained at an eighth part of the expense, in a tenth part of the time, and with infinitely less labour, and great quantities of lead and copper at the same time preserved.

The methods hitherto employed for the reduction of the silver ores of this country are exceedingly imperfect and inefficient; the manipulations are tedious, operose, and expensive; and a considerable proportion of the silver is entirely lost in its extraction by means of amalgamation, while much of the mercury is also unnecessarily wasted. But great advantages may be expected to arise from the introduction of improved methods of mining and metallurgy. These mines can never be worked to advantage in the manner which has of late been so generally followed. More skill and capital are requisite to render them productive and remunerating.

Roads. The roads which form the means of communication between Bolivia and the surrounding countries, and between the various provinces of the same republic, are in no respect commensurate to the important purposes which they are destined to serve. By inattention to the formation and preservation of roads, the Spaniards and their descendants have fallen greatly behind the Peruvians, whose industry and civilization they affected to despise, and laboured hard to depreciate. We have the testimony of a late observer, that the most distinct traces of an ancient Peruvian road may be observed at the present day as far south as the valley of Uspallata, in 32 degrees of south latitude; and there is little doubt that it was continuous with that formed between Potosi and Cuzco, since the inhabitants of the provinces of Mendoza, San Juan, and La Rioja, which are situated along the eastern base of the Cordillera of the Andes, separating Chili from the Argentine provinces, are in the constant practice of conveying to the upper provinces of Peru their wines, brandies, dried fruits, and mules, by this mountain route, which is distinguished by the name of El Despoblado. Those persons who are in the habit of travelling by this route describe it as by no means difficult, since, with only occasional interruptions, it proceeds along longitudinal valleys, running north and south in a direction parallel with the Cordillera; and it has been remarked by Andrews, a recent traveller in Bolivia, that there is another road distinct from that by Jujuy, which might easily be made passable for carriages, from Salta to Tupiza and Potosi, and even to Cuzco, and which is only distant twelve leagues from the one presently in use between Potosi and Jujuy,—a miserable tract, incapable of being passed except on mules and horses, and in many places not only difficult, but dangerous. The present route, for Bolivia. it can scarcely be designated by the name of road, from Potosi to Jujuy, the first city belonging to the Argentine republic, is about 310 miles in length; and this place forms the point where a road commences for carriages and waggons as far as Buenos Ayres, an additional extent of land carriage of about 1617 geographical miles. The various routes from Bolivia to the coast of the Pacific, by the way of Cobija or Puerto Lamar, Tarapaca, by Oruro to Tacna and Arequipa, can only be passed on mules or horseback; and travellers are sometimes exposed to great perils and hardships from exposure to those storms which occasionally prevail at such great elevations. The President Ballivian, however, while in office, did much to obviate these difficulties, and initiated a new era of things by the construction of a splendid highway, which leads from Sucre, and passing Santa Cruz connects Moxos and Chiquitos and the fertile plains of the Beni and Madera. Other roads of equal magnitude and importance are now in course of formation.

Climate. The climate of Bolivia is exceedingly various, being principally dependent upon the proportional elevation of the district above the level of the sea. In some parts the mountains are covered with eternal snows, below which are extensive plains or *paramos* destitute of vegetation, where the climate is cold and rigorous. Here travellers are frequently exposed to great danger and hardship, owing to the storms that occasionally prevail, especially snow storms, which, besides other inconveniences, frequently produce the *surumpi* or snow blindness, an affection which has proved fatal to some travellers, and to many of the brave and energetic men employed in the late eventful struggle for independence. On the less elevated of these plains are situated the cities of Potosi, Oruro, and others. The climate of Potosi, at an elevation of from 13,314 to 13,668 feet, is disagreeable, and so various that in one day it frequently exhibits the vicissitudes of the four seasons of the year. Thus, during the night and the early part of the morning it is piercingly cold; in the forenoon it resembles our fine weather in March; in the afternoon the rays of the sun, in so pure and attenuated an atmosphere, are very powerful, and scorchingly hot; while towards evening the air usually becomes mild and serene. Europeans and the Creoles therefore require to be well clothed; but the Indians, who are inured to the climate from early infancy, seem less susceptible of its effects, and enjoy good health with inferior clothing. Strangers, on first arriving in this country, are usually affected with difficulty of breathing, owing to the extreme rarity of the atmosphere; they are likewise frequent sufferers from dysentery, which, however, for the most part soon disappears, and then they enjoy tolerably good health. Here no inconvenience is experienced from troublesome insects. The climate of Oruro, which has an elevation of 12,441 feet above the level of the sea, is likewise cold, but by no means unhealthy. From its sheltered situation, the city of La Paz, at an elevation of 12,195 feet, enjoys a mild and pleasant climate; but that of Chuquisaca, with 9331, and Cochabamba, with 8448 feet of elevation, are universally admitted to be the most delicious and agreeable places in Bolivia. In descending through the eastern provinces, towards the plains of Mojos and Chiquitos, are experienced all the gradations of climate, from the mildness of Chuquisaca to the temperature which characterizes the equinoctial regions of America, where intermittent fevers, dysenteries, and other diseases peculiar to warm climates, are found to prevail.

Commerce. The only productions hitherto furnished by Bolivia as articles of commerce have been the precious metals, which were exchanged for various articles of luxury and necessity. The rude and simple fabrics manufactured by the Peruvian Indians are usually appropriated to their own

Bolivia. domestic uses; while the valuable vegetable productions, and the herds of cattle and mules, which are reared in the eastern parts of the republic, have hitherto scarcely been sufficient for the supply of the inhabitants of those populous mining districts, that are principally dependent on them for subsistence. Coca to the value of 200,000 dollars is annually exported from La Paz to other parts of Bolivia and Peru.

Before the revolution a very extensive traffic was maintained between the upper provinces of Peru and the provinces of the Rio de la Plata, for supplies of cattle and mules. These were reared in great numbers in all the interior Argentine provinces, expressly for the use of those countries, and were first sent by easy journeys to the luxuriant pastures of Salta and Jujuy, where they were carefully fed and tended during the winter, previous to their being conveyed to their final destination in Bolivia and Peru. Some idea may be formed of the extent of this traffic by stating, that besides all those furnished by the other Argentine provinces, the province of Salta alone supplied annually to Upper and Lower Peru from 60,000 to 80,000 mules, on all of which they realized considerable profits, the prices being proportioned to the distance to which they were conveyed. The war of independence, which has so greatly desolated the northern provinces of the Rio de la Plata, and the diminished working of the mines of Bolivia, have almost annihilated this lucrative traffic; but it may be expected to revive with increasing vigour on their again resuming their former habits of tranquillity, and becoming stimulated to increased exertion, by the accession of laborious and intelligent Europeans, and by the spread of education and intelligence.

By the route of Cordova, Tucuman, and Salta, the provinces of Upper Peru or Bolivia formerly received their supplies of articles of commerce from Europe, which were landed at Buenos Ayres; and by the same channel they likewise obtained large supplies of *Yerba* or Paraguay tea, to the great amount, it is affirmed, of 100,000 *arrobas*, or about 2,500,000 pounds annually, which had been previously conveyed by water from Paraguay to Buenos Ayres, and from thence by waggons and mules to Jujuy and Bolivia; thus enhancing its value by a circuitous and expensive land-carriage of from 2000 to 3000 miles, while by a more improved system of conveyance it might be sent by the rivers Vermejo and Pilcomayo into the heart of Bolivia, at a vast saving of trouble and expense. The large amount of goods sent from Buenos Ayres by waggons to Jujuy tended greatly to enrich the various provinces through which they passed, giving employment to numbers of the inhabitants; and Jujuy, which formed the most distant point that could be reached by waggons or carriages, became a place of considerable importance, forming the entrepôt of the commerce of Peru and the Argentine provinces. From this place the various articles of commerce were conveyed on mules to their ulterior destination.

The new order of affairs consequent on the revolution has necessarily produced important changes in this branch of commerce, and Bolivia has in a great measure ceased to receive her supplies of foreign commodities by this expensive route. Commerce, where unrestricted, always finds out the shortest and least expensive channels for the introduction of its commodities. The trade is now in a great degree diverted to the ports of the Pacific, called the Puertos Intermedios. Tacna and Arequipa, with their respective ports, have now become the principal channels through which Bolivia receives the produce and manufactures of other countries. How far the Bolivian government has succeeded in making Cobija or Puerto la Mar of that exclusive commercial importance which it contemplated, remains yet to be ascertained. Nature presents great obstacles to the success of the undertaking, which is certainly a most praiseworthy one; while Bolivia. all the rest of the coast, in which are situated the Puertos Intermedios, forms part of the republic of Peru, to which, therefore, they must necessarily pay transit duties. A new and very important channel of communication for commerce will be opened between Bolivia and the Atlantic, whenever commercial enterprise and increasing civilization shall have established steam navigation on the Rio de la Plata and its tributary streams, the Vermejo and Pilcomayo, and from the mouth of the Amazons to its distant tributaries the Beni and the Mamori.

By a decree of the republican government of Peru, dated 22d February 1831, the following judicious regulations have been established for settling the commercial relations of that state with the republic of Bolivia:—1. The productions of the territory of the Bolivian republic, introduced into Peru for its consumption, shall be subject to an import duty of four per cent. on their valuation. 2. Those productions of Bolivia which only pass through the territory of Peru for embarkation from its ports, shall only be subjected to a transit duty of two per cent. 3. Silver and gold, either coined or otherwise, introduced from Bolivia into Peru, shall be exempted from any duties. 4. All foreign articles of commerce passing through the territory of Peru, and destined for Bolivia, shall only be subjected to the payment of two per cent. *ad valorem*; and the decree of 22d January 1830, which imposed transit duties of from fifteen to forty-five per cent. on such commodities, has been repealed. 5. All articles of foreign commerce which are exempted from the payment of duties on their introduction into Peru, such as books, quicksilver, iron, machinery, &c., shall likewise be exempted from the payment of any transit duties on passing into Bolivia; and the decree of 5th March 1830, imposing a transit duty on such articles of fifteen per cent. has been repealed.

Population. The population of Bolivia has been variously estimated. By some authorities it has been computed at little more than half a million; by others, Berghaus in the number, at considerably more than two millions. No means existed, however, by which even an approximate correctness could be attained until in the year 1845 the existing government determined to take the census. It was then ascertained that Chuquisaca or Sucre, the capital and seat of government, contained only 20,000; Cinti, 15,000; the city of La Paz, 57,000; Lorata, 12,000; and Cochabamba, 30,000. In the western districts of the republic the towns and cities are even more thinly peopled. Atacama contains 1000 inhabitants; and Cobija or Puerto la Mar, the only seaport of the state, despite the efforts of the government to attract to it all the foreign commerce of Bolivia, has a resident population of only 500 souls. The exports of copper and the guano trade have of late years elicited some symptoms of vitality in these desolate regions, and Cobija is one of the few towns in the Bolivian republic whose population exhibits a tendency to increase. Its prosperity, however, is in the meantime seriously retarded by the proximity of Arica, a seaport of Peru, situated much nearer the productive districts of Bolivia, and in a region infinitely more fertile than that which surrounds Cobija. In 1562 a royal mint was established in Potosi, and the population of that city, formerly insignificant, increased with such rapidity that in the year 1611 it amounted to more than 160,000. At the end of the seventeenth century, however, the silver-mines in the neighbourhood ceased to yield the enormous returns which had once attracted adventurers from every quarter of the earth, and from that date the population of Potosi gradually declined. When the census was taken by govern-

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ment in the year 1845, it was found to amount to no more than 42,000.

The subjoined tables are compiled from the statistical returns made to the Bolivian government in the year 1845. It has been deemed advisable to append the names of the provinces, and the numbers of the cantons into which the departments have been respectively divided.

Department of Charcas La Plata, or Chuquisaca, now called Sucre.

Provinces.	No. of Cantons.	Population.
Chuquisaca	4	110,000
Cinti	9	
Yampares	16	
Tomina	11	
Oruro	6	
Carancas	8	

Department of Potosi.

Potosi	5	265,527
Atacama	6	
Lipes	3	
Porco	26	
Chayantas	19	
Tarrija or Chicas	7	

Department of La Paz.

Pacajes	17	573,980
Sicasica	16	
Chulumani	20	
Omasuyas	24	
Laricajas	9	
Apolobamba	6	

Department of La Cochabamba.

Cochabamba	4	488,947
Clisa	8	
Tapacari	9	
Arque	7	
Oyapaya	7	
Misque	7	

Department of Santa Cruz de la Sierra.

Santa Cruz de la Sierra	6	71,952
Valle Grande	6	
Moxos	4	
Chiquitos	10	
Cordillera	4	

The sum-total of the population of Bolivia according to these returns is 1,510,406. The literal accuracy of this estimate, however, is hardly to be depended upon, as the condition of the country has until recently been such as to afford few facilities for the correct investigation of many important points in its social economy.

Indians.

The civilized Indians inhabiting Bolivia, and descendants of the Peruvians under the empire of the Incas, are still numerous, notwithstanding the many causes which have so much tended to diminish their numbers, and form a distinct and peculiar race, preserving the language, the manners, and even the dress of their ancestors; their habits having been only somewhat modified by the peculiar circumstances and situation in which they have been placed since they came under the dominion of the Spaniards. They are naturally mild and passive, and seemingly a subdued and apathetic race; but these qualities are the natural result of that state of subjection and debasement in which they have so long been held by their merciless conquerors; and, under every disadvantage, they still possess a latent energy, which was fearfully exemplified in the insurrection under Tupac Amaru, during which great numbers of them perished, the victims of their patriotism. Their defects originate from extraneous causes; their virtues are their own; and, with the exception already mentioned, they are generally unstained by those great moral crimes which prevail in more civilized countries, and require the strong arm of the law to repress them. The plaintive ditties, or *yaravis*, in their sweet and melancholy tones, evince the prevailing feelings which animate them, and are highly characteristic of the race. They possess considerable intellectual talents and capabilities, and are exceedingly sensible of kindness and justice; to which, however, they have long been strangers. Any attempt at dictation, or an imperious behaviour, on the part of their superiors or strangers, always produces an opposite effect to that desired, and they become stubborn and reserved; but when treated with mildness, they usually relax from their accustomed apathy, and often evince to strangers, when in sickness or distress, proofs of the most genuine humanity and hospitality. This was experienced, in a remarkable manner, by General Miller, during his administration of the department of Potosi, where, by his just and benevolent demeanour towards them, he so completely won their confidence and good-will, that his name is still a sufficient passport with the whole nation. With their great numbers, the union of purpose they still exhibit, and the energy of which they are capable, it will require much tact and discernment on the part of the new republican government to prevent their eventually obtaining a powerful, perhaps injurious, ascendency in the country. By the judicious and excellent regulations established by the distinguished individuals into whose hands the charge of first organising the Bolivian administration devolved, all those odious and oppressive distinctions which had so long depressed the native energies of the Peruvian Indians have been for ever abolished, and in point of legal rights they have been placed on the most perfect equality with the other portions of the community. But new laws are often very inefficient when opposed by long-continued customs and inveterate prejudices; and the Indians of Bolivia are still in too many instances subjected to acts of oppression and injustice on the part of their more fortunate fellow-citizens. These occurrences, however, may be expected to diminish in frequency and extent, as education prevails and intelligence extends its beneficial influence over the country.

The Bolivian Indians are very industrious. The men attend their flocks and herds, and cultivate the land according to their rude and primitive modes of husbandry; while the women are usually employed in spinning, knitting, and weaving coarse fabrics, in the laborious occupation of pounding maize in a rude mortar, and in other domestic occupations. They live principally on vegetable food, especially maize and potatoes; but indulge freely in their favourite *chicha*, an intoxicating liquor, which they prepare from maize. They are apparently contented and happy, mild and submissive in their manners, and particularly amenable to those placed in authority over them, especially when *caciques* of their own nation, who in fact commonly hold the situation of *alcalde* in the Indian villages, and carry a gold-headed cane as their badge of office. By appealing to the people through these *alcaldes*, travellers will generally have their wants supplied in a manner which, under different circumstances, money could not provide for them. The Indians are very superstitious, and scrupulously devout in the performance of their religious duties.

They are generally of small stature, and resemble Malays in their physiognomy. They are robust and muscular, and are capable of undergoing great fatigue when travelling

Bolivia. on foot. Thus the postilions who usually accompany persons travelling on mules are frequently in advance, although they proceed on foot; and they perform long and toilsome pedestrian journeys of from twenty to thirty leagues a-day, with scarcely any other sustenance than a portion of the leaves of the *coca* plant, which they masticate in combination with the *llipta*, an alkaline substance prepared for the express purpose, and with a little roasted maize. From this custom of habitually travelling on foot, they are equal to undertakings which no other persons in South America can accomplish. They travel at a trot, take short steps, and keep their feet close to the ground. To this cause may in a great measure be ascribed the circumstance of the Spaniards having been able, during so long a period, to maintain their political superiority in the mountainous parts of Peru, and the success which usually attended their military operations in that country. Their infantry force being principally composed of native Indians, compelled to serve as soldiers, they were thus enabled to move with that decisive celerity which characterized most of their evolutions during the war of independence. As striking instances of this fact may be cited the feats of General Valdez and others previous to the dispersion of the patriot army of General Santa Cruz in 1823. Valdez, with his division of infantry, marched during fifty-seven successive days at the rate of seven leagues a day; at another time the royalist army marched eight leagues a-day for eight consecutive days; and on one occasion, previous to coming into action, they had actually accomplished a march of thirty-nine leagues, or 117 miles, in three days.

In all parts of South America, even in the most distant parts of Chili, the Argentine provinces, Colombia, and Brazil, may occasionally be met with, parties or groups of certain tribes of Peruvian Indians, who are denominated Callavayas. They always travel on foot, and carry on an extensive traffic in a variety of gums, resins, barks, and other medicinal productions, collected in the Yungas and other parts of the mountains, which are plentifully covered with vegetation, and in other parts of the provinces of La Paz and Larecaja, near which they principally reside. They also carry on an extensive and profitable practice as itinerant physicians, employing only their native remedies. They always travel along the remains of the ancient Peruvian roads, where such exist, these being uniformly the most direct; and they generally return to their own districts, sometimes after an absence of several years. They are very loquacious, and employ considerable artifice in extolling the virtues of their remedies and the extent of their own skill. Besides the Spanish language, which is that in general use in Bolivia, they employ the Quichua or language of the Incas; but the Aimaru is the language in common use in the department of La Paz.

Religion. Religion, as it has been practised in Bolivia and most other parts of South America, has long been in a very degraded state, consisting almost entirely in the repetition of a certain number of prayers, imperfectly understood by the greater part of the people, and the performance of a number of ceremonies, the object of which seems to be, to occupy the attention, and to serve as a pretext for extorting money from the community. It truly exhibited the form of sanctity without the substance; for the spirit of true religion was entirely lost sight of, and the higher faculties of reason and reflection were never called into exercise. With some few honourable exceptions, the clergy were profoundly ignorant of every thing appertaining to their sacred profession, and were only adepts in deception and immorality. They were notoriously licentious in their conduct, and although bound by their vow of celibacy to a life of chastity and virtue, they were the great promoters of vice and immorality, especially amongst the weaker sex, from the opportunities they enjoyed at the confessional, and the influence they possessed in virtue of the sacredness of their office. In South America, particularly in Bolivia and Peru, it has been quite customary for many of the curates to live in a state of concubinage with females, by whom they have numerous illegitimate children, who are generally designated as cousins, nephews, nieces, and the like, although every one is fully aware of the nature of the connection subsisting betwixt them. Bolivia.

The evil consequences resulting from this condition of the ministers of religion may easily be conceived. They fell as heavily upon the Creoles or Spanish South Americans as upon the Peruvian Indians; but the extortions which, under the semblance of religion, were exercised upon the ignorant, indigent, and inoffensive aborigines, almost exceed belief. Not contented with the salaries allowed them by the Spanish government, they weekly exacted contributions in various forms from the Indians on the administration of the communion and the other ordinances of religion, such as baptisms, marriages, and funerals; and the amount of these was graduated according to the discretion of the curate, and the knowledge he possessed of the ability of the devotee to defray them. By these, and other devices still more nefarious, the clergy generally contrived to amass large incomes, frequently seven or eight times the amount to which they were legally entitled; and many of the curacies in Peru thus afforded incomes of from 5000 to 15,000 dollars per annum.

Under the guidance of such spiritual leaders, and breathing a moral atmosphere so tainted, it could hardly be expected that pure and undefiled religion and morality could prosper and advance. The elements requisite to produce such effects were awanting, since neither precept nor example was given to the people; and it is rather matter of surprise that, in countries thus circumstanced, so many remarkable instances should be met with of individuals distinguished by a virtuous and amiable deportment. Such occurrences, however, speak volumes in favour of the naturally good disposition which characterizes them, and warrant the most pleasing anticipations of their future improved condition, when in the full enjoyment of the facilities and advantages presented by the extension of education and the diffusion of knowledge.

Free and unrestricted religious toleration does not yet exist in any part of South America, excepting in Buenos Ayres and Bolivia. Still, the bad consequences which have in some instances resulted from premature attempts to establish toleration in South America, where the public mind was not prepared for the reception of such a measure, induce us to deprecate the repetition of such attempts as exceedingly dangerous and injudicious, until some preparation has been made. At the same time, it would be an act of great injustice not to mention, that before and since the commencement of the revolution, there have appeared amongst the catholic clergy of South America, men whose just and benevolent demeanour, and whose enlightened patriotism and devotion to the cause of humanity, would do honour to any age or country. And of late years, when circumstances more fully favoured the development of the nobler faculties, many of them have taken a prominent part in promoting education, intelligence, and every institution calculated to improve the religious, moral, and intellectual condition of their countrymen.

Education. Since the commencement of the republican government, a considerable part of the revenues of the minor convents and monastic establishments in Bolivia has been diverted from their original purposes, to form a fund for the establishment and support of seminaries of education. Colleges on improved modern principles are forming in each of the departments, and Lancasterian schools are in course

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of being established in all parts of the republic. A university having long existed at Chuquisaca for the education of the youth of Upper Peru, the utility of the establishment was greatly augmented, during the administration of General Sucre, by an improvement in the modes of instruction, and an increase in the number of the departments of education, analogous to the advanced state of knowledge in other parts of the world. In Potosi, likewise, efficient means were adopted by General Miller, while prefect of that department, to establish there a college for the study of mineralogy; a branch of education of great importance in a place wholly dependent on mining.

Society.

The society in Bolivia is exceedingly agreeable, the inhabitants being kind, hospitable, and courteous to strangers. The ladies are particularly affable and pleasing in their manners, exhibiting a happy mixture between the reserve of the English and the vivacity of the French. Their countenances are handsome, they have small feet and ancles, and possess fine figures, with a most graceful carriage, especially in promenading, and when walking abroad. They dress with much taste, using at the church, and on occasions of ceremony, their former costume of the *basquina* and *mantilla;* but on other occasions they assume the more modern fashions of Europe. The fan, which they use with much dexterity, is a constant accompaniment on all such occasions. They have frequent *tertulias* or evening parties and balls, and dance with considerable gracefulness. Their conversation is agreeable, and even superior to what might be expected in a country which has enjoyed so little of the advantages of education and moral training.

History.

The early history of that part of the empire of the Incas which now forms the republic of Bolivia is so intimately connected with that of Peru, that the consideration of it may with propriety be deferred until we come to treat of that country, in which Cuzco, the capital of the Incas, is situated. Attention will therefore at present be directed only to that period of its history which is more recent, and which has so materially influenced its present condition,—the unsuccessful insurrection of the Peruvians or aboriginal population under Tupac Amaru, and subsequently the more fortunate war of independence. But before proceeding to the consideration of these, it seems requisite to point out the principal causes which gave rise to events so memorable in South American history.

Political state of the Indians.

The Peruvians, ever since the conquest of their country by the Spaniards in the sixteenth century, have been subjected to a system of tyranny and oppression which has few parallels in the history of the universe. They were treated little better than beasts of burthen. By their toil the gold and silver were obtained from the mines, the lands were cultivated, the flocks and herds were attended to, and all the domestic and menial offices performed. Yet the fruits of their labour, especially that of mining, which was attended with numerous privations, and too often with great loss of life, were altogether devoted to enriching their cruel oppressors. While so employed they were denied all the comforts and many of the necessaries of life; they were treated as minors, and considered as incapable of attending to their own affairs and interests, nay even deprived of the means of information and improvement; while the clergy powerfully contributed to the general degradation, by keeping them in the most profound ignorance of their moral and religious duties, and substituting instead of these a few unmeaning and useless ceremonies, by means of which they plundered the Indians, without ceremony or remorse, of the scanty pittance which they were able to save from the rapacity of their civil rulers. These heart-rending occurrences are fully detailed in the secret report of Don Jorge Juan and Don Antonio de Ulloa; which important document, after the lapse of nearly a century, was procured from the archives of Madrid, by our countryman Barry, and by him given to the public.

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One of their principal grievances was the *mita*, a compulsory kind of personal labour either in the working of the mines or in the cultivation of the fields, exacted from the Indians generally for the space of one year. The proprietors of mines and land to be worked or cultivated, were privileged to claim as their undoubted right, the personal services of the Indian population of the district surrounding that in which their property was situated. By the regulations of the *mita* a proportional number of the Indians of the district were annually chosen by lot for the purposes required; and some idea may be formed of the effects of such a regulation, by stating, that 1400 mines were registered in Peru alone, and that every mine which remained unworked a year and a day became the property of the first claimant.

So much was the labour of the mines dreaded by those persons on whom the lot fell, that they considered it as equivalent to a sentence of death, and made all their arrangements accordingly, carrying with them their wives and families to their new and dreaded place of abode. While thus employed, each person was nominally paid an allowance of four rials or two shillings daily, out of which he had to provide himself and family with food, clothing, and habitation, which were furnished to him at an exorbitant rate: the one third was retained for the purpose of paying the expense of returning his wife and family to their homes in the event of his death or at the expiry of his period of service; and besides, at the end of every year a tribute of eight dollars was exacted, which being in arrear, or any other debt contracted with his employer, was too often used as a pretext for retaining him in this odious service, generally till death put a period to his misery. An estimate may be formed of the extent of this evil, by stating that 12,000 Indians were annually required by the *mita* of Potosi alone; and it is calculated that, in the mines of Peru, no less than 8,285,000 Indians have perished in this manner.

Besides the *mita* for the service of the mines, the Indians were also compelled to labour for their superiors on their cultivated estates, their *estancias* or grazing farms, and also in their *obrages* or manufactories. In these latter establishments, according to Ulloa, they were obliged to work all day, and only received a pittance for their labour; the half of which was in many instances stopped to pay their arrears of tribute, and the other half was generally insufficient to pay for their necessary sustenance. The Indians were besides liable to serve as *pongos* or menial servants to the governors, and other functionaries, as likewise to the caciques and the curates; but for this service they received no recompense, excepting their food and clothing. The numbers employed in these domestic occupations in Peru and Bolivia have been estimated at 60,000.

The tribute exacted by the government from every Indian between the age of eighteen and fifty-five was a capitation tax of eight dollars. This was levied with the greatest rigour, and the official persons charged with its collection too frequently committed great injustice in doing so; obliging the Indians to commence these payments at fifteen, and continue them until seventy years of age, and putting the amount of tribute for the years before and after the legal period into their own pockets. In proof of the extent to which this evil was carried, and of the rapacity of the Spanish government, it may be stated that a law was enacted for the express purpose of augmenting the number of the people liable to pay tribute. By it the Indians were obliged to marry, the men at the age of fifteen, the women at thirteen. The governor of each province was responsible to the government for the amount of the tribute, which was regulated by a census of the tributary Indians,

taken every seven years; and in this many frauds were practised, the actual number being often much underrated. The governor of the province of Porco, in the department of Potosi, according to the testimony of Miller, was believed to have collected annually a surplus of 10,000 dollars by these fraudulent means. This tribute continued to be exacted until the year 1825, when it was finally abolished by General Bolivar on his arrival in the country; and all the Indians now enjoy the same rights and privileges as the other inhabitants of the country.

Besides all these, the Peruvian Indians were long subjected to another system of extortion no less grievous and unjust,—the law of *repartamiento*. This was originally established with the best intentions; the governors or *corregidors* of the districts being intrusted with the charge of supplying the inhabitants under their care with such articles as they might require at a fair and equitable price. But the law, which had so plausible an origin, was shamefully abused; and it was made compulsory on the Indian population to purchase articles of the most worthless description, both in kind and quality, whether they required them or not, and at a price double or treble that for which the same article of the best possible quality might have been purchased. Thus razors were forced at an exorbitant price on Indians who had no beards to shave; and those who had never gone otherwise than barefooted were compelled to purchase velvets and silk stockings, of the use of which they were even ignorant. On one occasion a large assortment of spectacles was forwarded to a merchant at Lima, who, finding them unsaleable in a country where the natives proverbially retain their vision unimpaired till an advanced period of life, got them disposed of at an exorbitant profit by consigning them to a *corregidor*, who issued a decree to the Indians of his district, ordaining that no Indian should be permitted to attend divine service on certain occasions without having on a pair of spectacles. A *repartamiento* took place in 1743, at about forty leagues from Lima, where the *corregidor* exacted the sum of 300,000 dollars for goods which he had purchased at 70,000 dollars. The Indians of this district, according to Ulloa, "finding themselves tyrannized over with greater cruelty than they had experienced from the predecessors of the *corregidor*, determined to complain to the viceroy, and produced before him the goods, together with the proofs of the exorbitant prices which they had been obliged to pay for them. We do not state this fact from report, as we happened to be present when the Indians came to make known their grievances. The viceroy heard them, and referred them to the *audiencia;* and the result was that the Indians were seized and punished as insurgents."

These accumulated grievances at length exceeded even the powers of endurance possessed by these pacific Indians, and gave rise to the memorable insurrection of Tupac Amaru in 1780, in which torrents of native as well as Spanish blood were shed before it was finally suppressed. This event, however, gave a death-blow to the law of *repartamiento*, which was then finally abolished.

Political state of the Creoles.

The constant and extensive operation of these demoralizing practices, although more immediately affecting the aboriginal population, could not fail to produce the most pernicious and injurious effects on the Creoles or descendants of the Spaniards; but, in addition to these causes of debasement, the latter were subjected to numerous unjust and oppressive laws, all tending to paralyze their advancement in industry, intelligence, and civilization.

The raising of those vegetable productions which form the principal objects of culture in Spain, as articles of commerce, was strictly prohibited to the South Americans, however favourable the soil and climate of their native country might be for the production of them. The prosperity and happiness of the transatlantic population were of no value or importance when put in competition with the interested views and wishes of the mother country. Thus the cultivation of the vine and the olive was either prohibited, or the plants were rooted out where they had been introduced. Prohibitory decrees were issued against the manufacture of wines, brandies, vinegar, olive oil, &c.; and even the culture of almonds and raisins was interdicted. No kind of manufacture of cloth or articles of clothing was permitted which could interfere with the commerce of Old Spain, excepting only the coarse fabrics manufactured and worn by the Indians. Even the valuable mines of mercury and iron found in South America were, in a great measure, hermetically sealed by prohibitory decrees, lest they might interfere with the traffic carried on by Spain in these articles. And, not contented with confining the commerce of South America entirely to Spain, and prohibiting it under the severest penalties with other nations, these colonies were not permitted to have any intercourse or commerce with each other.

The South Americans were generally excluded from all offices of honour or emolument in their own country; and when any deviation from this law took place, it was too frequently in consequence of enormous bribes received, or a reward to some unnatural Creole for acts of cruelty and oppression committed on his own countrymen. They were also systematically deprived of the means of obtaining a suitable education for their children; nothing being taught at their seminaries excepting Latin, philosophy, the civil and canon law, and theology, while every attempt at improvement on the part of the natives was resisted by the government.

Insurrection of Tupac Amaru.

The upper provinces of Bolivia and Peru were those which formed the principal scenes of the memorable insurrection of Tupac Amaru, so just in its origin, so energetic in its prosecution, and so unfortunate in its results to the Peruvian nation. From the details which have appeared of this eventful period, it is evident that a deep-rooted feeling of the oppressive and degrading servitude to which they had so long been subjected by the Spaniards, united with a lively recollection of the happiness and glory of their more fortunate ancestors, conspired to rouse the latent energies of the whole nation to accomplish their liberation from the cruel yoke under which they had groaned. And they found an able and a willing leader in Jose Gabriel Condorcanqui, cacique of Tungasuya, a lineal descendant of the Inca Tupac Amaru, whose name and title he afterwards assumed. But although an excellent and intrepid man, and possessing the entire confidence of his countrymen, he was deficient in that knowledge, foresight, and energy, so requisite for conducting to a happy termination so difficult and hazardous an enterprise. He experienced various successes and reverses, but was eventually taken prisoner, and put to death in the most barbarous manner by the Spaniards. He was succeeded in the direction of the enterprise by his nephew Andres, who, with the aid of Catari and other caciques, continued the contest with great and indiscriminate carnage on both sides; but having to contend against the superior skill, discipline, and arms of the Spaniards, aided by treachery, they were finally overcome, and the insurrection was put down in 1782.

Having thus failed in their arduous undertaking, after the destruction of great numbers of their nation—for neither the lives of men, women, nor children, were spared on either side during this sanguinary contest—their chains were rivetted with double force; and the sorrow and despondency which followed these disastrous events were so great that they never again recovered their wonted energies. Yet there is every reason to believe that, had they possessed better arms and discipline, more knowledge and

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experience, and leaders better adapted for such an enterprise, they would, from their number, union, and devotion to the cause, have finally accomplished their deliverance.

These circumstances will account in a great measure for the apathy and comparative indifference with which they viewed the rise and progress of the war of independence, the objects of which they did not rightly understand, and found difficult to reconcile with their knowledge of the active part taken by the Creoles in the suppression of their own previous endeavours to throw off the Spanish yoke.

War of independence.

From the causes already stated, the war of independence was principally carried on, as regards Bolivia, by the resources of, and in concert with, the neighbouring provinces of the Rio de la Plata and Peru, all of which had equal cause to avenge themselves on their oppressors, but were placed in circumstances somewhat more fortunate for accomplishing their purpose. When the patriots of Buenos Ayres had succeeded in liberating, from the dominion of Spain, the interior provinces of the Rio de la Plata, they turned their arms against their enemies in possession of Upper Peru. General Antonio Balcarce was therefore sent with the forces of Buenos Ayres into that country, and succeeded in defeating the royalist general Nieto, at Cotagaita, on the 27th October 1810; and on the 7th November following, a similar fate overtook Colonel Cordova at Tupiza. These successes gave him possession of the country as far as the bridge of the Incas, which crosses the river Desaguadero; at which time his army had been increased by recruits to about 4000 men. Castelli was sent from Buenos Ayres as governor of Upper Peru, and to act as the commissioner of the Argentine government, with the army of Balcarce. He was a man distinguished for his great and versatile talents, but was of a restless and fiery temper. By the violence of his proceedings, and numerous acts of unjustifiable cruelty, he so far succeeded in inspiring the Spaniards with terror and dismay, that the army of Buenos Ayres was enabled, on the 25th of May 1811, to celebrate the first anniversary of their independence among the ruins of the palace of the Incas at Tiaguanaco, on the shores of the lake of Titicaca, 690 leagues distant from Buenos Ayres. The dissolute conduct of Castelli, however, and the irregularities of the Buenos-Ayreans who accompanied him, tended greatly to alienate the affections of the inhabitants of Upper Peru from their deliverers, and considerably aided the efforts of Abascal, viceroy of Peru, who, after some unsuccessful attempts to conclude an armistice with Castelli, in which little courtesy seems to have been observed on either side, collected all his disposable forces under his best generals. The civil administration of the provinces was neglected by the patriots; and the army became disorganized, from the dissolute conduct and negligence of Castelli and his followers. General Goyeneche was intrusted with the command of the Spanish army, which, to the amount of 4000 men, took up a position on the north side of the Desaguadero, two days' march from their opponents. In the interim an armistice had been concluded between the two contending armies; but, regardless of the inviolability of such a transaction, Goyeneche attacked and defeated the patriot army under Balcarce and Castelli at Huaqui, on the 20th June 1811, six days before the expiry of the truce. Balcarce retired from Bolivia with the remains of his army, and took up a position at Jujuy, distant 236 leagues from the scene of action. After his success Goyeneche committed great cruelties in Bolivia, particularly at Chuquisaca and La Paz; but he met with considerable opposition from the patriots, who had retired to the mountains of Cochabamba, Santa Cruz de la Sierra, and Chayanta.

General Belgrano, who succeeded to the command of the army of Balcarce, had the good fortune, at Tucuman, to defeat the royalist army, 3000 strong, under General Pio Tristan, on the 30th September 1812, while his own force did not amount to half that number. And, again, on the 20th February following, he obtained another victory over the same general, who had entrenched himself in Salta with 2000 men, all of whom were either killed or taken prisoners. Belgrano generously permitted the vanquished Tristan, with his officers and men, to return to Peru, on their giving solemn pledges not again to bear arms against the republic of the Rio de la Plata. But all of them, influenced by the example of their general, and regardless of their obligation, violated their parole, and joined the army of Pezuela, which, by such dishonourable means, was augmented to 4000 men. With these he attacked Belgrano, who, with his army, had advanced into Upper Peru, and defeated him at Vilcapugio, between Oruro and Potosi, on 1st October 1813; and again at Ayoma, in the department of Cochabamba, on the 14th November of same year. Belgrano escaped with the remains of his army to Tucuman.

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Notwithstanding these disasters, the cause of independence did not slumber in Upper Peru, since numerous bands of patriots maintained themselves in Cochabamba, Santa Cruz de la Sierra, Chayanta, and Yamparaes, and obtained many advantages over the royalists, under the able command of Warnes, Camargo, and Padilla, who carried on a guerilla warfare. On 25th May 1814, Colonel Arenales obtained some advantages over his opponents in the provinces of Cochabamba, and Warnes was equally fortunate on the 9th October following, in the Quebrada of Santa Barbara. Guemes, with the irregular troops of the province of Salta, cut off the supplies of the royalists in front; whilst the guerilla parties under Warnes, Padilla, and Muñecas, in the rear, so distressed them, that Pezuela with his army was obliged to retire upon Cotagaita. The patriot army at Tucuman under the command of General San Martin never came into collision with the royalists until after his removal to the command of Cuyo, when General Rondeau succeeded him in the direction of that army, amounting to 3500. With these he marched again into Upper Peru against the royalists, whom, in nearly equal numbers under Pezuela, he encountered at Sipe-sipe, between Potosi and Oruro, on 28th November 1815, and was totally defeated; and this was followed soon after by another defeat at Viluma, which again placed Upper Peru under the control of the royalists. General Belgrano was a second time appointed to command the army stationed at Tucuman, composed of the remains of the army which had been vanquished at Sipe-sipe and Viluma; and, by unwearied exertions, he soon collected a force of about 4000, well equipped. But a spirit of disaffection and anarchy had crept into his army, which, incited by the principal officers, revolted against their general. He was deposed and made prisoner; and the officers, with such soldiers as chose to follow them, dispersed over the provinces, where, in many instances, they usurped the civil and military administration, which in some cases they retained until a late period.

To these events succeeded, under Pumacagua, an insurrection of the Indians of the neighbouring provinces of Arequipa, Cuzco, and Huamanga, in Peru; and the object being the independence of the whole country, it was joined by numerous Creoles from Bolivia and Peru. But this attempt was speedily put down by the activity of the royalist general, Ramirez, who inflicted a severe retaliation on Pumacagua and his followers. After this period Upper Peru remained tranquil for a considerable time, unless when disturbed by the enterprises of Lanza and his followers, who maintained themselves in the Yungas.

On the viceroy Abascal being superseded in that office

Bolivia. by Pezuela, General Laserna was appointed commander in chief in Upper Peru, where he arrived in September 1816, with 2000 fresh troops. He introduced many innovations, and very humanely prohibited the infliction of the punishment of death for political offences, without his previous permission. He made an attempt, with an army of from 4000 to 5000 men, to penetrate into the Argentine provinces, intending to march to Buenos Ayres; but he was completely foiled by the activity and intrepidity of the *Gauchos*, or irregular troops of the provinces of Salta and Jujuy, and was compelled to retire with the remainder of his army to Cotagaita.

The expedition of General Santa Cruz, prepared with great zeal and activity at Lima, landed in June 1823, in the Puertos Intermedios, and marched in two divisions to Upper Peru: the one under Santa Cruz by the Cordillera of Iscuchaca, obtained possession of the bridge of the Incas on the Desaguadero on 29th July, and occupied La Paz on the 7th August; the other division, under General Gamarra, marched by the route of Tacora and San Andres de Machaca, and reached Calamarca on the 10th August, where it had a sharp rencontre with a division of the army of General Olañeta, and then marched to Oruro, where it was joined by Lanza with 600 men. During six years the latter had maintained himself in the Yungas with great valour against all the efforts of the Spaniards. At this period General Urdininea, with 1000 men, occupied the quebrada or defile of Humaguaca, near Jujuy, ready to approach Potosi on the first favourable occasion.

At this time the royalist force in Upper Peru, under Olañeta, did not exceed from 2000 to 3000 men, besides about 1500 men in garrison at Puno and La Paz. But Canterac, then near Lima, hearing of the large army which had gone to Upper Peru under Santa Cruz, dispatched General Valdez with three batallions of infantry, 400 cavalry, and two cannon, to unite with the forces under the viceroy Laserna, and Generals Carratala and Olañeta. On the other hand, General Sucre also sent from Lima 3000 troops, either to co-operate with Santa Cruz, or to act separately, as occasion might require; and he soon afterwards proceeded in person to command them, with authority from the congress, if necessary, to assume also the command of the army under Santa Cruz.

Santa Cruz remained in quiet possession of Upper Peru, occupying the country from Oruro to the bridge of the Incas, his head-quarters being at La Paz. Valdez proceeded by Andaguaylas and Sicuani towards Puno, having completed a march of about 400 leagues in fifty-seven successive days. On the approach of the royalists, Santa Cruz took up a position near the bridge of the Incas; and at Zepita, on the 25th August, fought an indecisive action with Valdez, who commanded 1800 men, his own force being only 1600. The royalists immediately concentrated their forces at Sicuani, amounting to 4500 men, whilst those of Santa Cruz were about 7000 men. Various movements now took place on both sides, which evinced much skill and activity on the part of the royalists, and great indecision and want of judgment on the part of Santa Cruz. The royalists being at length joined by the forces of Olañeta, amounting to 2500 men, and considering themselves equal in number to the patriots, began to act on the offensive, and came in contact with the army of Santa Cruz at Sicasica. But this general showed no disposition to come into collision with the royalists, and retreated towards Aya-aya, losing some of his baggage, and many deserters. He appears to have resisted all the endeavours and entreaties of his officers, as well as the declared wishes of his army, to rally and engage the enemy. A severe storm, which overtook them here, served to increase their disasters, and converted the retreat of the army into a precipitate flight. The fugitives retired by Santa Rosa and Moquegua towards Ilo, where about 1300 embarked in the transports; but of an army of 7000 men only 1000 returned to Lima. About 1000 retired from Sicasica with Lanza, but were afterwards defeated by Olañeta, and their leader and a few followers only escaped to the mountains. It is difficult to account for the strange infatuation which led to the destruction of this fine army, as Santa Cruz on other occasions had shown himself an able commander; but these events will always remain as a cloud upon his military character. Bolivia.

In May 1824, Generals Valdez and Olañeta occupied Upper Peru, each with about 5000 men under his command, but opposed to each other on political points; the former having withdrawn his allegiance from the viceroy Laserna, in consequence of advocating the constitutional cause of Spain, while Olañeta adhered to the principles of absolute monarchy. This dispute was useful to the cause of the patriots, as it prevented Olañeta from uniting his forces with the viceroy during the campaign which terminated in the battle of Ayacucho, so glorious to the cause of freedom. General Sucre, whose abilities and valour so much contributed to the success of that day, improved the advantages he had obtained, by his clemency and generosity to the vanquished, and by the rapidity with which he followed up his successes; so that none of the fugitives could unite with the army of Olañeta, now the only royalist general in arms in Upper or Lower Peru. A part of the army, therefore, proceeded towards Upper Peru, and in their march experienced in some instances great hardships; the division of General Cordova having lost many men near Santa Rosa, from *surumpi* or snow blindness.

On hearing of the victory of Ayacucho, the patriot prisoners of war confined in the island of Chuquito, in the lake of Titicaca, rose on their guards, whom they overcame; and placing themselves under the command of General Alvarado, likewise a prisoner, they took possession of the country as far as the bridge of the Incas; a division of 1500 patriots under the command of General Urdininea still occupying the quebrada of Humaguaca, on the southern frontier of the department of Potosi. General Olañeta, however, still retained his position in Upper Peru, at the head of about 4000 men, having refused to accede to the liberal and even generous terms of accommodation proposed to him by General Sucre. The latter, therefore, on recruiting his army after the fatigues they had undergone, and supplying them with clothing and other necessaries, advanced to Oruro, and afterwards to Puno, which he reached on the 1st February 1825, and there obtained information that the royalist garrisons of Cochabamba, Chuquisaca, and Santa Cruz de la Sierra, had declared for the patriots, and that the city of La Paz was in possession of the gallant and indefatigable Lanza. Olañeta, with his army, diminished to 2000, was confined to the department of Potosi, but still persisted in his determined opposition, notwithstanding the entreaties and remonstrances of Colonel Medina Celi, his second in command, who at length, with a considerable portion of his army, rose against him. Olañeta, with a few resolute followers, resisted to the last; until, in an action with some of his own revolted troops at Tumusla, sixteen leagues south of Potosi, he was mortally wounded, on the 30th of March 1825.

General Sucre was now invested with the supreme command in Upper Peru, until the requisite measures could be taken to establish in that country a regular and constitutional government. Deputies from the various provinces to the number of fifty-four were assembled at Chuquisaca, the capital, to decide upon the question proposed to them on the part of the government of the Argentine provinces, respecting their separation or otherwise from that country. In August 1825 they decided this question, and declared

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it to be the national will that Upper Peru should in future constitute a distinct and independent nation. This assembly continued their session, although the primary object of their meeting had thus been accomplished, and afterwards gave the name of Bolivia to the country; issuing at the same time a formal declaration of independence. They also voted one million of dollars to General Bolivar, as a reward for his past services; and an equal sum to those belonging to the army who had served in the campaign of 1824. The former grant, however, was only accepted by Bolivar on the express condition that it should be wholly appropriated to purchasing the freedom of about a thousand slaves still existing in Bolivia.

The first general assembly of deputies of Bolivia dissolved themselves on the 6th of October 1825, and a new congress was summoned, and formally installed, at Chuquisaca, on the 25th May 1826, to take into consideration the constitution prepared by Bolivar for the new republic. A favourable report was made to that body by a committee appointed to examine it, on which it was approved by the congress, and declared to be the constitution of the republic; and as such, it was sworn to by the people. General Sucre was chosen president for life, according to the constitution; but only accepted the appointment for the space of two years, and on the express condition that 2000 Colombian troops should be permitted to remain with him, which request was agreed to by the congress.

Bolivian code.

The Bolivian constitution is founded on the strictest principles of justice, in as far as regards the civil rights and privileges of the community; but in other respects, and particularly in reference to the supreme executive authority, its provisions savour strongly of a monarchical spirit. The supreme authority is vested in a *presidente vitalicio*, or president for life, with the power of naming his successor. It guarantees to the Bolivians civil liberty, security of persons and property, and equality of rights; the free exercise and communication of thoughts and opinions, either by the press or otherwise; liberty to remain or leave the territory of the republic with their property, at their pleasure, but without prejudice to others; equality in the imposition of taxes and contributions, from the payment of which none can be exempted; and the abolition of all hereditary employments, privileges, and entails. No profession, trade, or employment, can be prohibited, unless repugnant to public feeling, or injurious to the health and security of the community; and every inventor is secured in the benefits of his discovery. No one can be arrested without previous information of the alleged fact of delinquency, unless when taken in *flagranti delicto*. All trials and judgments are public; and in criminal cases none can be imprisoned more than forty-eight hours without having presented to him the charges preferred against him, and being delivered over to the proper tribunal or judge. No demand for redress in civil or criminal cases can be brought judicially before the justices of peace, until they have first endeavoured to promote reconciliation, by hearing the representations of the parties, explaining to them their respective rights, and proposing some means of accommodation.

By this constitution, all legitimate power emanates directly from the people, and is in the first instance exercised by all who can justly claim the privilege of citizens. Of these, every ten nominate an elector, who exercises his delegated authority for a period of four years. At the commencement of each year all the electors assemble in the capitals of their respective provinces, and regulate their proceedings and the exercise of their various functions by a plurality of votes. They elect the members of the three legislative chambers, the number for each amounting to thirty; those for the chamber of tribunes being nominated for four years, and renewed by moieties every two years; those for the senate for eight years, and renewed by moieties every four years; and those for the chamber of censors being nominated for life. The electors also exercise the privilege of proposing in ternaries, 1*st*, To the executive power, all candidates for the prefectures of departments, for the government of provinces, and for corregidors of cantons and towns, and also curates and vicars for the vacancies in their provinces; 2*dly*, To the senate, the members of the courts of the judicial district to which they belong, and the judges in the first instance; and, 3*dly*, To the prefect of the department, the alcaldes and justices of the peace, who are to be appointed in their respective provinces.

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The functions of the chamber of tribunes are, to originate all laws respecting the revenue, peace and war, and to exercise an immediate inspection of those branches which are administered by the executive, with the least intervention of the legislature. This chamber also possesses the initiative in the settlement of the territorial division of the republic; the coinage, weights and measures; the seaports, roads, bridges, and public buildings; the police, &c.

The attributes and functions of the chamber of senators are, to form the civil, criminal, and ecclesiastical regulations and codes, and watch over the tribunals of justice and religion; to choose, from the ternaries presented to them by the executive and by the electoral body, the prefects, governors, corregidors, judges of districts, and all others in the department of justice; to propose to the chamber of censors those who are to be members of the supreme tribunal of justice, the archbishops, the bishops, dignitaries of the church, canons, and prebends; and to examine the decision of ecclesiastical courts, bulls, rescripts, and pontifical briefs, with a view to their approval or disapproval.

The chamber of censors exercise a political and moral power. It is their duty to watch that the constitution, the laws, and treaties, are strictly adhered to and executed; and to express the national judgment, when such is rendered necessary by the good or bad administration of the executive government. The censors are also charged with the protection of morality, the arts and sciences, education, and the press. They exercise the important functions of condemning those who usurp sovereign power, or are guilty of high crimes and malversation; and they bestow public honours and rewards on the services and virtues of illustrious citizens. This chamber also exercises the functions of choosing, from the ternaries presented to them by the senate, those who are to form the supreme courts of justice, to become archbishops, bishops, canons, and prebends.

The general or collective duties and attributes of the three chambers, when united, are, to nominate the president of the republic for the first time, and to confirm his successor; to approve of the vice-president proposed by the president; to determine on the seat of government; to decide on any charge against members of the chambers, the vice-president, or secretaries of state; to invest the president with extraordinary powers in cases of great emergency or danger; to select from the candidates presented in ternaries by the electoral bodies, those members who are to fill up the vacancies of the chambers; and to regulate and judge the department of police. All the sessions must be public, excepting in such state cases as require secrecy. No public functionaries are capable of being members of the chambers; and the latter enjoy inviolability in their persons for opinions expressed, and are not subject to arrest.

The executive government consists of a president, vice-president, and three secretaries of state. The president of the republic is named for the first time by a majority of the collective legislature, and retains the dignity during life, with the power of naming his successor. He is the chief of the administration of the state, and is not

 responsible for the acts of his administration. On his death, resignation, or infirmity, the vice-president is virtually his successor. In the absence or non-existence of both of these functionaries, the three secretaries of state take charge, *ad interim*, of the administration of the government, the oldest in office acting as president until the assembling of the legislature. The constitutional privileges of the president are the most limited that have been intrusted to the supreme chief of any nation. They extend only to the nomination of the officers of the revenue, of peace and of war, and the command of the army. He proposes to the chambers the vice-president, and he nominates the three secretaries of state, and can remove any of these functionaries when he judges it necessary. He appoints all diplomatic functionaries; receives foreign ambassadors and agents; directs all negociations; and, with the previous sanction of the legislature, concludes treaties of peace, alliance, commerce, &c. He presents to the senate, for its sanction, one of the three candidates proposed by the electoral body for each of the situations of prefect, governor, and corregidor; and to the ecclesiastical government, one of the three candidates proposed by the electoral body for each of the offices of curate and vicar in the provinces. He authorizes the regulations for the proper fulfilment of the constitution, laws, and treaties; he forwards and causes to be executed the sentences of the tribunals; and he has the power of commuting capital punishments awarded by them.

The president cannot deprive any Bolivian of his liberty, or inflict punishment on him, of his own accord; nor can he imprison any one longer than forty-eight hours without delivering him over to the proper judge or tribunal; nor deprive any individual of his property, unless such a proceeding be urgently demanded by the public interests; nor impede the elections or any other public functions authorized by the laws; nor absent himself from the republic or the capital without permission of the legislature. He is nominated for life, and made irresponsible as a security for his permanency; but his hands are nevertheless tied, so that he cannot do injury to any one. He does not nominate the magistrates and the judges, nor does he appoint to any ecclesiastical dignity, however subordinate; and hence he is, at least nominally, deprived of the powerful influence over society which is exercised by other supreme rulers. The administration belongs wholly to the ministry, which is responsible to the senate, and is subject to the zealous vigilance of the legislators, magistrates, judges, and citizens.

The vice-president is proposed by the president, and approved of by the legislature. He is at the head of the ministry, and, with the secretaries of state, is responsible for all the acts of the administration; while, in the name of the president and the republic, he signs all the public documents, along with these secretaries, in order to legalize the orders of the executive. Of all the magistrates intrusted with command, the vice-president is that one whose hands are most shackled; for he has to obey both the executive and the legislature. He receives laws from the latter, and orders from the former; and between the two has often a difficult course to steer. His nomination as the successor of the president insures the services of an individual whose previous experience in the difficult art of government, and knowledge of those in subordinate situations, render him the most eligible of any for such an office; and by this means are avoided those elections for the supreme ruler so productive of mischief in other republics. As the expectant of the supreme command, the vice-president has the most powerful motives for the zealous and conscientious discharge of his functions, in order to secure, on the one hand, the confidence and support of the president, and, on the other, that of the legislature and the people. The three secretaries of state are for the home and foreign departments, for the finance, and for war and marine; and each is required to give in accounts of the expenses incurred in his respective department, and the estimates for each ensuing year.

The judicial power enjoys the most perfect independence, the members composing it being proposed by the people, and chosen by the legislature; a condition which insures the strict and impartial administration of the laws. Tortures and confessions are altogether abolished, as repugnant to humanity. The territory of the republic is governed by prefects, governors, corregidors, justices of the peace, and alcaldes; and the proportion of these is regulated by the population: the details to be defined by the congress; and every one in the enjoyment of office is made responsible for his actions. The armed force is composed of the regular army to garrison and defend the frontiers, of the national militia to preserve internal order, of the preventive service to protect the revenue, and of the navy, when circumstances may require the formation of such.

Slavery in every form was abolished, as inconsistent with the just rights of mankind, and at variance with the whole spirit of the constitution. The exercise of religion was freed from all restraints; it being considered incompetent to legislate in matters affecting the conciences of others.

Such are the principal features of the Bolivian constitution, the merits of which will be variously estimated, according to the particular political bias of each individual. It contains in theory much that seems calculated to insure the liberty, the prosperity, and the happiness of the community. The legislative portion has been objected to as being too complicated for practical purposes; but this requires to be put to the test of experience. No part of it, however, has excited more criticism, or given rise to more sinister suspicions, than that which provides for the election of a president or supreme ruler for life, with the power of nominating his successor. With such a provision, the Bolivian constitution is, in fact, nothing more nor less than a limited monarchy, somewhat incuriously disguised under republican forms. This seems undeniably its political character; and although it may have worked tolerably well in Bolivia, the country for which it was ostensibly intended, and where, according to the latest accounts, it still subsists, yet there seems to be little doubt that it was conceived in a spirit more friendly to individual aggrandizement than to the liberty of the people or the ultimate consolidation of republican institutions.

Had Bolivar, the lawgiver of this republic, ceased to exist, or had he retired altogether from public life, on the promulgation of the Bolivian code, his reputation as a patriot and a statesman would have been handed down to posterity as one of the brightest in the annals of history. But, unfortunately, the formation and establishment of this constitution gave rise to events in Peru, Colombia, and other parts of South America, which incontrovertibly prove that it was not dictated by that pure spirit of patriotism which his friends and admirers have attributed to Bolivar; but that under it lurked a gigantic scheme of ambition and aggrandizement, in fruitless endeavours to accomplish which much crime and misery were occasioned, whilst the glory which its author had previously earned contracted a stain which, it is to be feared, no length of time will ever efface. The project which emanated from the promulgation and establishment of this code in Bolivia, and in the prosecution of which Bolivar principally employed his active energies during the latter years of his life, was, the establishment of the same constitution in Peru and Colombia as well as in Bolivia, and the union of these three republics, either federally, or as one state, of which he was to be the president for life. The celebrated congress at Panama, which took place in June 1826, was originally pro-

Bolivia. jected by him for this express object; and many other expedients, which it is foreign to our present purpose to enumerate, were also resorted to for the accomplishment of his design. But all his schemes proved abortive, and he died without effecting any of the objects, personal to himself, for which he had compromised his fame, and incurred the suspicion and dread of all who were friendly to republican institutions.

The congress which sanctioned the adoption of the Bolivian code, and elected General Sucre as the president of the republic, continued its sessions, to legislate more in detail. The republic was peculiarly fortunate in its first choice of a president in the person of the conqueror of Ayacucho, whose mildness, urbanity, integrity, love of justice, and devotedness in the discharge of the important duties confided to him, endeared him to every one capable of being influenced by generous feelings. He had few personal enemies; and those who opposed him were principally influenced by the impression of his intimate connection with Bolivar, and of his favouring the political principles advocated by the latter; for all viewed Sucre as the firmest and most energetic supporter which Bolivar possessed. Under the upright administration of this officer much progress was made in organizing the various departments of the administration; the resources of the country were called forth; and effectual means were adopted for promoting the extension of education and intelligence throughout the community.

Amidst these powerful inducements to tranquillity, much discontent was excited by the presence of a body of Colombian troops in the country, which, in a period of profound peace, was considered by many as derogatory to the dignity, and inconsistent with the liberty, of the republic. The number influenced by such feelings was greatly augmented by the accession of those aspirants to place and power, who considered their respective claims as having been neglected or ill requited; and strength and consistency were given to these malcontents, by a belief, which subsequent events proved to be well founded, that the government of Peru favoured their views, and that they would be supported by a numerous and well-appointed Peruvian army, stationed in the department of Puno.

Meanwhile they succeeded in gaining over to their party the Colombian battalion of voltigeros stationed at La Paz, among whom a mutiny took place on the 23d December 1827; but this was speedily suppressed by the Colombian cavalry under Colonel Brown, and the armed peasantry of La Paz, after a desperate resistance on the part of the mutineers, of whom eighty were killed. The battalion was consequently disbanded. This revolt was hailed with loud demonstrations of joy by the government and people of Peru, who viewed it as the first step towards the downfall of the policy of Bolivar.

General Sucre, convinced that removing the principal source of discontent was essential to the stability of the constitution and the welfare of the country, applied to the government of Peru for permission to the Colombian troops to march through the territory of that state, and embark at Arica. But the Peruvian administration denied to these brave men the privilege of returning to their native country by the route by which they had formerly advanced to establish the freedom of Peru, unless they submitted to the humiliating condition of suffering themselves to be disarmed; a condition which was spurned at by Sucre and the Colombians. On the 5th March an interview took place near the Desaguadero, between Generals Sucre and Gamarra, the latter commanding the Peruvians. On this occasion each disclaimed any intention of interfering in the internal affairs of the republic to which the other belonged; a pledge which subsequent events proved to have been insincere on the part of Gamarra. General Sucre succeeded, however, in obtaining the sanction of Gamarra to the embarkation at Arica of all the Colombian troops in Bolivia, excepting about 500 men; and this was accordingly carried into effect without any further opposition on the part of the Peruvians. Bolivia.

While Sucre was occupied with these transactions, the spirit of discord had extended itself to Chuquisaca the capital, and spread amongst the garrison. With the view of repressing this disorder, Sucre rode in amongst the mutinous soldiers, accompanied by his staff and a few other officers; but he was unsuccessful in his attempt to quell the mutiny; Colonels Lanza and Escalona were mortally wounded, and the general himself was so severely wounded as to be made prisoner. This revolt, however, was ultimately suppressed by General Lopez with some troops from Potosi, aided by the well-disposed inhabitants of Chuquisaca; and Sucre was set at liberty. But he intimated his fixed determination not to resume the office of president, except for the purpose of resigning it into the hands of congress, at its first meeting.

On hearing of the affair at Chuquisaca, Gamarra called a council of war, the members of which, with only one dissentient voice, agreed as to the propriety of his marching into the Bolivian territory, with the ostensible object of preventing anarchy, and protecting Sucre from further personal violence; and this resolution was soon afterwards sanctioned by orders to the same effect from the Peruvian government. Accordingly, Gamarra and his army crossed the Desaguadero on the 1st of May; but they were coolly received by the Bolivians, whose forces being too few for resistance, retired from La Paz, and concentrated themselves towards Oruro and Potosi, under the command of General Urdininea. But the latter, instead of advancing with his whole forces to encounter Gamarra, weakened his army by detaching a large division, in order to reduce a mutinous regiment of cavalry under Colonel Blanco, in the province of Chichas. Ineffectual endeavours at negociation were followed by some indecisive affairs between the two armies in the province of Paria. Meanwhile Blanco, eluding the vigilance of the party sent against him, placed himself in communication with the Peruvian forces, and with a party of them proceeded to Chuquisaca, where he seized General Sucre, hurried him by forced marches to the head-quarters of Gamarra, and during the whole journey treated him with the greatest inhumanity and indignity.

A treaty of peace was now entered into between Generals Gamarra and Urdininea at Piquisa (6th July), by which the independence of Bolivia was guaranteed, and the object of the Peruvian invasion accomplished by the retirement of General Sucre, and the removal of the remaining Colombian troops from the territory of the republic. Accordingly the latter embarked at Arica for Colombia on the 28th of July, under the command of Colonel Brown. Sucre was then set at liberty, and formally resigned the presidency of Bolivia on the 18th of August 1828; on which occasion General Santa Cruz was elected as his successor.

General Sucre descended from his high station in a manner which accorded well with his elevated character. His message to the congress of Bolivia, dated the 4th of August, will serve as a lasting monument of his merits in organizing Bolivia, and of his impartiality in pointing out that part of the Bolivian code which he considered as most imperfect. During the two years of his administration, colleges and Lancasterian schools were established in the capitals of each of the departments, and schools of the same description for females were instituted in three of them; besides which, other schools were multiplied throughout the country under improved regulations, and

Bolivia. well provided with funds. Important ecclesiastical reforms were effected, and the number of friars so diminished that only six convents remained of the thirty-six in existence when he came into office, the funds of those suppressed having been devoted to the purposes of education and various useful public institutions. Some progress was also made in the improvement of the police, prisons, &c.; and the army was left in a very efficient state. Agriculture had been improved in all its branches, and no forced loan or contribution of any kind was made. Mining had increased so much, that during the preceding year one-third more of the precious metals had been extracted than in any former year. Commerce had also been promoted, and efforts were made to establish the free port of Cobija or La Mar. Although the amount of the revenue received had diminished in consequence of the changes in the imposts, yet such had been the economy observed by the administration, that the revenue was not only sufficient to defray all necessary expenses, but a surplus had been accumulated to meet extraordinary charges.

Santa Cruz was now elected president of the republic; General Velasco vice-president. The new governor, who happened to be absent in Chili, found, to his surprise, on reaching Chuquisaca, that General Blanco had in the mean time usurped his functions, and appointed a new vice-president. The usurper, however, did not live long to enjoy his honours; for in a week he was assassinated, and his death left Santa Cruz in undisputed possession of the chief power. From this date till the year 1834, the president directed all his efforts to developing the internal resources of the state. The better to gain his end, and attract to his own country a share of the foreign commerce which had hitherto been almost monopolized by the neighbouring states of Chili and Peru, he formed the bold design of uniting Bolivia and Peru into a confederation. The latter country was at this time in a state of anarchy. At the invitation of Orgebozo, the deposed president, Santa Cruz marched an army into Peru, gained two battles, and reinstated Orgebozo, with whose assistance he carried out his scheme, and was appointed protector of the Peru-Bolivian confederation. The two countries had just begun to prosper under his rule, when the Chilians, jealous of their commercial interests, sent an invading army, which defeated Santa Cruz at Yungay in 1839, dissolved the confederation, and compelled the protector to abdicate. He now became an exile from his country, where his influence was still dangerously great; and though he more than once tried to return, he was always intercepted. In 1843 he fell into the hands of the Peruvians, by whom he was delivered up to the Chilian government, which detained him for some time as a prisoner at Chilöe. It was at last found convenient to despatch him to Europe as Bolivian plenipotentiary; and he was till 1852 the accredited minister of that country at the courts of London, Paris, Madrid, Rome, and Brussels. After the battle of Yungay, another revolution occurred in Bolivia, which left Velasco president, and Ballivian vice-president. As the former soon showed himself incapable, the army mutinied in 1841, and endeavoured to reinstate Santa Cruz. To prevent this, the Peruvians interfered, and invaded Bolivia with a large army. The vice-president hurried to meet the invaders, routed them completely at Ingavi, in his turn entered Peru, and established himself at Arica on the Pacific. Intestine troubles, however, compelled him soon after to return home, where in 1843 he was duly elected president of the republic. Despite the numerous attempts to dispossess him of his power, he retained it till 1848, when a new revolution more formidable than its predecessors compelled him to abdicate. No regular president was appointed for two years; but the administration was carried on by Manuel Isidoro Belzu, commander-in-chief of the army. These two years are signalized by the number of revolts and conspiracies, and by the bloody atrocities of a civil war scarcely yet put down. Belzu, in spite of his extreme unpopularity, has contrived to maintain himself in power. His life has been often attempted, and more than once he has been severely wounded by the pistol-shot of the assassin. The policy of the present government of Bolivia is, unfortunately, ill adapted to repress these outrages, and is itself characterized by that narrow and jealous spirit of distrust so injurious to the prosperity of young states. A decree of 1850, for example, deprives all foreigners of the right to trade with the interior of the country, and leaves them only the inaccessible port of Cobija. In 1853, however, this act, so injurious to the prosperity of Bolivia, was rescinded; and not only was free trade proclaimed, but a large reward offered to the first steamer of any nation that should sail up to the Bolivian territory through the rivers La Plata or Amazon. Bolivia.

The year 1852, to the astonishment of all, elapsed without a revolution, or even a new civil war. It was signalized by no event of public interest, except the retirement of Santa Cruz, the death of the ex-president Ballivian, and the enactment of certain measures for the prevention of treacherous designs against the government. By these every soldier who is tempted to revolt, and gives instant information against the conspirators, is rewarded with two grades of promotion if an officer, and 6000 piastres if a private. All who are tampered with, and do not inform, are subject to the same penalties as the rebels. At the beginning of 1853, another rupture broke out between this country and Peru. The principal cause of this event was asserted to be the Bolivian coinage. Since 1830 the money struck at the national mint was stated to be only 23 per cent. below the usual alloy; the Peruvians, into whose country this coinage readily found its way, maintained that it was 33, and even 40 per cent. below the legal value. The bad feeling engendered on both sides by the mutual complaints and recriminations on this subject, was further complicated by another untoward event. The Bolivian government accused M. Paredes, the Peruvian chargé d'affaires at La Paz, of communicating false intelligence to the authorities at home, and spreading alarming rumours about the intentions of the state, and demanded his recal. The Peruvians refused to comply with the demand, but to obviate difficulties M. Paredes voluntarily retired. Pending negotiations, he was seized and expelled the country by the police. His countrymen demanded reparation for this outrage, which was refused. Then began a mutual system of reprisals; the result of which was a declaration of war, and the occupation of Cobija by a Peruvian fleet. The matter here rests for the present (Jan. 1854), as the war has not yet been prosecuted to extremes by either party.

In 1836, slavery was formally abolished in Bolivia by act of congress, though the native Indians are still considered as in a state of tutelage, and continue to pay the capitation tax; and in 1839 the entire political constitution of Bolivia was remodelled. In 1843 it was again altered; and was not finally established till 1848. The executive is now vested in a president, who holds office for four years, and is re-eligible after an interval of the same duration. He is assisted by a council of state and four ministers. The power of legislation belongs to the congress, which consists of a senate and a chamber of deputies. The congress, whose sessions last for two months, meets annually on the 6th of August. Every department returns three senators; while the deputies are elected in the proportion of 1 to 40,000 electors. Every elector must be able to read and write, and possess a capital of 4000 piastres, or an equivalent.

Justice is administered gratuitously. There is a justice of peace for each canton; a *juez de letras* at the headquarters of the province; a court of appeal in the capital of each department; while the supreme court sits at Chuquisaca,

Boll || Bollards.

and is composed of four judges and a president. By the decree of 1845, a system of public instruction was organized and promulgated. A university was founded, colleges were established, and elementary schools opened in some places. Teachers and professors, however, were not to be found in Bolivia; and the inducements held out by the government were insufficient to attract men of learning and skill from other countries. The funds, moreover, which were originally set apart by Bolivar for this most important object, have been gradually diverted by succeeding governments, so that now the *beneficencia* is in arrears in almost all the departments. That of Cochabamba has lost since 1844, 300,000 piastres, while those of Oruro, Potosi, and Chuquisaca, are unable to defray current expenses.

The present military force of Bolivia consists of three battalions of infantry, and two regiments of cavalry. Though the sum total of the standing army amounts only to 1500 men, yet the exigencies of the country render every man more or less familiar with the use of arms.

The finances of Bolivia have, of late years, been much impaired by the general insecurity that pervaded every department of public affairs. During the civil wars, according to the report of the minister of finance in 1850, the mint, the bank, and the public treasury, were literally swept of their funds. In 1849 the deficit amounted to 473,752 piastres, in 1849 it rose to 506,516 piastres. In 1850 there was a surplus of 237,473 piastres. The national debt of Bolivia is entirely confined to the country itself, and consists, 1. Of the bonds of the loan contracted in 1826, chiefly to reimburse the founders of the independence; and, 2. Of the loan of 1843, which amounts to 2,181,216 piastres, bearing interest at 6 per cent. The interest of arrears since 1847 amounts to 392,618 piastres. The value of the entire commerce of Bolivia, imports and exports included, is at present about L.1,000,000 sterling.

Bologna.

The press is not without its representatives in Bolivia. The majority of the journals published there are printed at the expense of the government, which, however, does not hold itself responsible for any statements they may contain, In Chuquisaca is published *The Naked Truth*; in La Paz, *The Epoch* and *The Prism*; in Oruro *The Republican*; and in Tarija *The Telegraph*. The existence of these journals is almost the only sign of intellectual life in the Bolivian republic. (*Secret Report of D. Jorge Juan and D. Antonio de Ulloa*, by Barry; *Rélation Historique des Voyages de Humboldt et Bonpland*; Brackenridge's *Voyage to South America*; Andrews' *Travels in South America*; Temple's *Travels in South America*; *Edinburgh New Phil. Jour.* Oct. 1829 to April 1830; *Memoirs of General Miller*.[1] (J. G.)

BOLL (Saxon *bolla*, a bowl), a Scotch measure for corn, containing 4 firlots. (See FIRLOT.) The boll of wheat or beans is equivalent to 4 Winchester bushels; of oats, barley, or potatoes, to 6 bushels. A boll of meal is equal to 140 lb. avoirdupois. This measure is now abolished, corn being measured by the imperial standard measure.

BOLLANDUS, JOHN, a learned Flemish Jesuit, born at Tirlemont in Limbourg Aug. 13. 1596. He is celebrated as the first of that series of hagiographers, called after him *Bollandists*, who compiled the vast collection of the lives of Romish saints known as the *Acta Sanctorum*. Rosweide, a learned Jesuit, had published in 1607 the plan of such a work, but died in 1629 without having realized his design. Bollandus was appointed to this work, with the approval of Pope Alexander VII., by the conclave of his order, and in 1635 received as his coadjutor Godfrey Henschen. Discarding Rosweide's plan of reproducing unchanged the whole of the ancient legends, he set himself to the task of verifying their contents by an examination of all the historical sources at his command. Of this immense work he lived to complete only five volumes. After his death in 1665, the series was continued by Henschen, Papebroch, Baert, Janning, and a host of other writers. On the abolition of the Jesuit order in 1763, the work was for a time interrupted. It was resumed in 1779, and again interrupted in 1792 by the French invasion. At this time the series extended to 54 vols. folio. The order pursued in the work was to give under the names of each month the lives of the saints whose days occur in that month. The number of biographies is estimated at 25,000. The 54 vols. brought down the series to the 16th of October. A continuation of this work is now in progress, under the auspices of the Belgian government. Two additional volumes have already appeared. This vast collection, with much that is useless and legendary, contains a valuable mine of facts in civil and ecclesiastical history.

BOLLARDS, large posts set into the ground on each side of a dock. On docking or undocking ships, large blocks are lashed to them; and through these blocks are reeved the transporting hawsers to be brought to the capstans.

BOLOGNA, one of the legations or provinces of the Papal States, bounded on the north by Ferrara, east by Ravenna, south by Tuscany, and west by Modena. Area 1430 square miles; pop. 350,600. It is a district of great natural fertility, and though but indifferently cultivated produces abundant crops of rice, barley, wheat, and pulse, besides hemp, flax, silk, oil, wine, figs, almonds, chestnuts, and other fruits.

BOLOGNA, the principal city of the above legation, and the see of an archbishop, is situated between the rivers Reno and Savena, in a beautiful and fertile plain at the foot of the lower slopes of the Apennines, 399 feet above the level of the Adriatic, and 23 miles S.E. of Modena. Lat. 44. 30. N. Long. 11. 21. E. The city is about 2 miles in length by 1½ in breadth, and is surrounded by a high brick wall, having 12 gates, but without fortifications. It is intersected by the Reno canal, and is divided into four quarters. The streets are clean and well paved, but generally narrow and crooked; the houses are mostly three stories high, with deep projecting roofs, and are generally surrounded with arcades. The *Piazza Maggiore*, or principal square, has many fine edifices. In the centre is a fountain, adorned with a colossal statue of Neptune, by Giovanni de Bologna, and said to be one of the finest modern statues in Italy. Among its principal buildings are the *Palazzo Pubblico*, the *Palazzo del Podesta*, and numerous private palaces; the two leaning towers of Asinelli and Garisenda, the *Scuole Pie*, cathedral, &c. The university, the oldest and at one time the most celebrated in Italy, has lost its reputation, and is not now frequented by above 600 or 700 students. The library contains about 140,000 volumes and 9000 MSS. The famous linguist Cardinal Mezzofanti was for some time librarian here. The *Accademia delle Belle Arte* has a rich gallery of paintings, chiefly by native artists. There are cabinets of mineralogy and natural history; academies of science, music, sculpture, &c.; several schools; a public library; 74 churches, 35 convents for monks, and 38 for nuns; 9 hospitals, a *monte di pietà*, and many other benevolent institutions. Its principal manufactures are crape, silk, glass, chemicals, wax can-

[1] The principal facts connected with the later history of Bolivia were obtained from some valuable manuscripts and public documents with which the writer (the late Dr Gillies) was favoured by the author of the *Memoirs of General Miller*. More recent sources have furnished the supplementary portion of this article.

Bologna ‖ Bolscheretsk.

dles, musical instruments, paper, the celebrated *Mortadelle* sausages, &c. Pop. (1844) 75,000.

Bologna is said to have been founded by Felsina, an Etruscan king, who gave it his name and made it the capital of the twelve Etruscan cities. When, in the time of Tarquinius Priscus, it was occupied by a tribe of the Boii, its name was changed to Bononia, although some contend that this name was given to it by an Etruscan king Bonor. Under the Romans Bononia gradually became a place of some consequence, and it was chosen in the time of the second triumvirate as the seat of an interview between Octavius, Antony, and Lepidus. After the fall of the Roman empire it passed into the power of the Lombards, and on their subjugation by Charlemagne it was united to the empire of the Franks. In 962 it threw off the yoke and became a republic, at first aristocratic, but towards the end of the thirteenth century democratic. The middle ages formed the period of its greatest celebrity and importance. In the contest between the Guelfs and the Ghibellines, the Bolognese, after a long neutrality, sided with the former, and became deeply involved in struggles both foreign and intestine. After innumerable revolutions of fortune, Bologna was finally annexed to the papal dominions by Pope Julian II. in 1506. After its capture by the French in 1796, it was made a constituent part of a new republic, and afterwards of the kingdom of Italy. On the fall of Napoleon it reverted to the papal dominion. A revolution in 1831 was quelled by the intervention of Austrian troops. In 1848 the Austrian general Welden made an attack upon this city, but was repulsed with great bravery by the inhabitants. The following year, however, the Bolognese were obliged to surrender after a heroic defence of ten days. The Austrians have since then maintained possession, which has subsequently been sanctioned by a treaty with the papal government.

Bologna, *Giovanni di*, (or Giovanni Bologna, as he styled himself), a very celebrated sculptor, born at Douay in 1524. He went early to Italy, and studied at Florence, where his finest works still remain. His two most celebrated productions are the single bronze figure of Mercury, poised on one foot, resting on the head of a Zephyr, as if in the act of springing into the air (in the Florentine gallery); and the famous marble group of the Rape of the Sabines, which received this name, as we read in Lanzi, after it was finished. It is now in the Loggia de Lanzi of the ducal piazza. Giovanni was also employed at Genoa, where he executed various excellent works, chiefly in bronze. All his pieces are characterized by great spirit and elegance.

The surname of Bologna is common to a large number of Italian artists and literary men, from the twelfth to the seventeenth century.

BOLOGNESE School, sometimes called the Lombard School of painting, was founded by the Caracci. Among the principal painters it produced were Domenichino, Lanfranco, Coreggio, Guido, Schidone, Caravaggio, Zampieri, Primaticcio, &c.

BOLOGNIAN Stone, a radiated sulphate of barytes, found in roundish masses, composed of radiating fibres. When calcined, pulverized, converted into a paste with mucilage, and then dried in pieces about a quarter of an inch thick, it affords a pyrophorus, which, after a few minutes' exposure to the sun's rays, gives light enough in the dark to render the figures on the dial-plate of a watch visible. It was first discovered at Monte Paterno near Bologna, whence it derives its name.

BOLSCHAIA Reka, or the Great River, a river of Kamtschatka, which rises in a lake about 120 miles from its mouth. It flows into the sea of Okhotsk, in Lat. 54. 52. N. It is navigable from its source to its mouth, on the south side of which there is a lighthouse.

BOLSCHERETSK, a town and fortress of Kamtschatka, formerly the capital of that peninsula, and the seat of the government. It is situated on the river Bolschaia Reka, twenty miles from its mouth, in an extensive plain stretching along the sea-shore. Present pop. scarcely 200. Long. 157. E. Lat. 53. N.

Bolsena ‖ Bolton-le-Moors.

BOLSENA (ancient *Volsinium* or *Vulsinium*), a town of the Papal States, in the delegation of Viterbo, and ten miles S. by E. of Orvieto. It is situated on the north shore of the lake of the same name (*Lago di Bolsena*); but is chiefly remarkable for the remains of the ancient city in its vicinity, among which are numerous granite columns, supposed to have formed part of the temple of the Etruscan goddess Norcia. This was one of the most ancient and powerful of the Etruscan cities. After a series of struggles with the Romans, the Volsinians were finally subdued, their city razed to the ground, and themselves obliged to settle in a less defensible site in the plain. The new city was the birthplace of Sejanus, the favourite of Tiberius. It is now a miserable village of 1700 inhabitants.

The lake of Bolsena is about ten miles in length by eight in breadth, and surrounded by well-wooded hills. It contains two small islands, and discharges its waters by means of the Marta into the Mediterranean. The surrounding country is extremely unhealthy.

BOLSOVER, a small town in Derbyshire, best known for its limestone quarries, which have supplied the yellow stone for the new houses of parliament. Pop. of parish in 1851, 1611.

BOLSWERT, Boetius-Adam, an eminent engraver, born at Bolswert in Friesland, about the year 1580: died in 1634. It is inferred, from his style, that he studied in the school of Blömaert. His principal works are the following:—after Rubens, "The Last Supper," "Resurrection of Lazarus," "The Crucifixion," and "The Judgment of Solomon;" "The Martyrdom of St Stephen," after Coningloo; "Jesus with Martha and Mary," after Goiomar; after Blömaert, "The Adoration of the Shepherds," "The Holy Women in the Desert," in twenty plates, four landscapes, and twenty landscapes inscribed *O nimium felix*, 1616. Bolswert was also the author of a romance entitled *The Pilgrimage to Jerusalem.*

Bolswert, or Bolwert, Schieltius, the younger brother of the preceding, lived at Antwerp about the middle of the seventeenth century, and has left admirable prints after some of the finest works of Rubens and Vandyck. He worked entirely with the burin, and without stippling. His finest works are—the "Christ crowned with Thorns," after Vandyck; "The Assumption," "The Brazen Serpent," "Mercury and Argus," and two prints of Satyrs, after Jordaens; "A Lion Hunt," after Rubens; and a "Crucifixion."

BOLT-Rope, a rope sewed round the edges of a sail, to strengthen it.

BOLTER, or Boulter, a kind of sieve, made of woollen, hair, or wire, for separating bran from flour, &c.

BOLTING Mill, an engine for sifting with more expedition. The cloth around it is called the *bolter.*

BOLTON, or Boulton, Edmund, an ingenious English antiquarian of the seventeenth century. His principal work is that entitled *Nero Cæsar, or Monarchie Depraved*, dedicated to his patron the Duke of Buckingham, lord high admiral, printed at London 1624, folio, and adorned with several curious and valuable medals. It contains also an interesting account of the British revolt under Boadicea. He also wrote, 1. An English translation of Lucius Florus's Roman History; 2. *Hypercritica*, or a rule of judgment for reading or writing our histories; 3. The Elements of Armories; and some other works. The time of his death is unknown.

Bolton le Moors, a municipal and parliamentary borough of England, in the hundred of Salford, Lancashire, 12 miles N.W. of Manchester. The small stream Croal,

Bomb. which falls into the Jewell, divides it into Great and Little Bolton; the former being on the south side of that stream. This town has latterly been much improved by the formation of wide and well-paved streets and squares, but it has still several narrow and crooked streets and lanes. In the vicinity are some handsome villas, particularly on the south side of the town. Bolton is well supplied with water, a company having been formed for that purpose in 1824. It is brought from springs about four miles N.E. of the town. The corporation has lately purchased the water-works from the company. Bolton has an ancient parish church, six other churches, and a chapel of ease, two Roman Catholic chapels, three Independent, six Methodist, and nine other dissenting chapels; a free grammar-school, two charity schools, and numerous others. Among its public buildings are the town-hall, cloth-hall, public baths, exchange, theatre, barracks, &c. It has also a mechanics' institute, savings-bank, several libraries and reading-rooms, and numerous charities. The woollen manufacture was introduced here by the Flemings in the fourteenth century, but it is only since the introduction of spinning machinery that Bolton has become one of the principal seats of the cotton manufacture in England. In 1849 there were 53 cotton mills within the borough, giving employment to 9759 persons. It has also a number of large foundries and iron works, bleach works, a paper mill, &c. There are numerous coal mines in the vicinity. Bolton is connected by canal as well as by railway with Manchester and Bury; and by railway with Liverpool, Preston, Leigh, and Blackburn. Since the Reform Act it returns two members to parliament. Population (1851) 61,171. Arkwright and Crompton, inventors of the spinning-frame and mule-jenny, were both natives of the parish.

BOMB (*βόμβος*, a loud noise), in military affairs, a large shell of cast-iron, with a vent to receive a fusee, which is made of wood. The shell being filled with gunpowder, the fusee is driven into the vent within an inch of the head, and fastened with a cement made of quicklime, ashes, brick-dust, and steel-filings, worked together in a glutinous water; or of four parts of pitch, two of colophony, one of turpentine, and one of wax. This tube is filled with a combustible matter made of two ounces of nitre, one of sulphur, and three of gunpowder-dust, well rammed. To preserve the fusee, it is pitched over, but uncased when the bomb is put into the mortar, and covered with gunpowder-dust, which, taking fire by the flash of the powder in the chamber of the mortar, burns all the time the bomb is in the air; and when the composition in the fusee is spent, it fires the powder in the bomb, which bursts with great violence and commits dreadful devastation. Bombax.

Bombs may be used without mortars, as was done by the Venetians at Candia, when the Turks had possessed themselves of the ditch. Bombs were rolled down upon them along a plank with ledges set sloping towards their works. Bombs did not come into common use before the year 1634, and then only in the Dutch and Spanish armies. One Malthus, an English engineer, is said to have first carried them into France, where they were used at the siege of Collioure. The art of throwing bombs or shells constitutes a branch of gunnery. See GUNNERY.

BOMB-*Vessel*, or *Bomb-Ketch*, a small ship of unusual strength, employed for throwing bombs into a fortress; said to have been invented by M. Reyneau, and first used at the bombardment of Algiers. Till then it had been judged impracticable to bombard a place from the sea.

BOMBARDIER, a gunner whose business is to drive the fusee, fix the shell, and load and fire the mortar.

BOMBARDO, a musical instrument of the wind kind, similar to the bassoon, and used as a bass to the hautboy.

BOMBASINE (*bombycinus*, from *bombyx*, a silkworm), a name given to two sorts of stuffs, the one of silk, the other crossed of cotton.

BOMBAST, in composition, is a serious endeavour, by strained description, to elevate a low or familiar subject; which, instead of being sublime, never fails to be ridiculous. The mind, in some animating passions, is indeed apt to magnify its objects beyond natural bounds; but such hyperbolical description has its limits, and when carried beyond these it degenerates into burlesque. An ambitious writer who has not natural elevation of genius is extremely apt to glide unconsciously into bombast. He strains above his pitch, and the violence of the effort generally carries him beyond the limits of propriety.

BOMBAX, a genus of soft, spongy trees, of the natural order of Bombaceæ. The most noted is *B. Ceiba*, the silk-cotton tree of South America, the trunk of which is often 100 feet high, and of enormous thickness, so that a canoe hollowed out of its spongy stem will carry at once fifteen or twenty hogsheads of sugar. *B. pubescens* of Brazil attains only a height of 20 or 30 feet. Its tough bark is manufactured into ropes.

END OF VOLUME FOURTH.

Fig 13

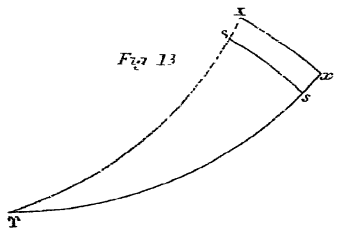


Fig. 14

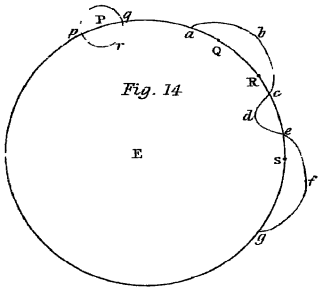


Fig 15

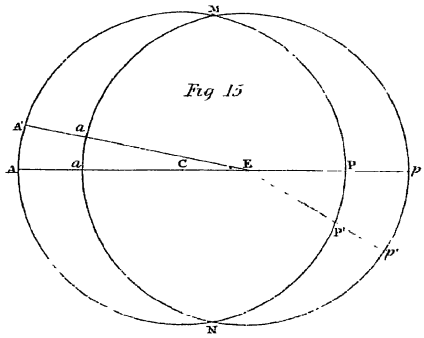


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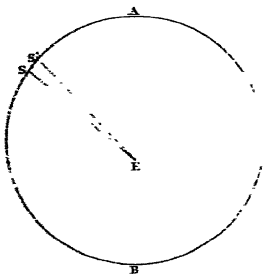


Fig 17

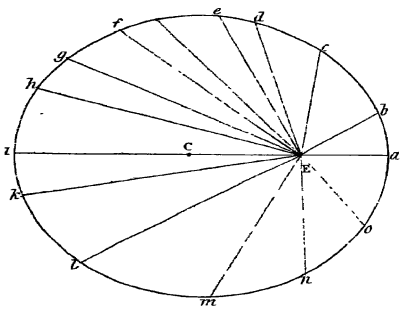


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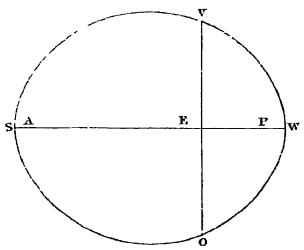


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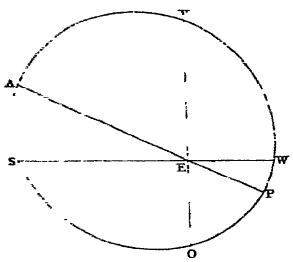


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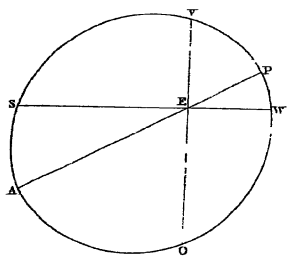


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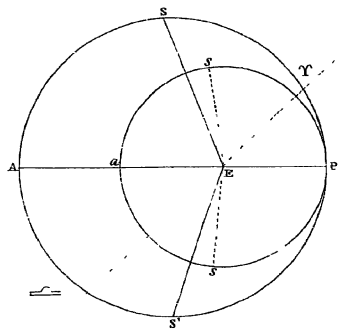


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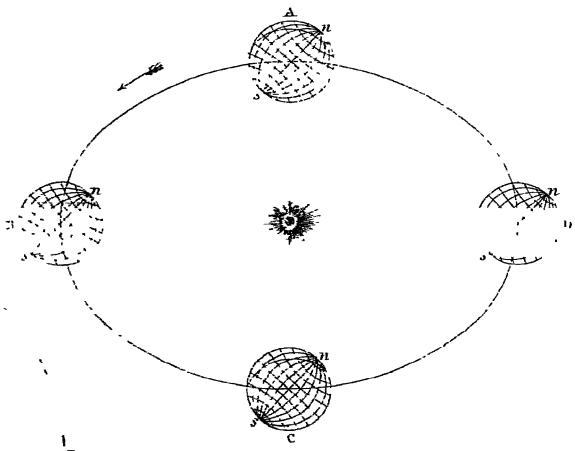


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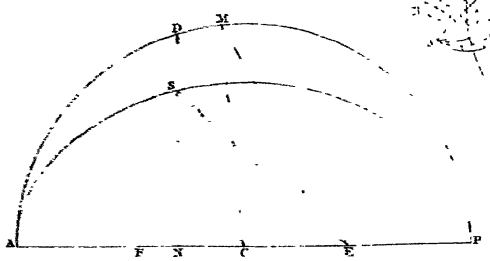
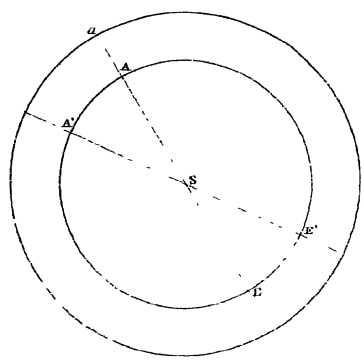


Fig 23



ASTRONOMY.

PLATE LXXVII.

Fig 1.

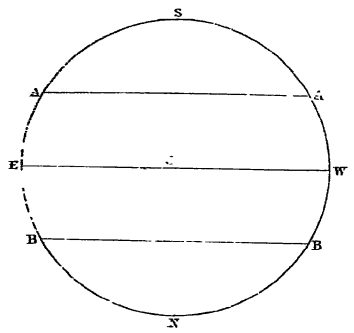


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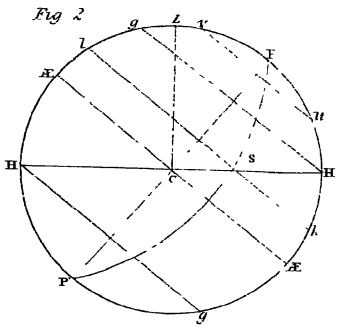


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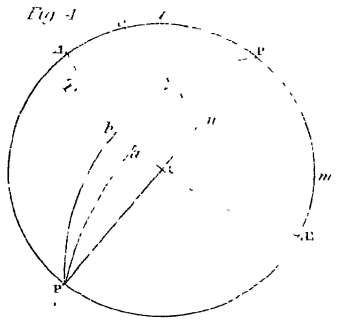


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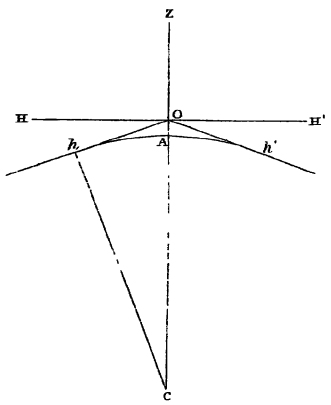


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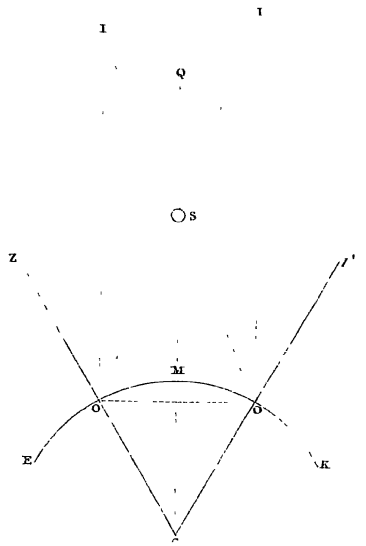


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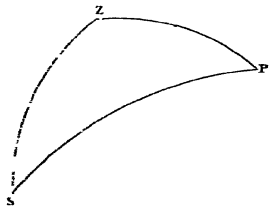


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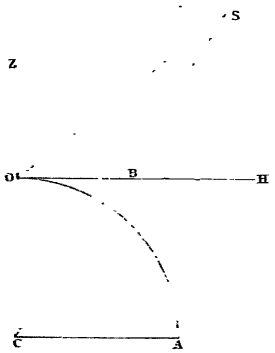


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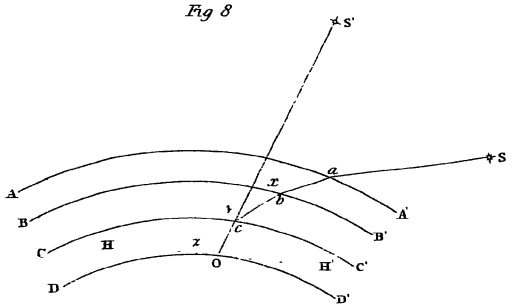


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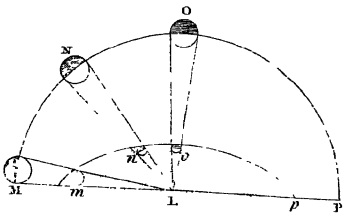


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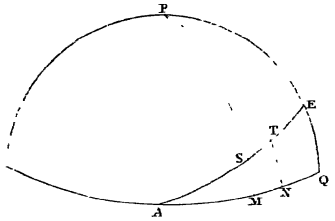


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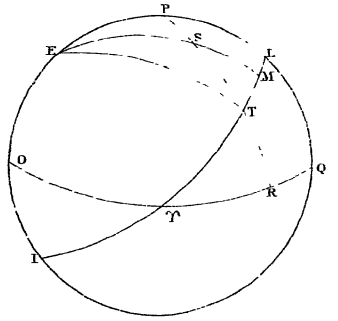


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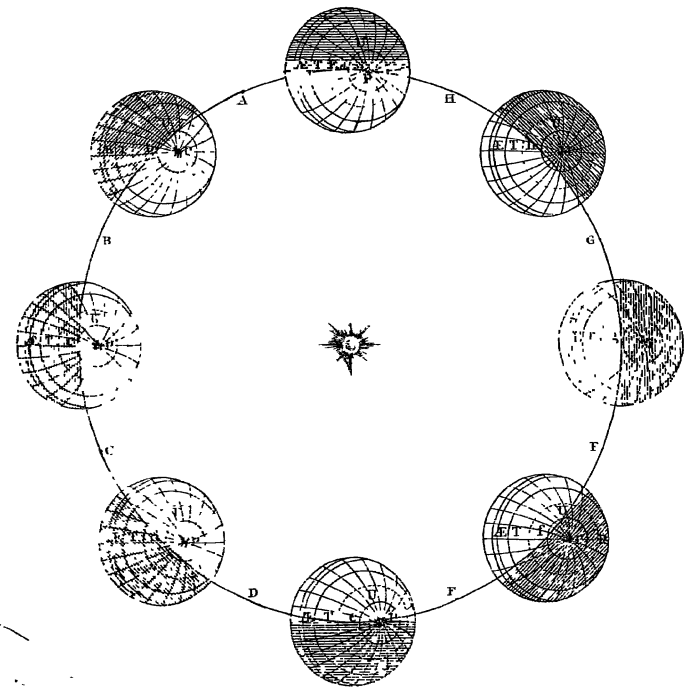


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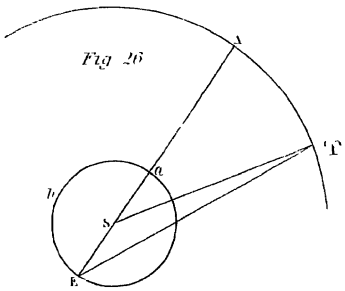


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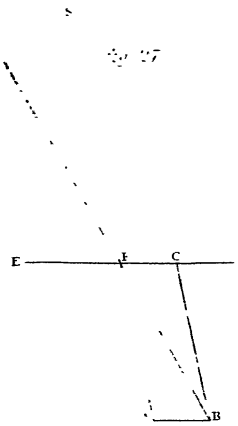


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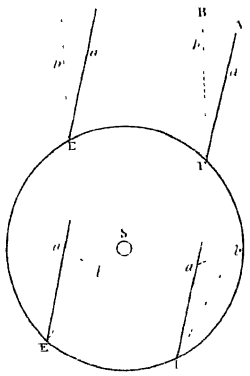


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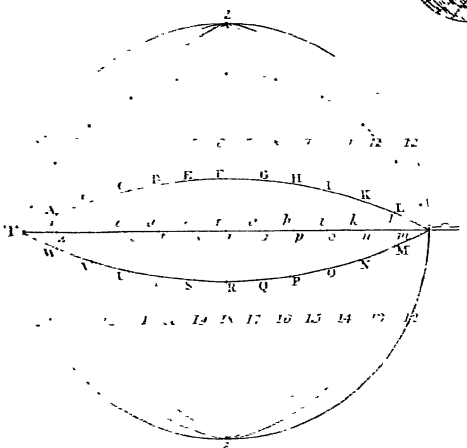


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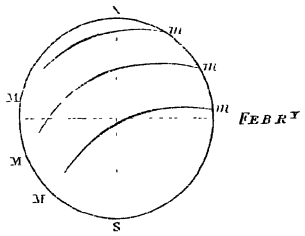


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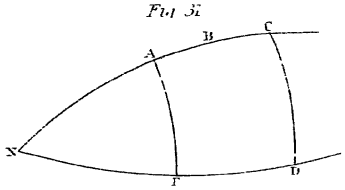


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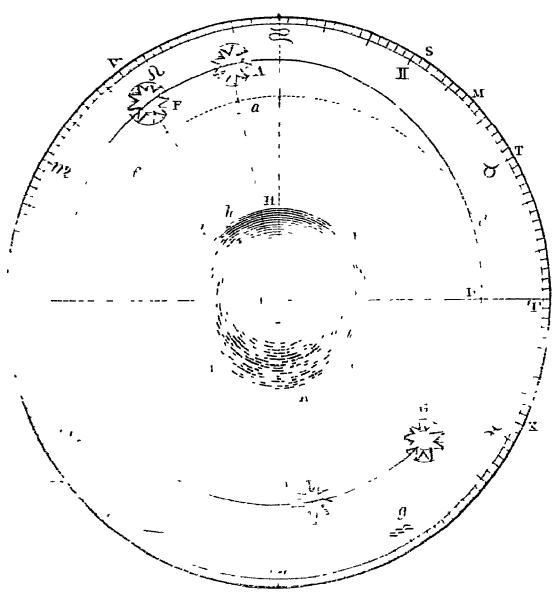


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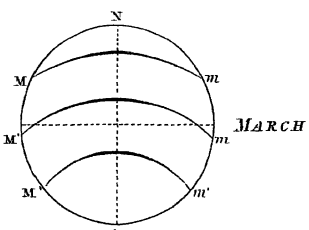


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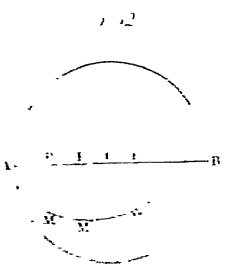
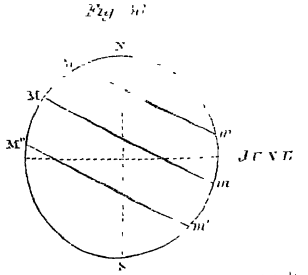
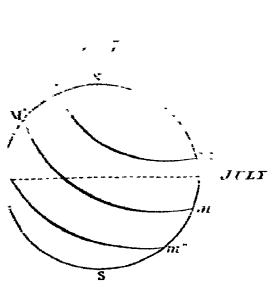


Fig 35



Fig 36





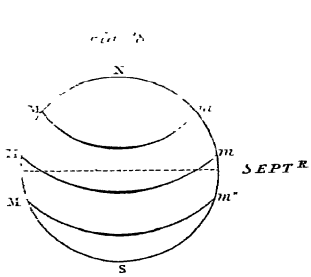


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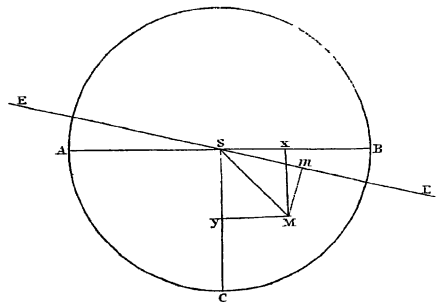


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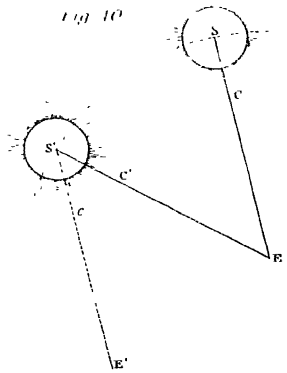


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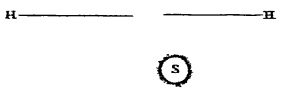


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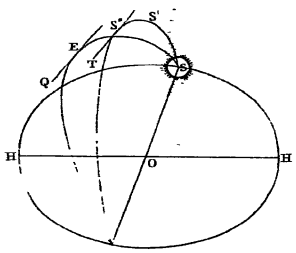


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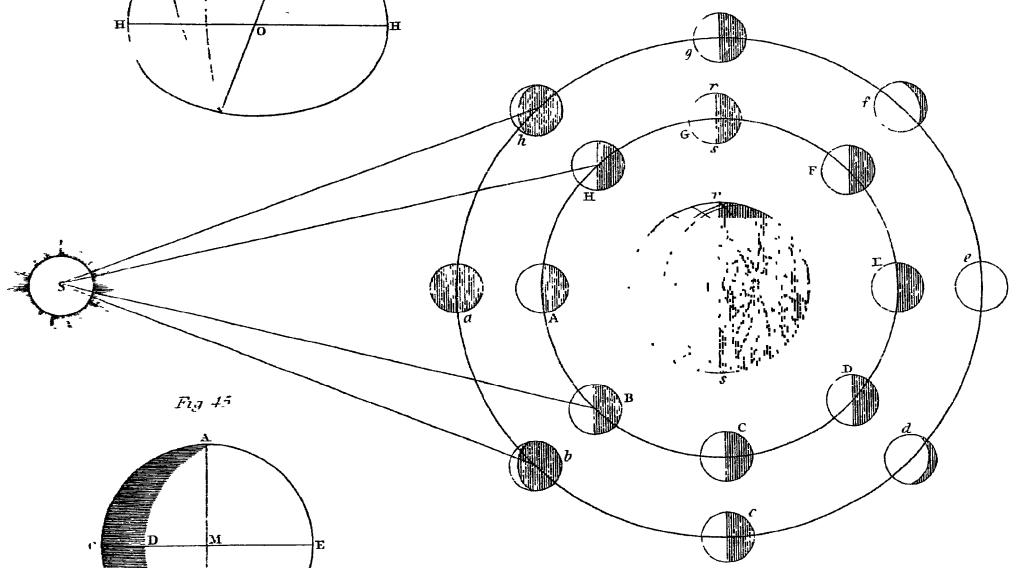


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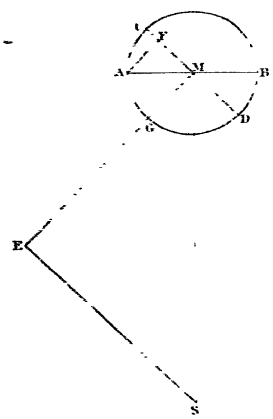


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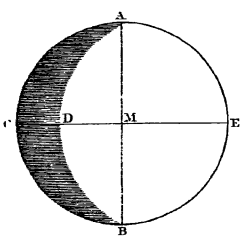
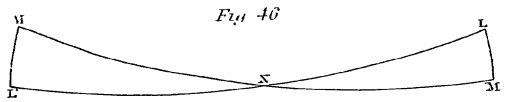


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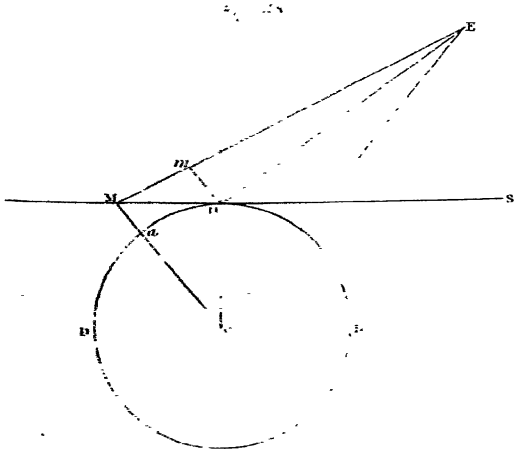


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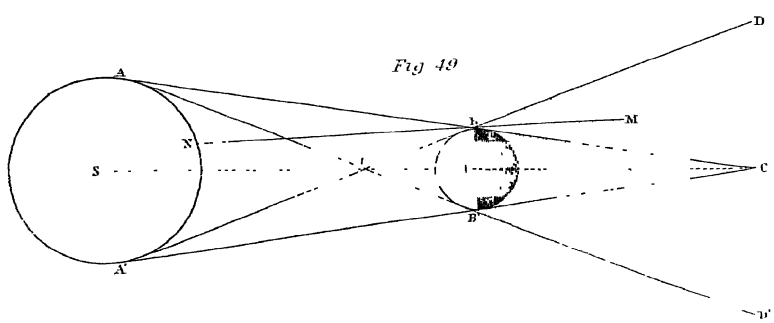


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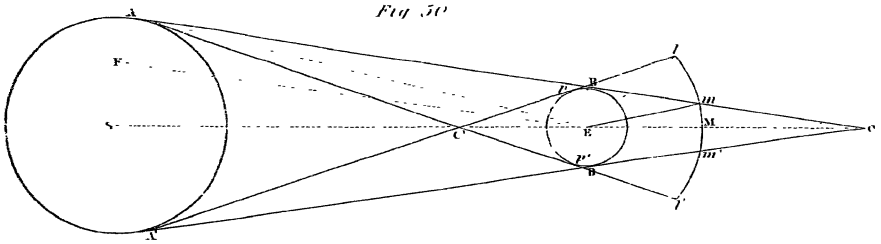


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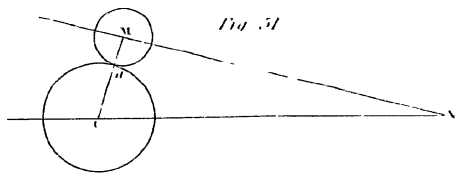


Fig 52

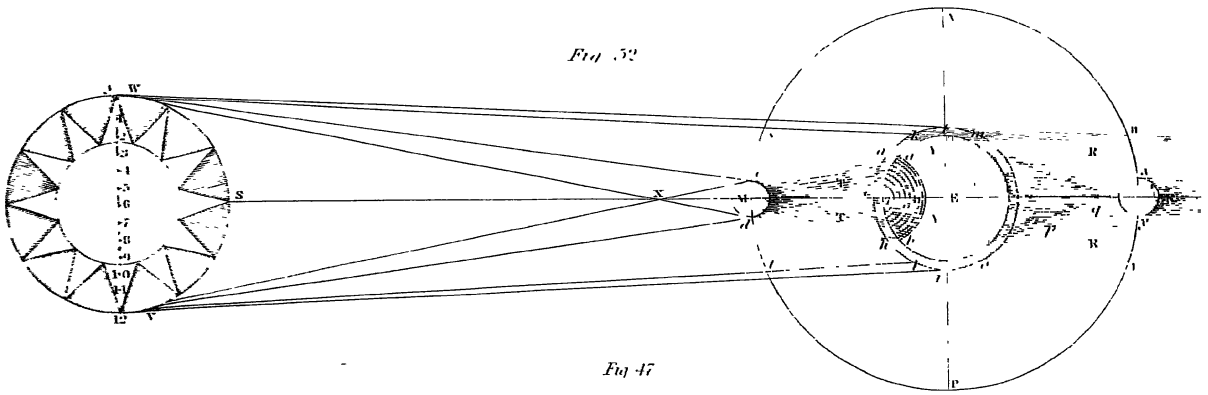


Fig 47

THE MOON IN HER MEAN LIBRATION

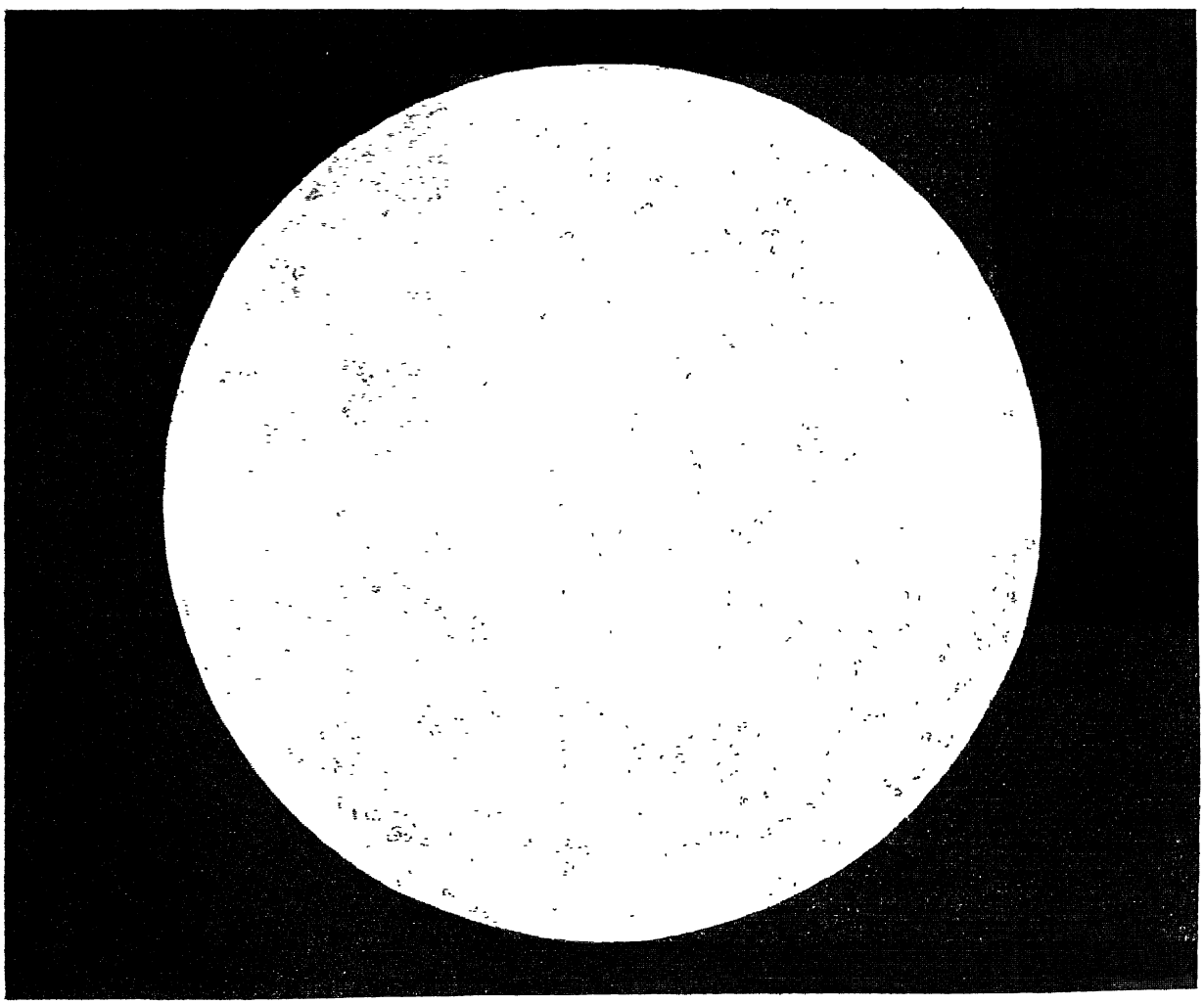


Fig 51

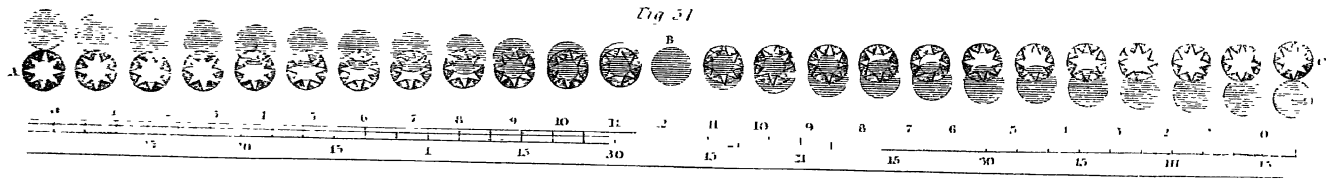
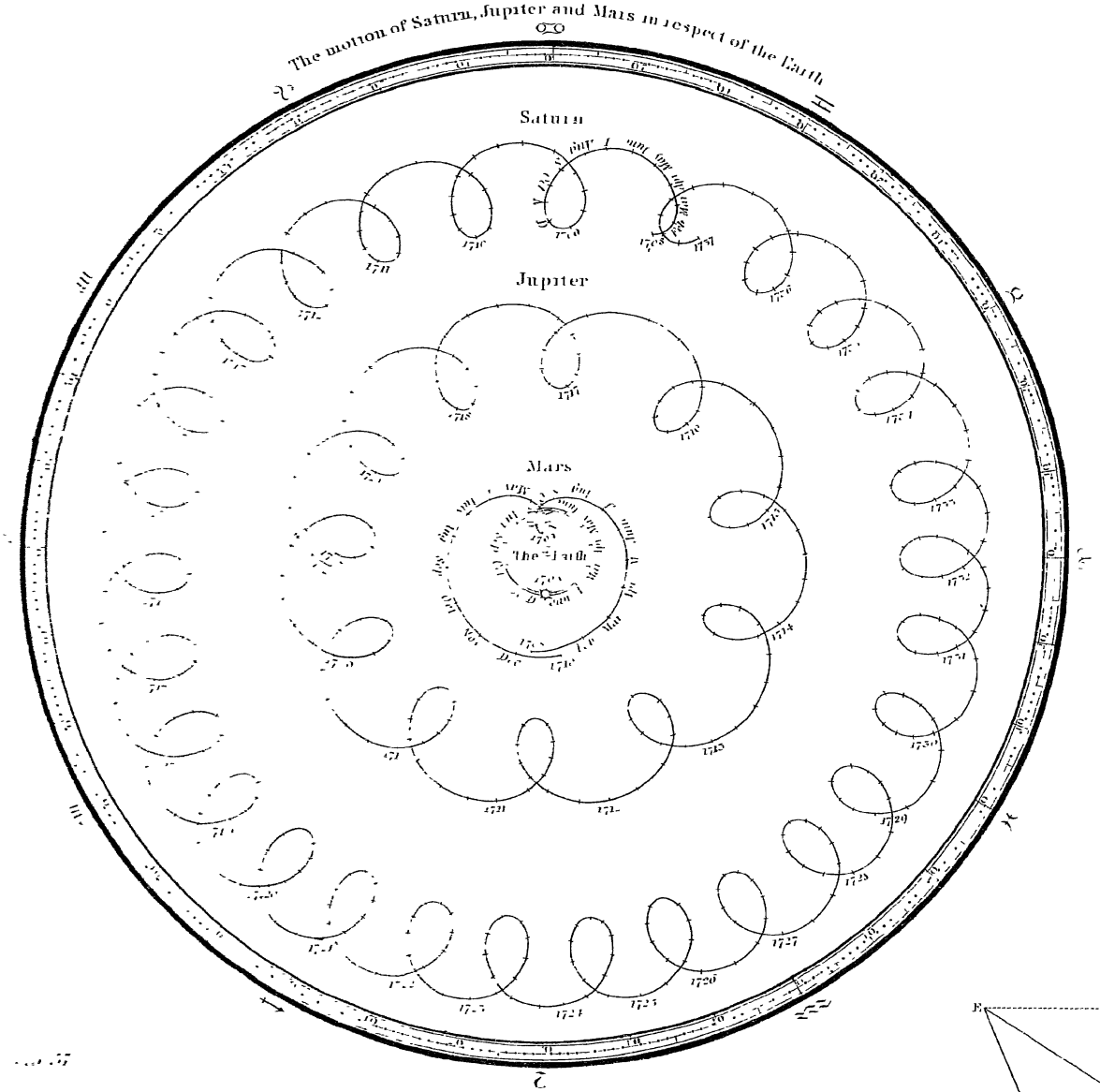
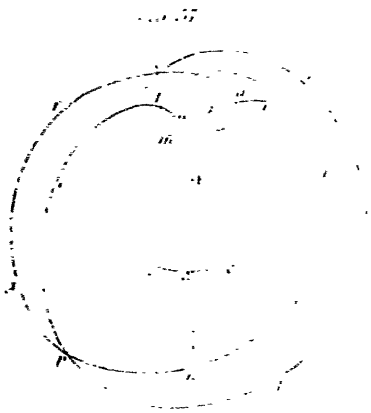


Fig 52

The motion of Saturn, Jupiter and Mars in respect of the Earth





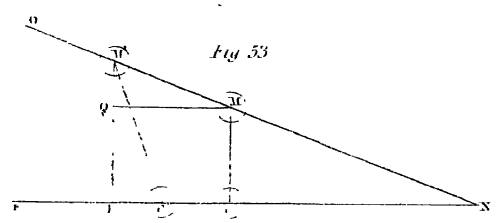


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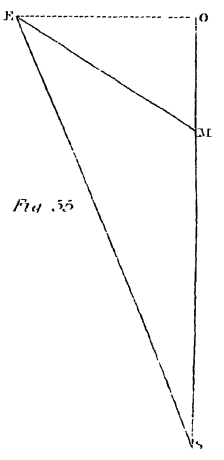


Fig 55

Fig. 59

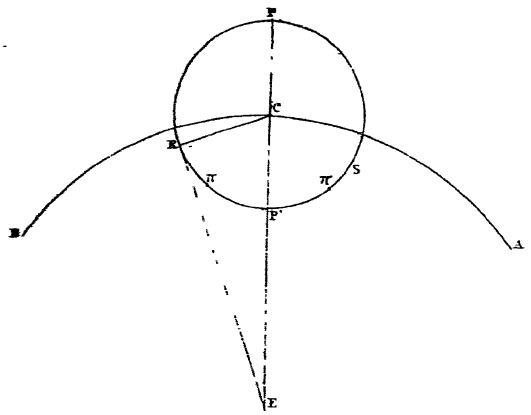


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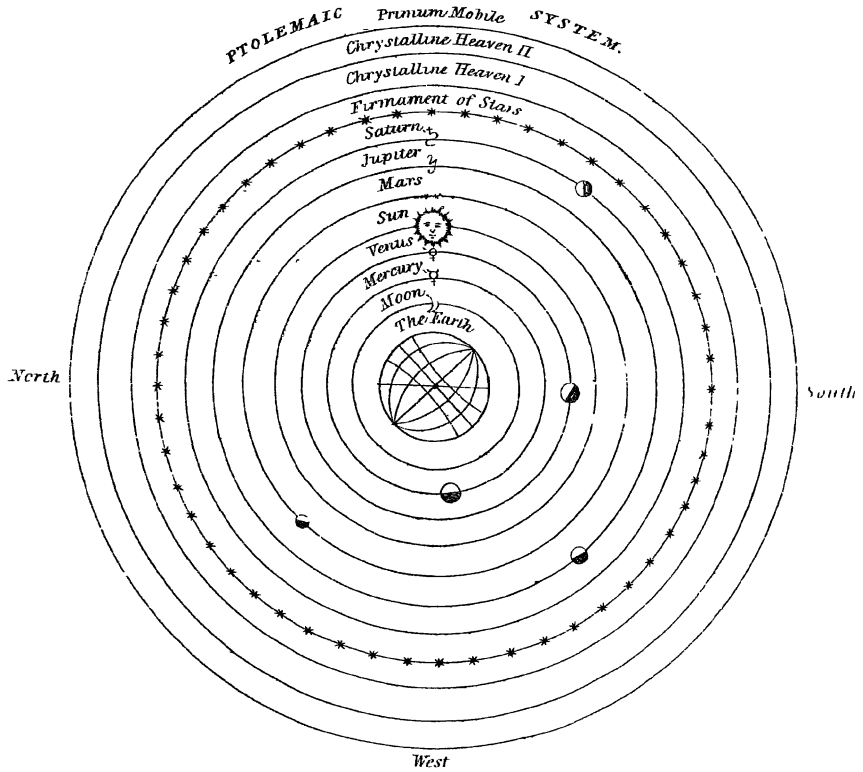


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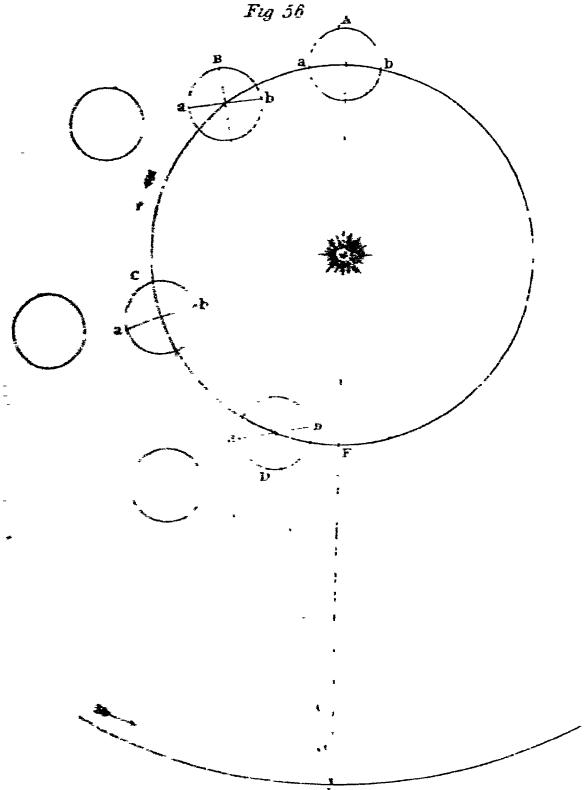


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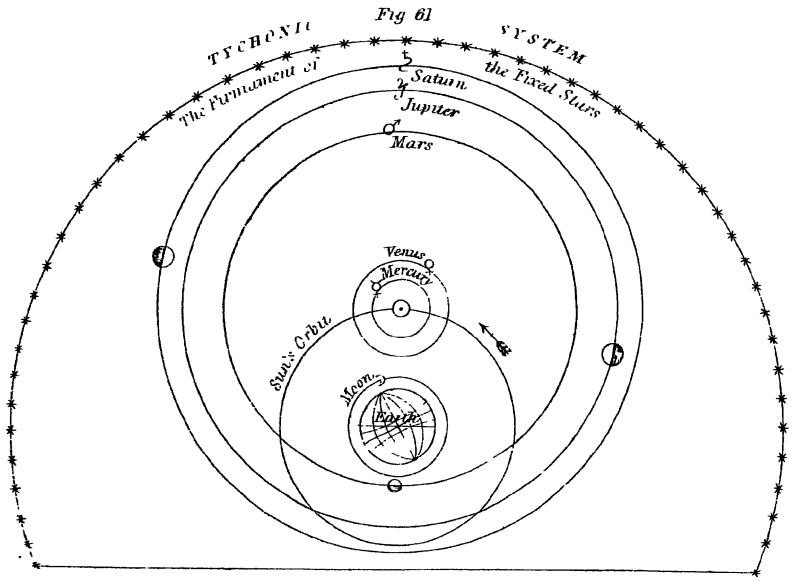


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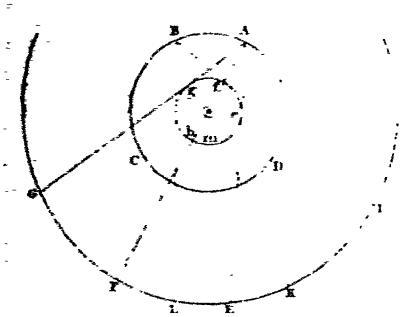


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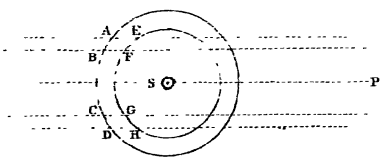


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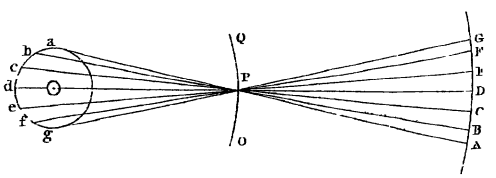


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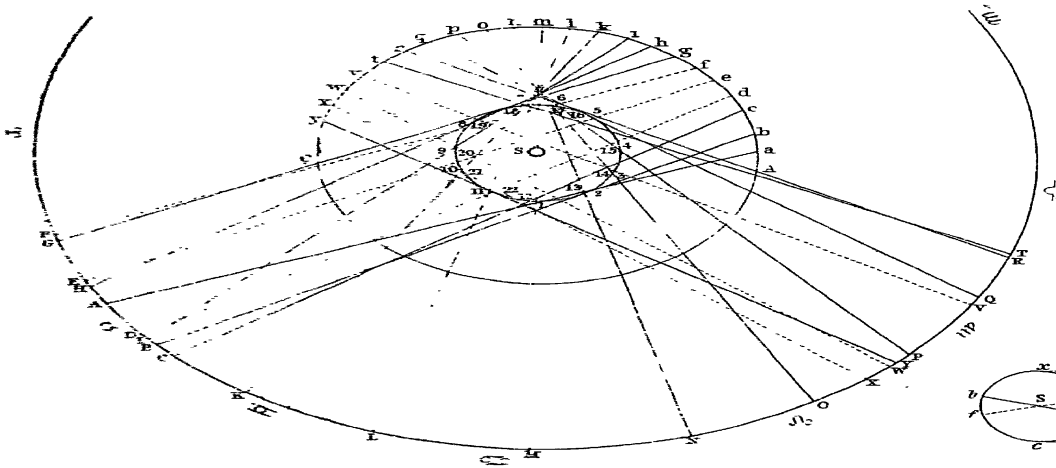


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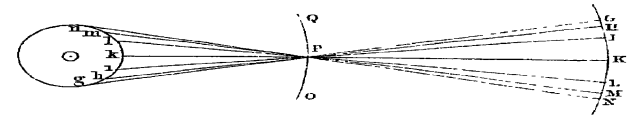


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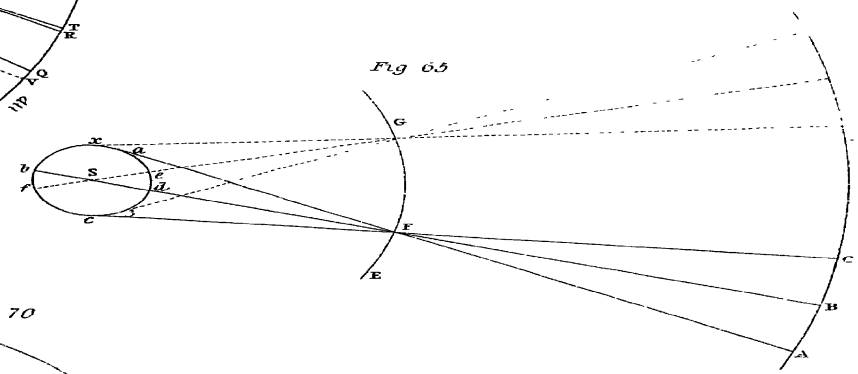


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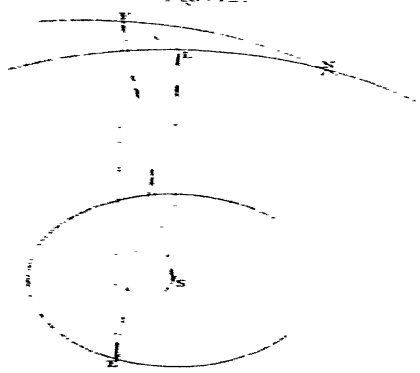


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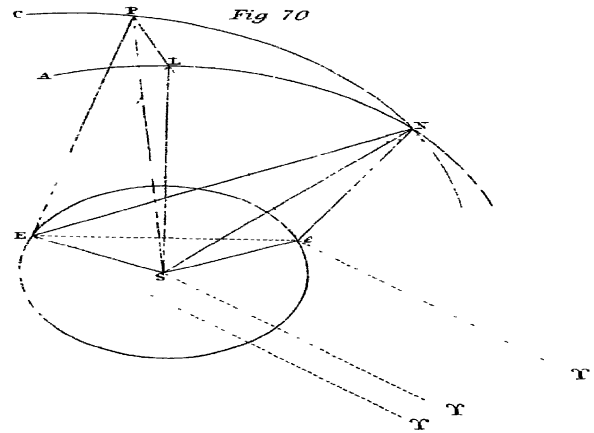


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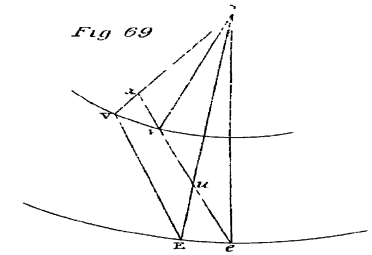
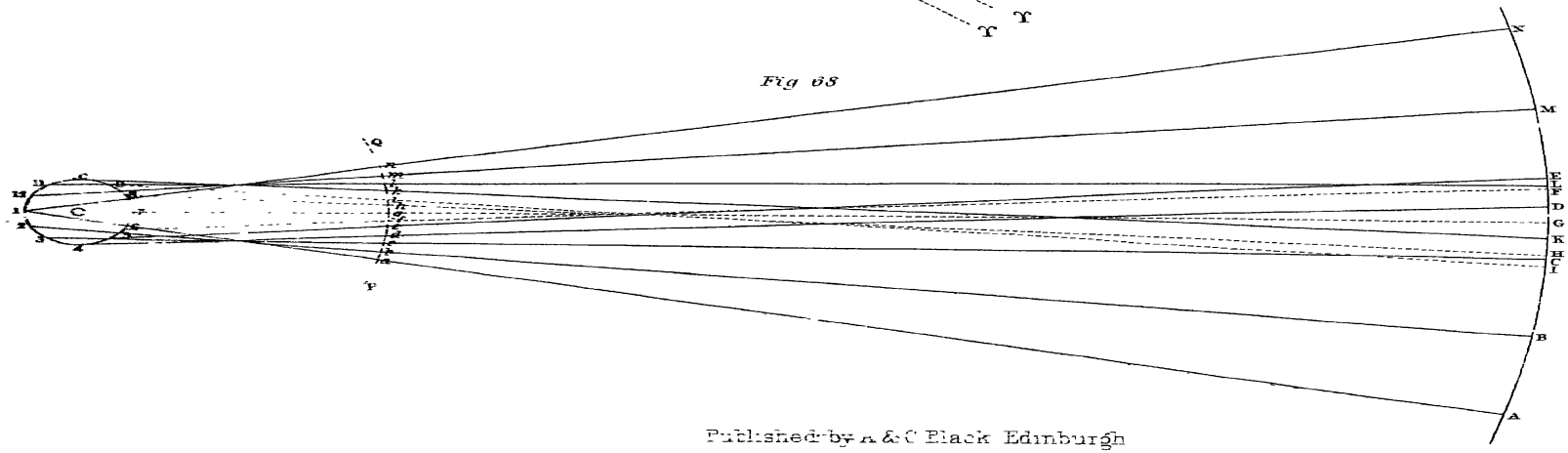


Fig 68



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Fig 72

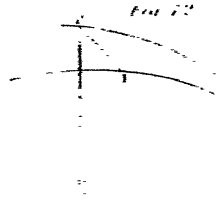


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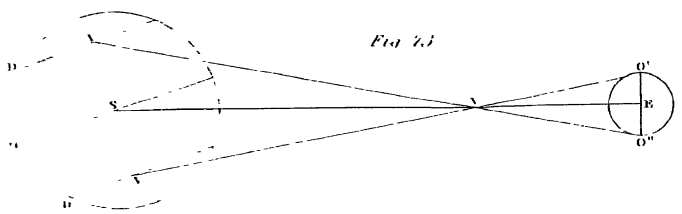
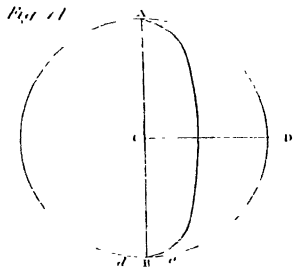


Fig 74



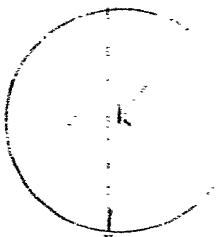


Fig 75



Fig 76



Fig 77



Fig 78



Fig 79





Fig 82



Fig 83

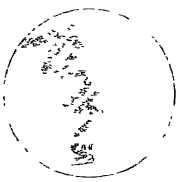


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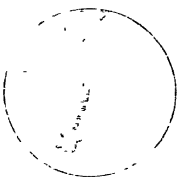


Fig 85



Fig 86



Fig 87



Fig 88



Fig 89



Fig 90



Fig 91



Fig 92



Fig 94

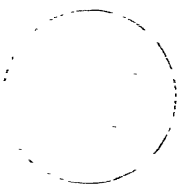


Fig 95



Fig 96

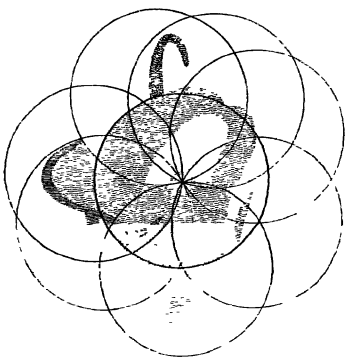


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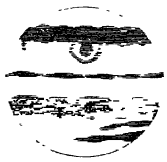
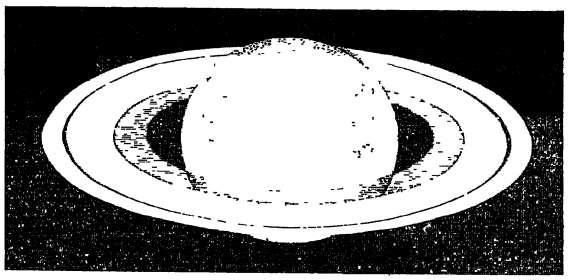


Fig 103



SATURN
Seen at Malta by W Lassell with a 20 feet reflector on 9th Oct 1852

Fig 99



Fig.98



Fig 100

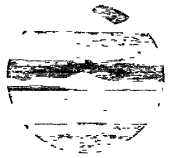
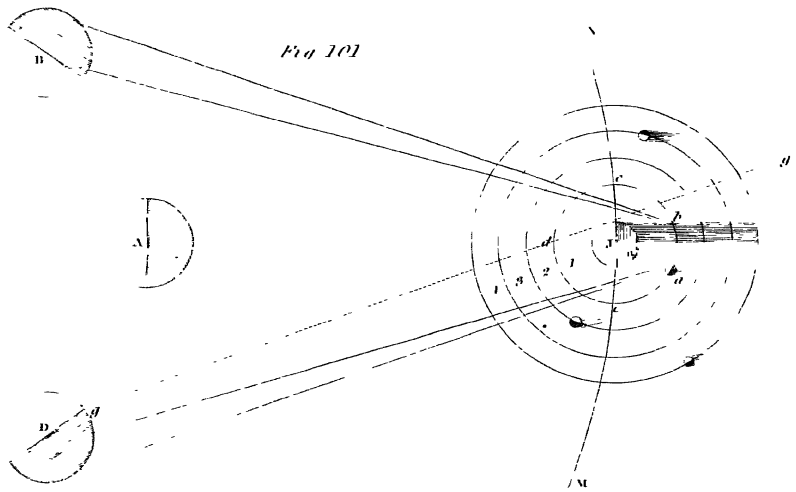


Fig. 102



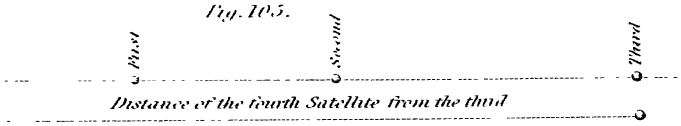
Fig 101

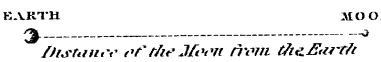


JUPITER
& his Satellites



Fig. 105.





SATURN
& his Satellites



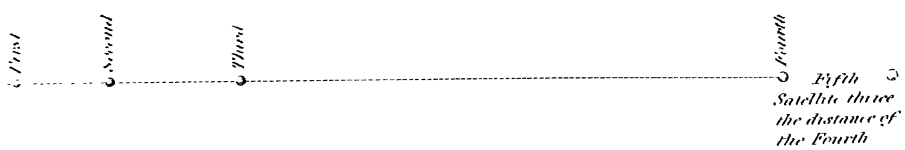


Fig 104.

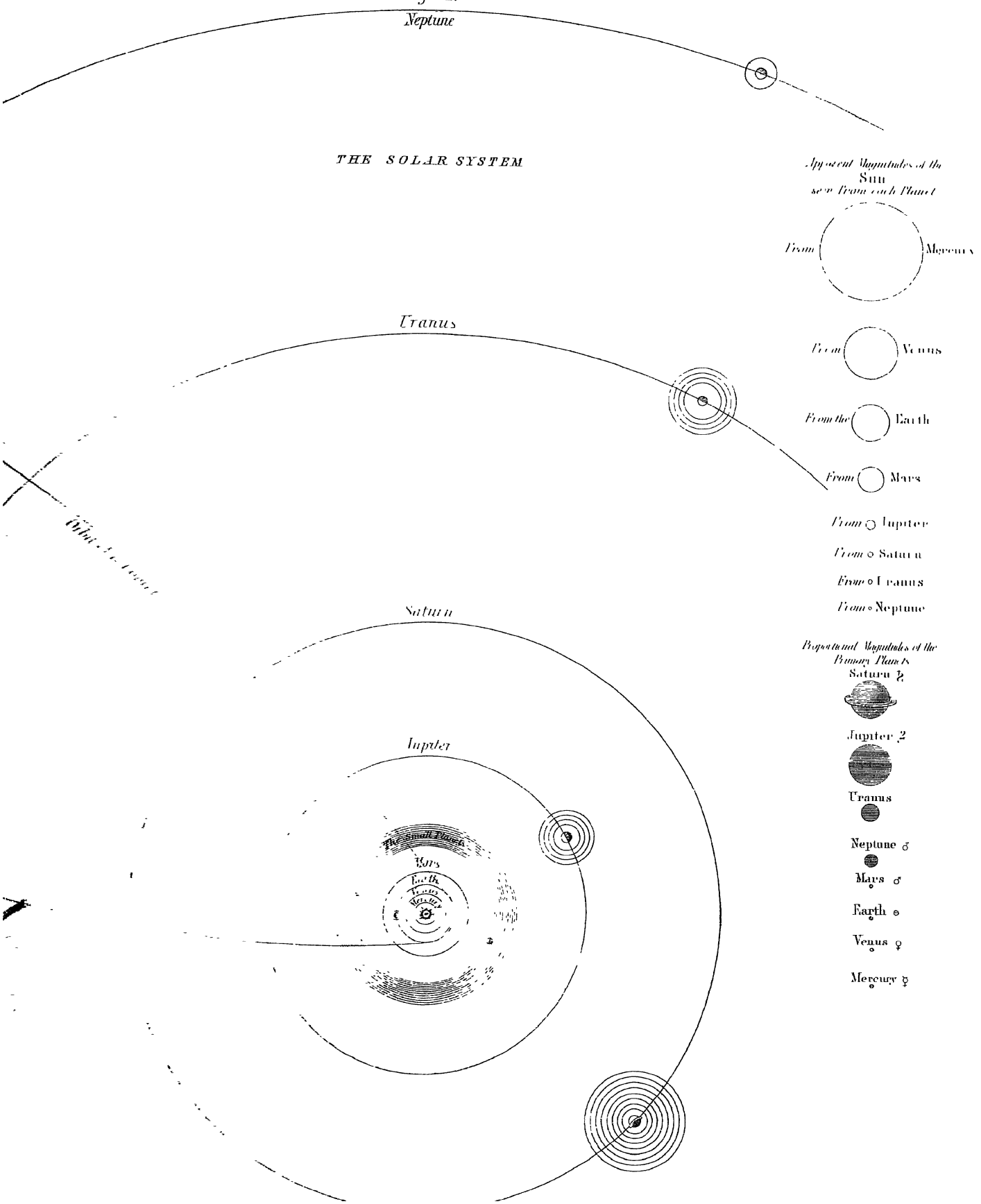
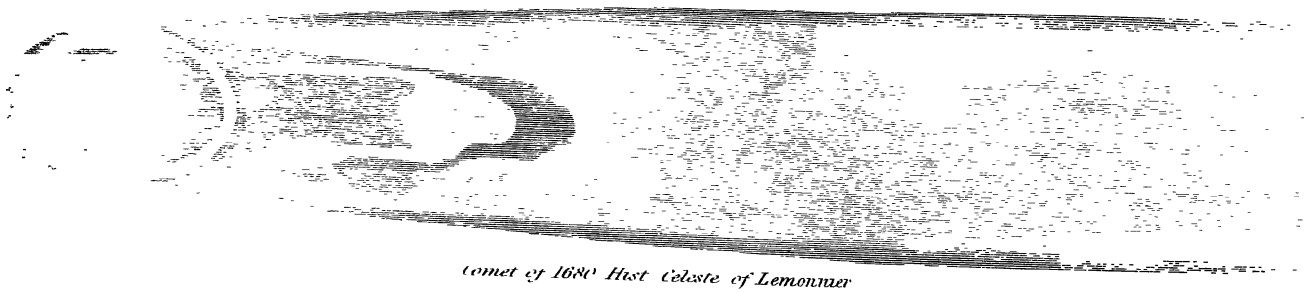

Neptune
THE SOLAR SYSTEM
Apparent Magnitudes of the Sun seen from each Planet
From Mercury
From Venus
From the Earth
From Mars
From ♃ Jupiter
From ♄ Saturn
From ♅ Uranus
From ♆ Neptune
Uranus
Orbit of a Comet
Saturn
Jupiter
The Small Planets
Mars
Earth
Venus
Mercury
Apparent Magnitudes of the Primary Planets
Saturn ♄
Jupiter ♃
Uranus ♅
Neptune ♆
Mars ♂
Earth ⊕
Venus ♀
Mercury ☿

Fig 106



Comet of 1680 Hist Celeste of Lemonnier

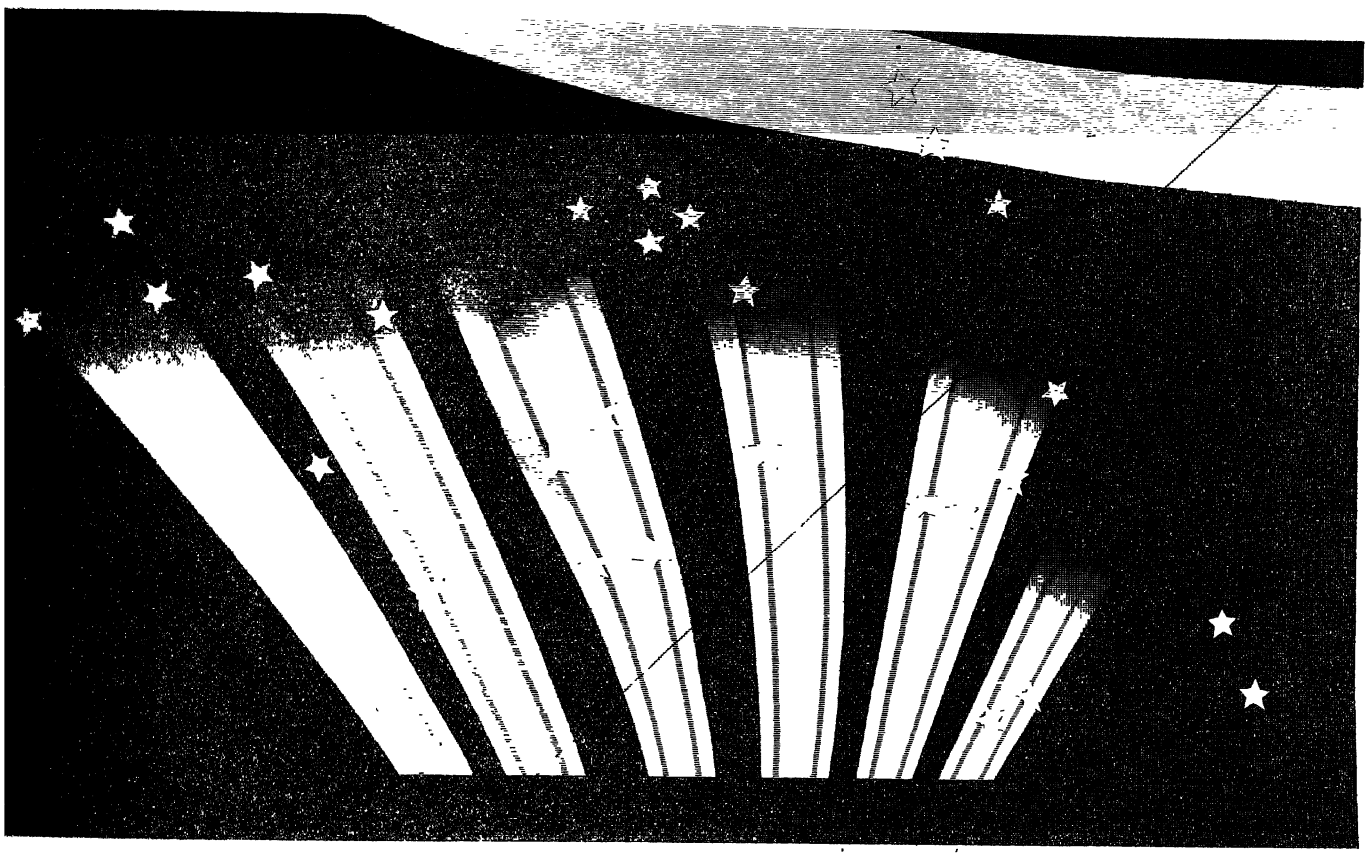
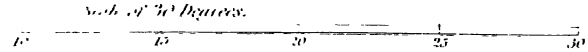


Fig 107

Comet of 1744 according to Chezeaux

Scale of 30 Degrees.



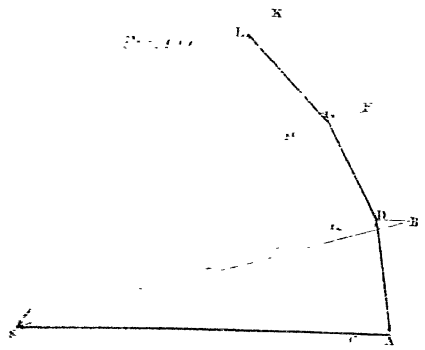


Fig 110

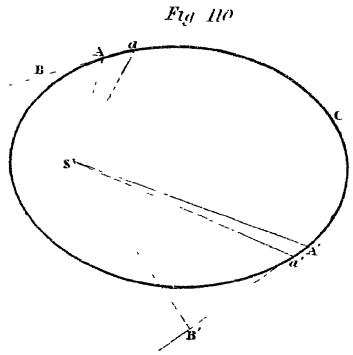
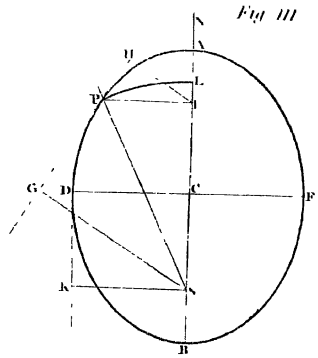


Fig 111



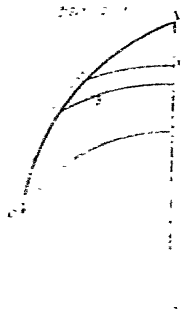


Fig 113

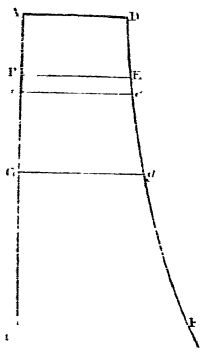


Fig 114

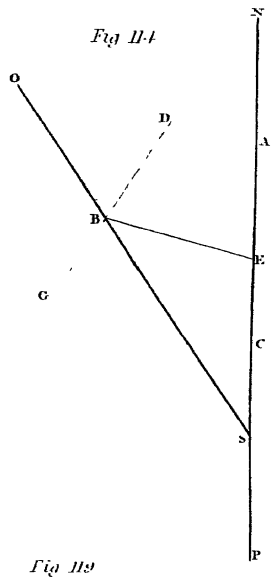
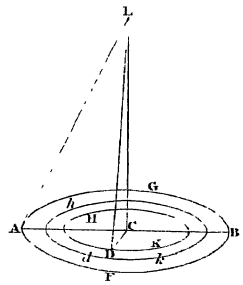


Fig 115



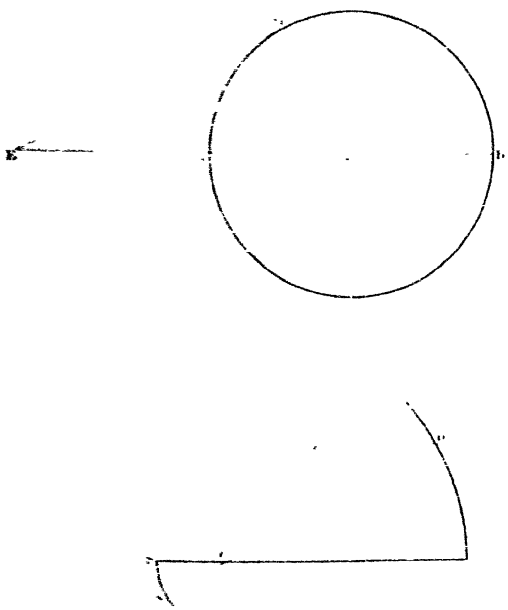


Fig 119

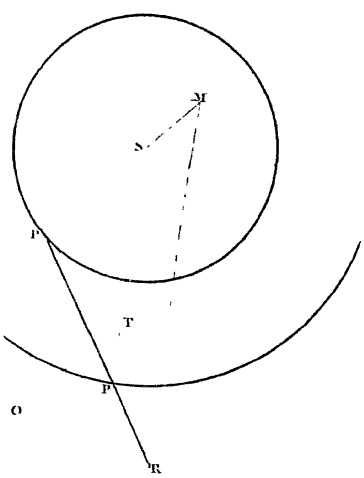
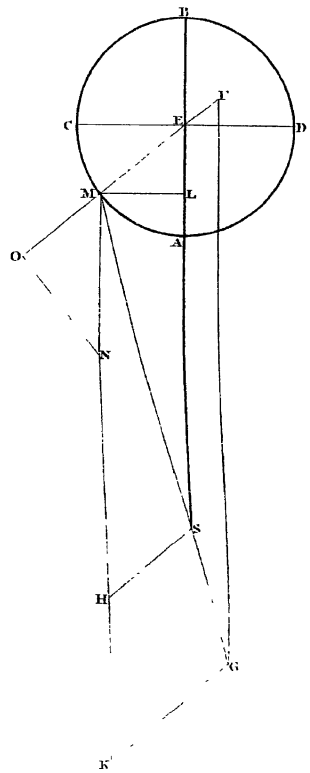


Fig 118



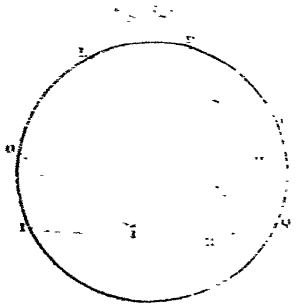


Fig 121.

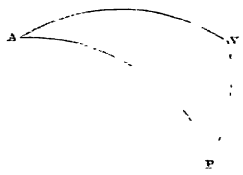
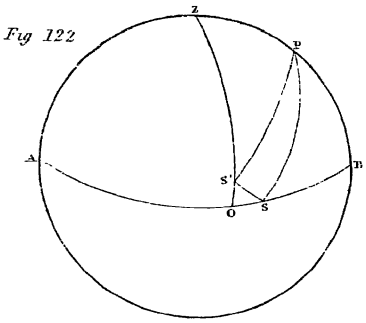


Fig 122



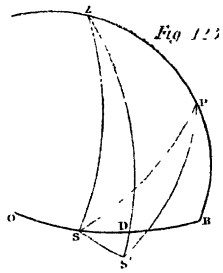


Fig 123

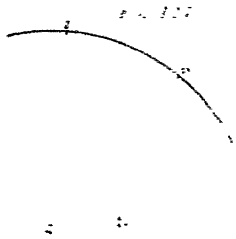


Fig 125

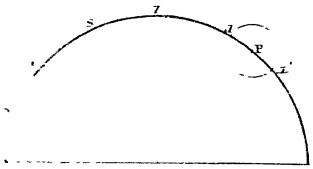
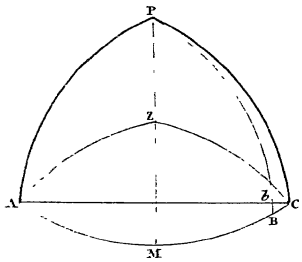
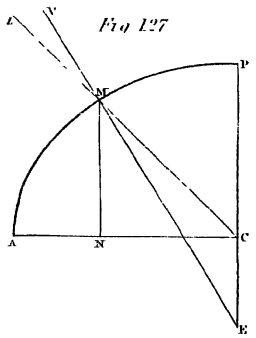


Fig 126





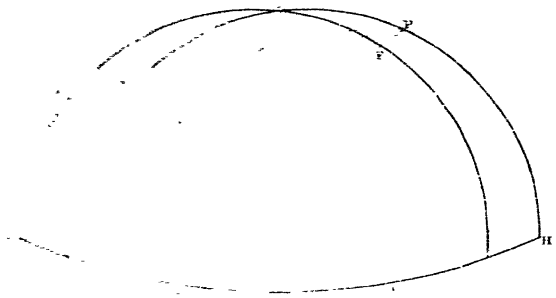
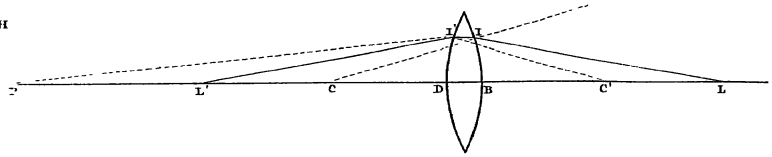


Fig 131



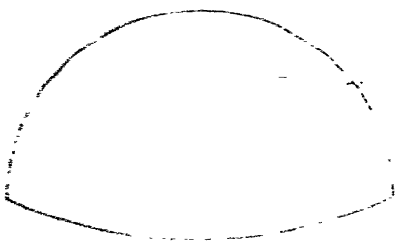


Fig 132

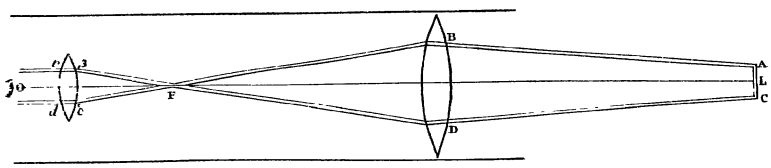


Fig 133

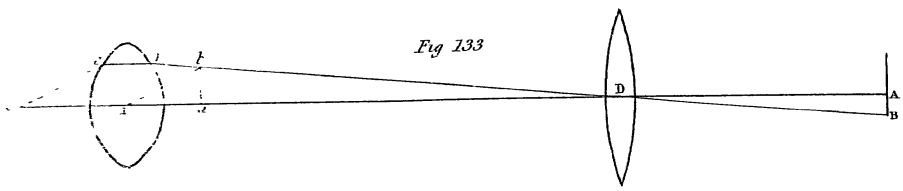
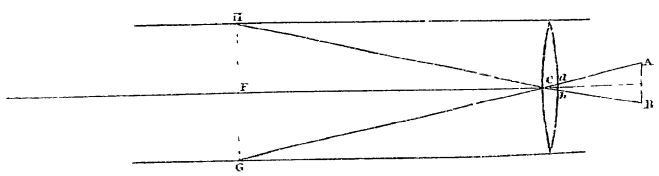
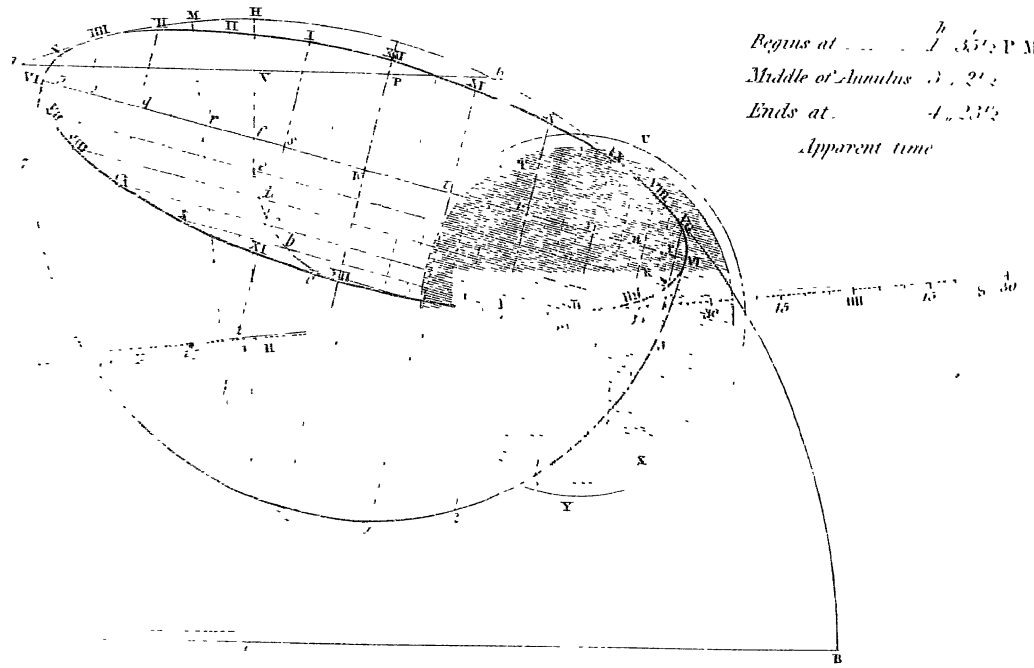


Fig 135



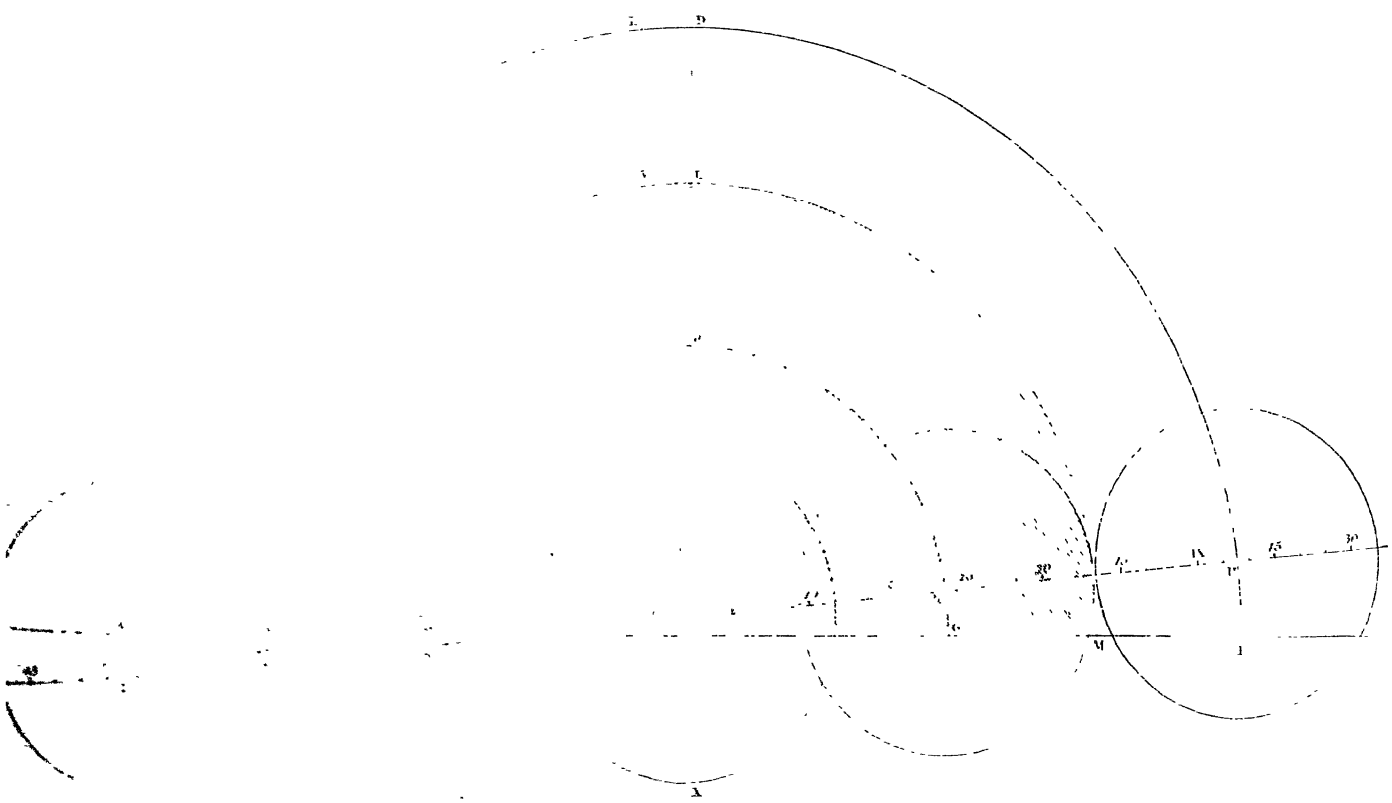
Projection for Edinburgh of the Annular Eclipse of the Sun, 15th May, 1836.

Fig. 136

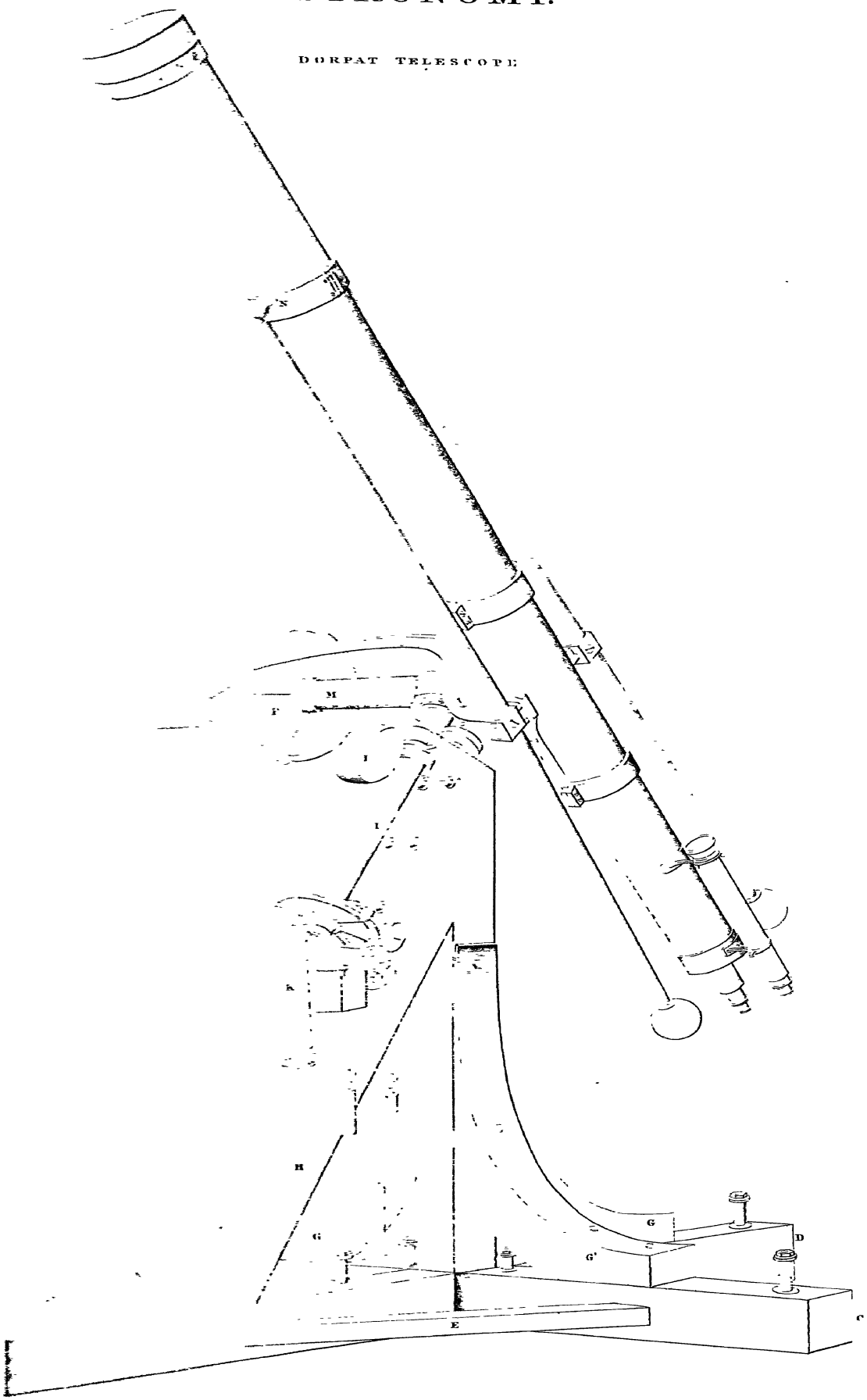


Annular Eclipse 2d Sept 1830

Fig. 137



DORPAT TELESCOPE.



ASTRONOMY.

PLATE XCIII.

Fig. II.

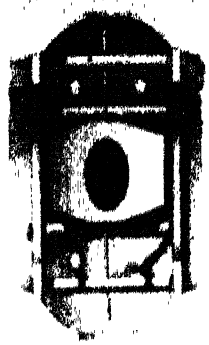


Fig. I

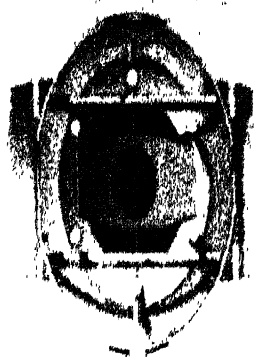


TRANSIT INSTRUMENT

Fig. V.



Fig. I

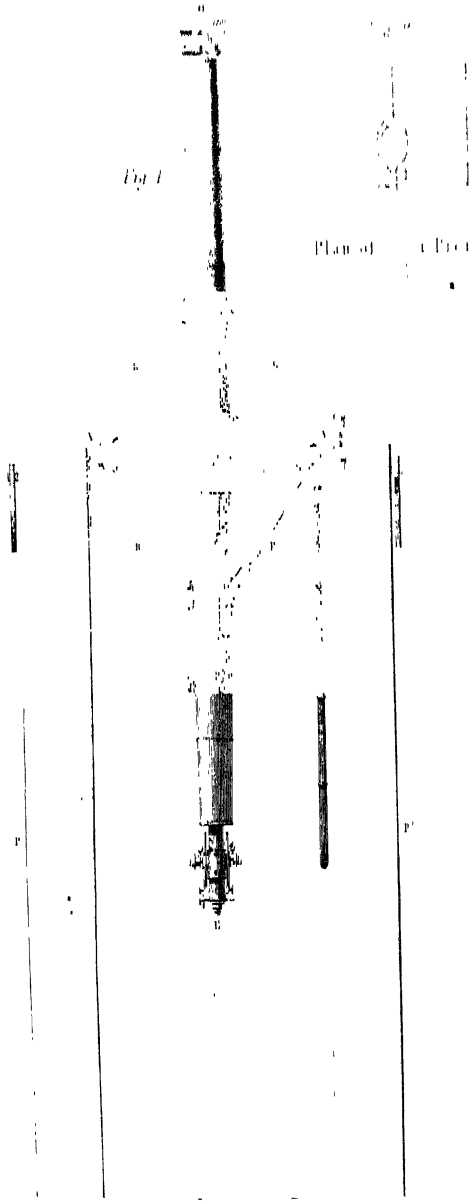


Section through the axis of the Telescope

Front view

Looking through the axis of the Telescope

Fig. I



Plan of [illegible] Piece

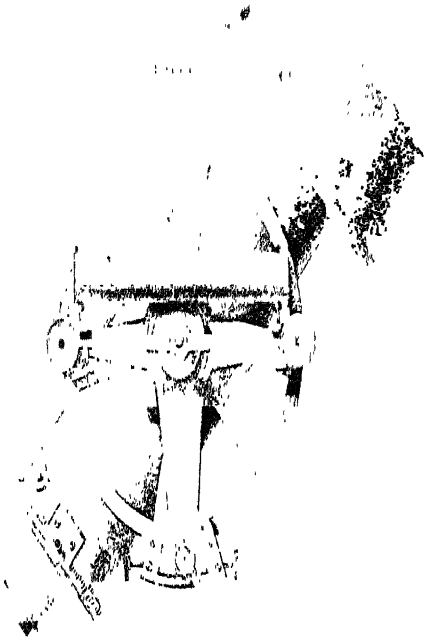
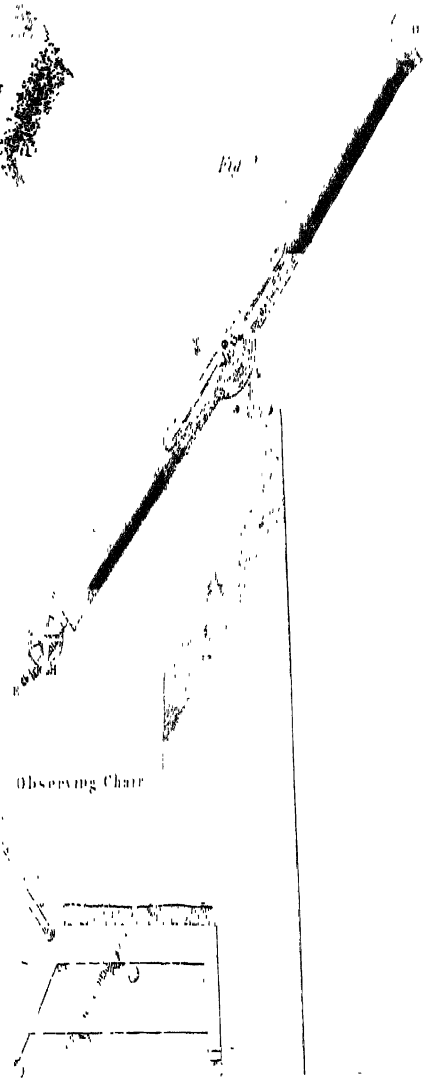


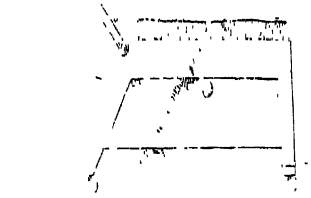
Fig. I



Back of Chair.

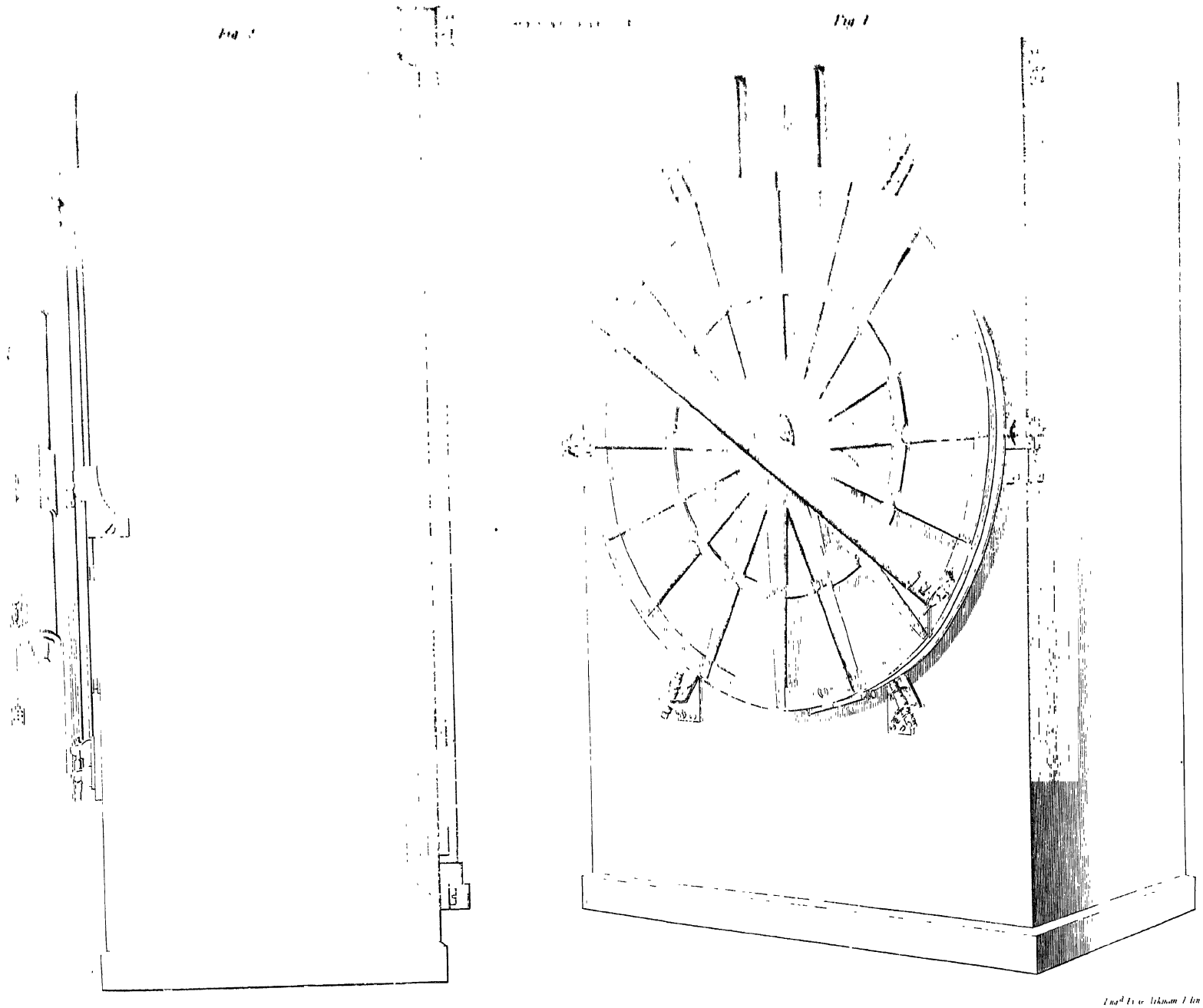


Observing Chair

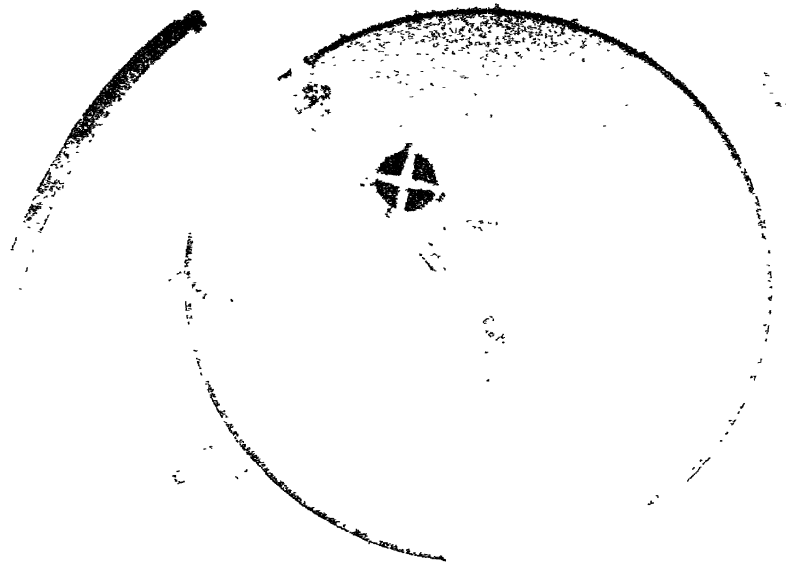


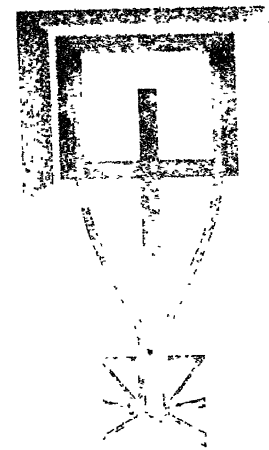
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Fig. I. Fig. II. Fig. V.



Published by A & C Black Edinburgh





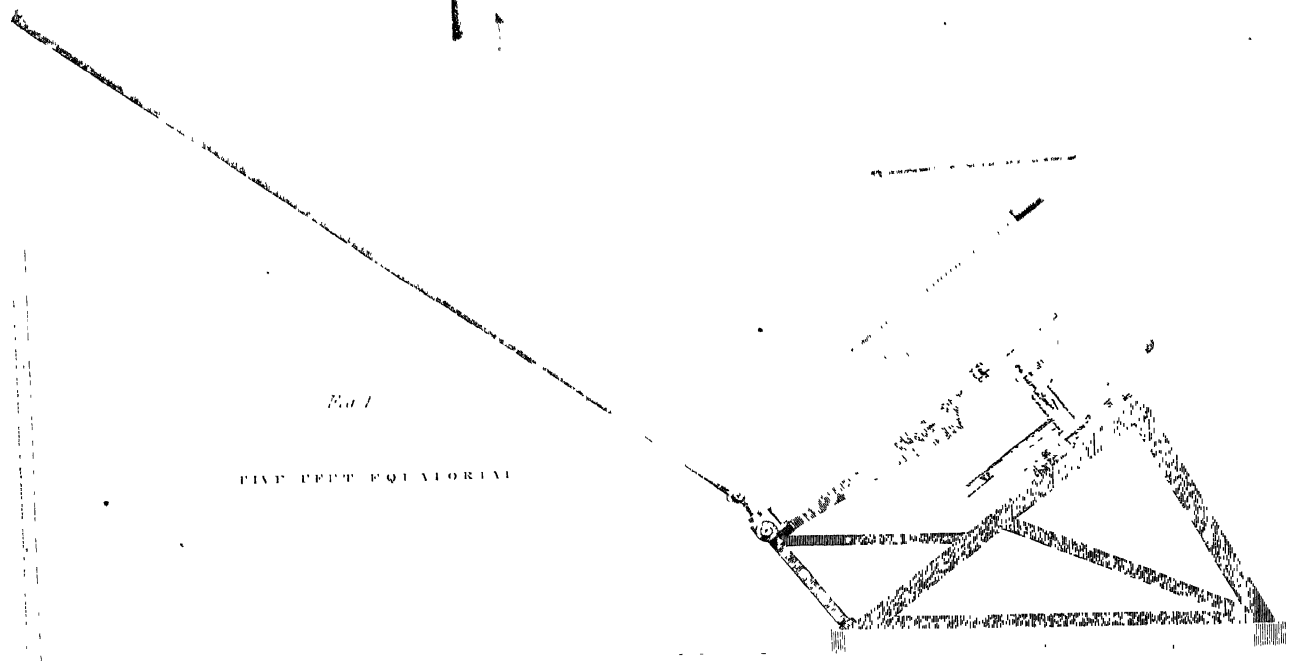


Fig 1

FIVE FEET EQUATORIAL

Engd by G. Aitman Edin.

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ASTRONOMY.

THE FEET EQUATORIAL

FRONT VIEW.

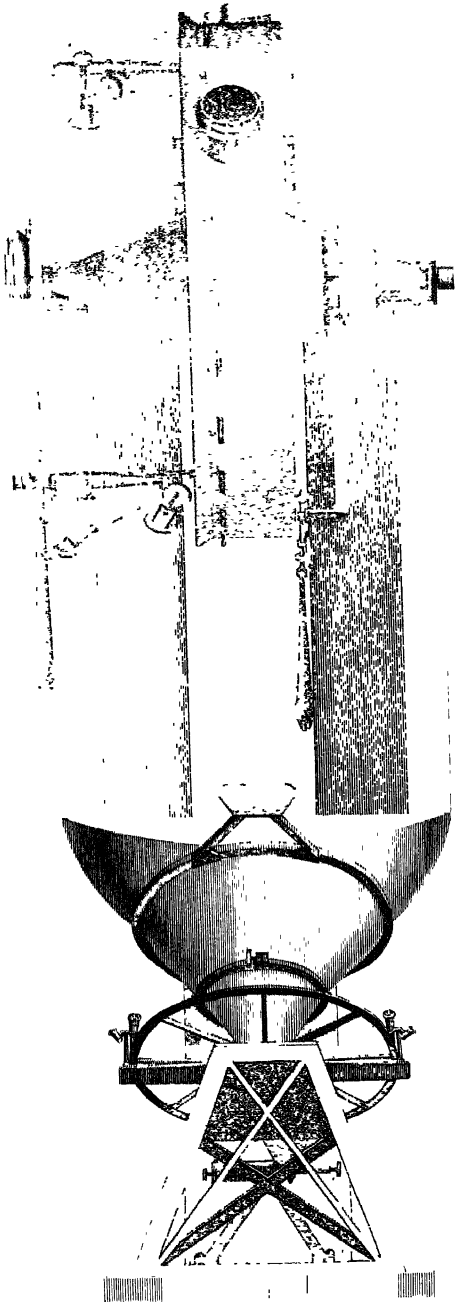


Fig. 1

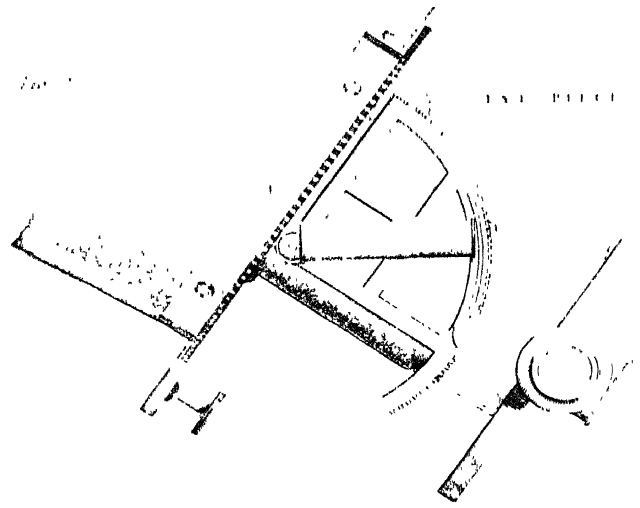
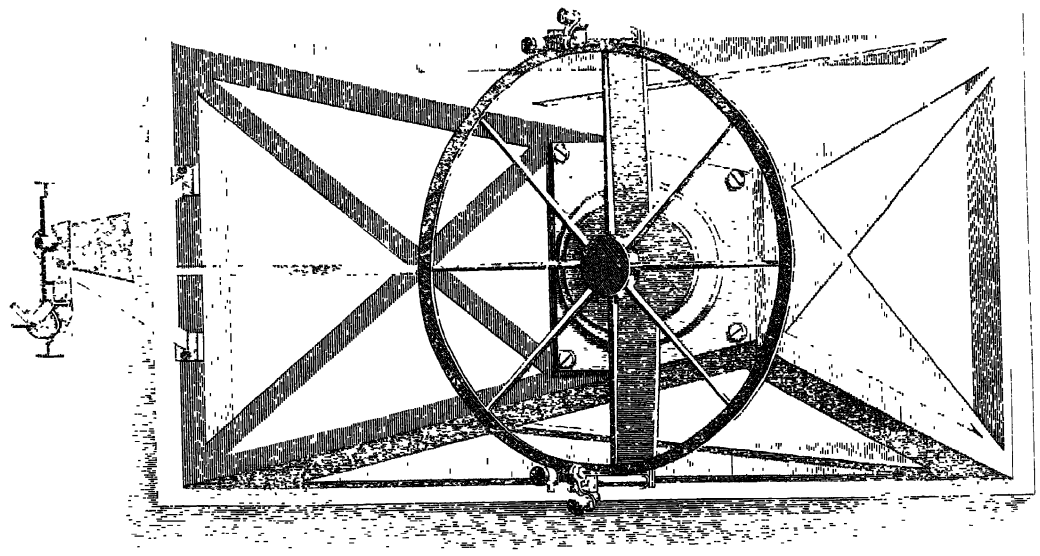


Fig. 3

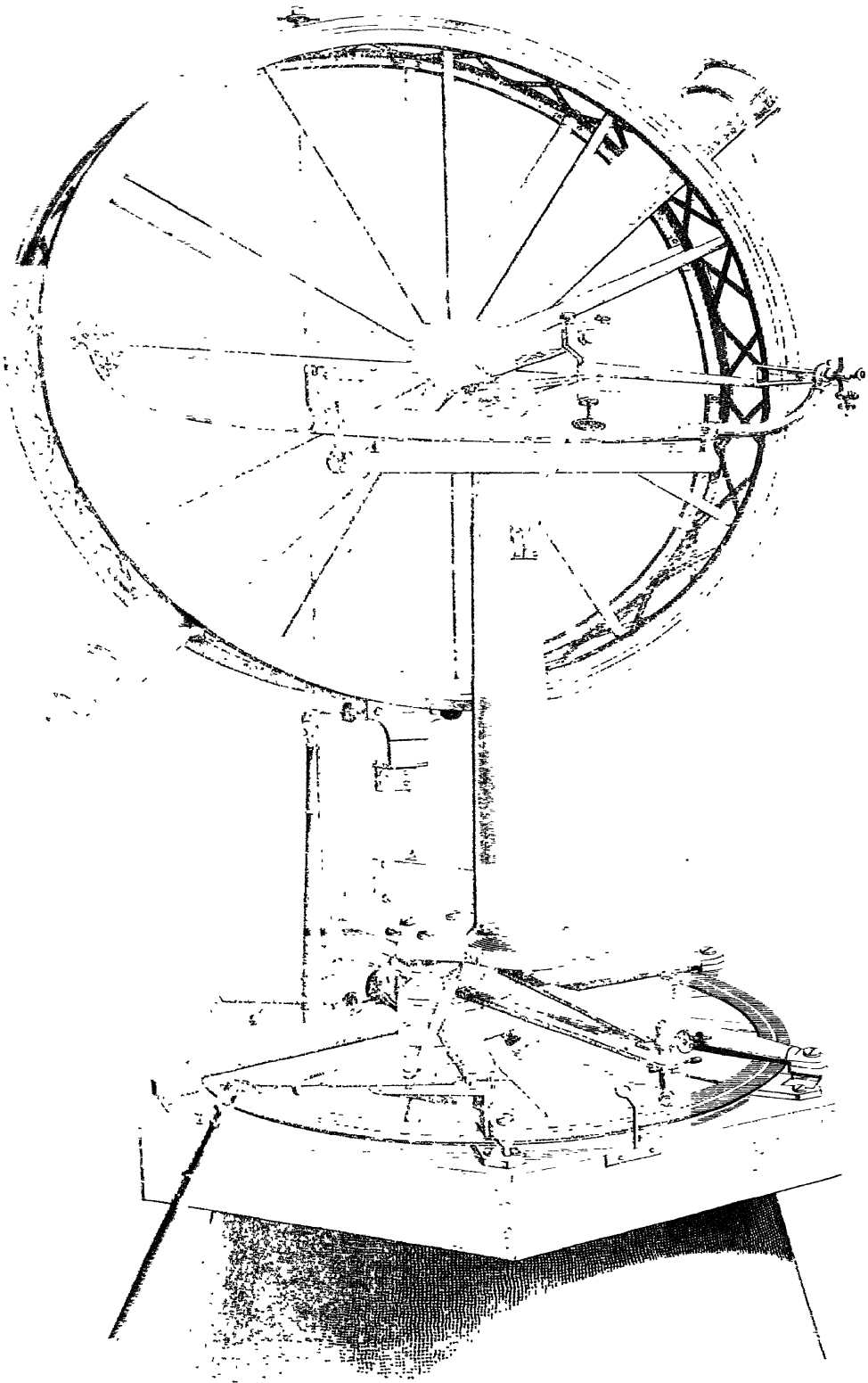
PLAN OF IRON FRAME AND HOUR CIRCLE



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Engd by G. Aikman Edin.r

AZIMUTH AND ALTITUDE CIRCLE.



ATTRACTION.

Fig. 1

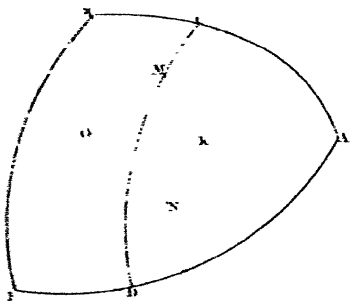
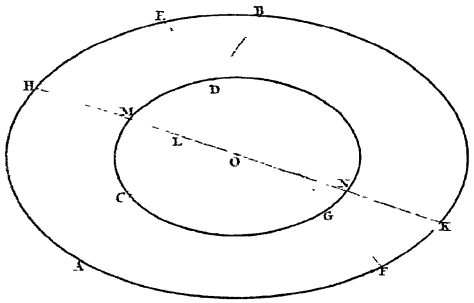


Fig. 2.



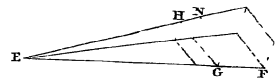


Fig 4.

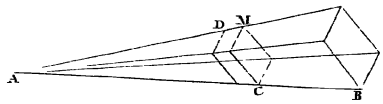


Fig. 3

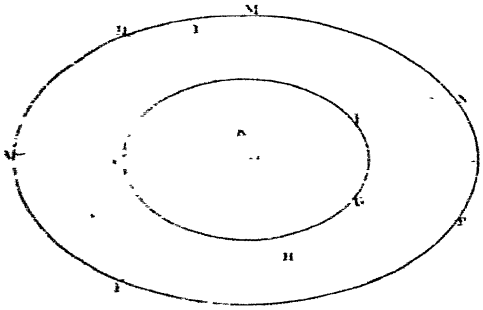


Fig. 5

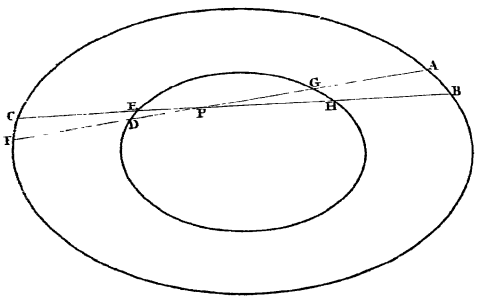


Fig. 6

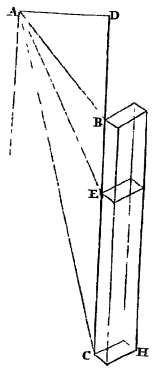
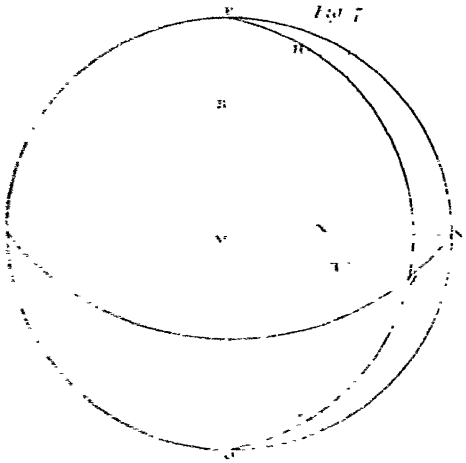


Fig 7



E.

Fig 7

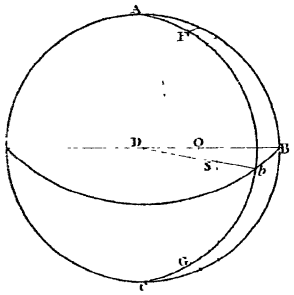


Fig 8

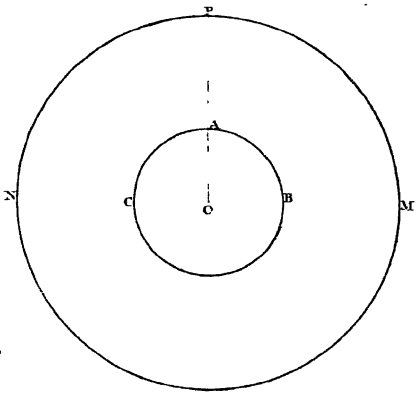


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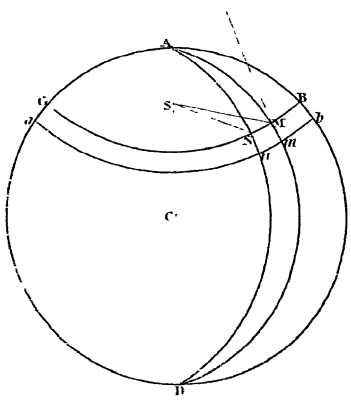


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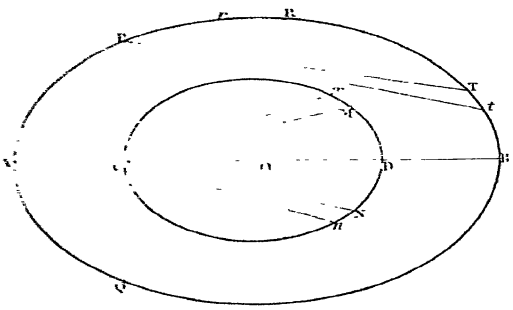


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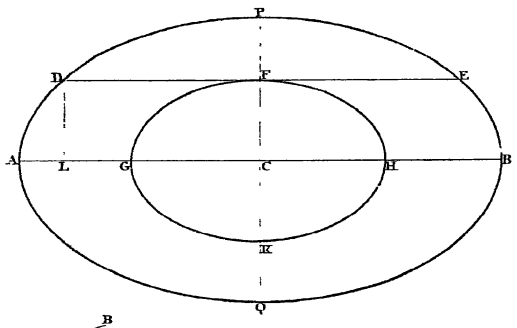


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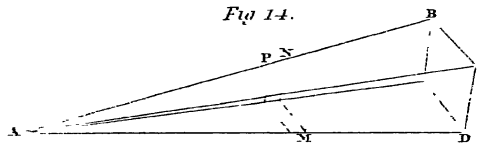


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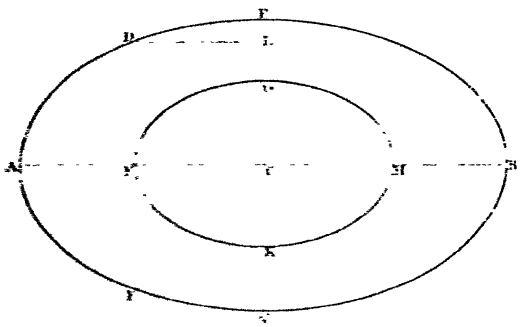


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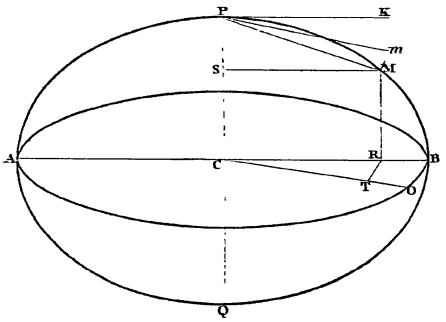


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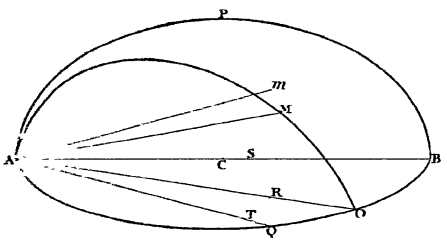


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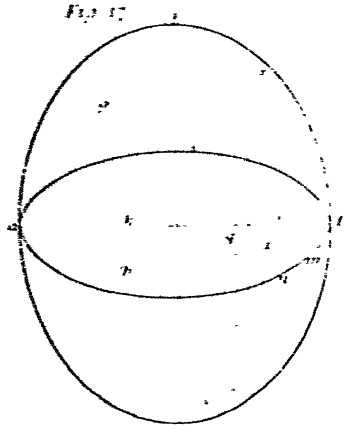


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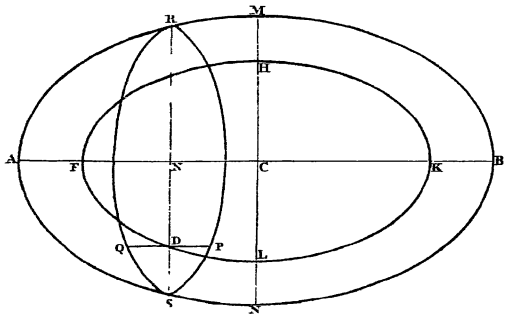


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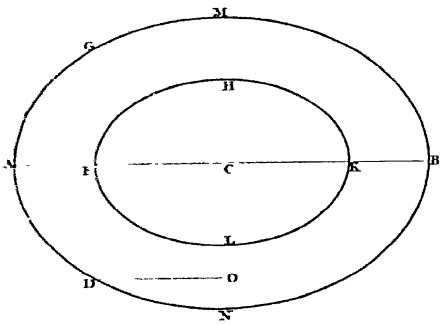


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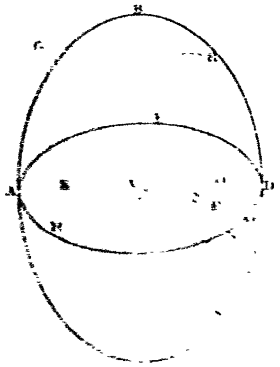
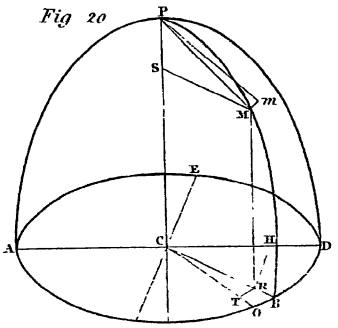
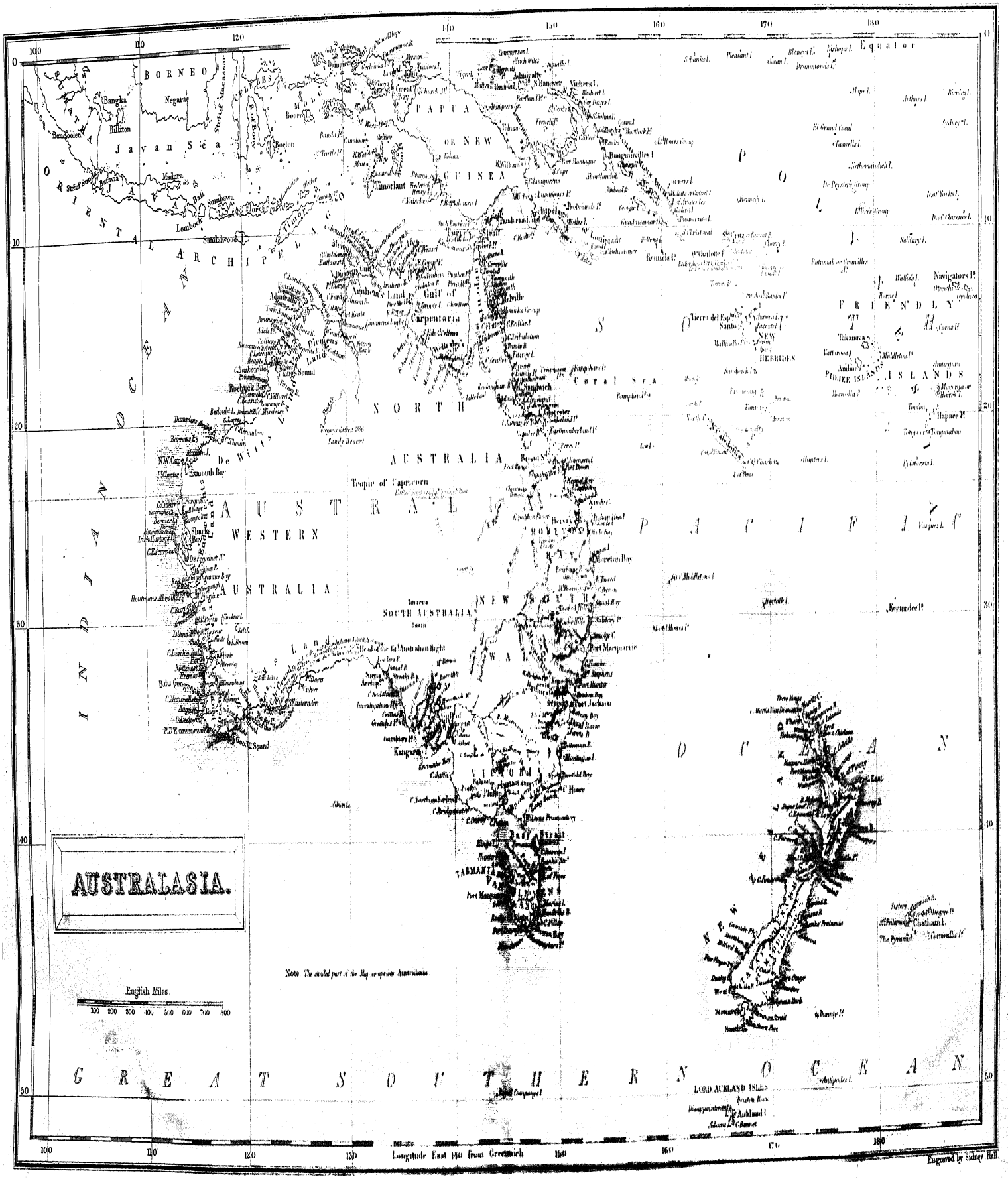
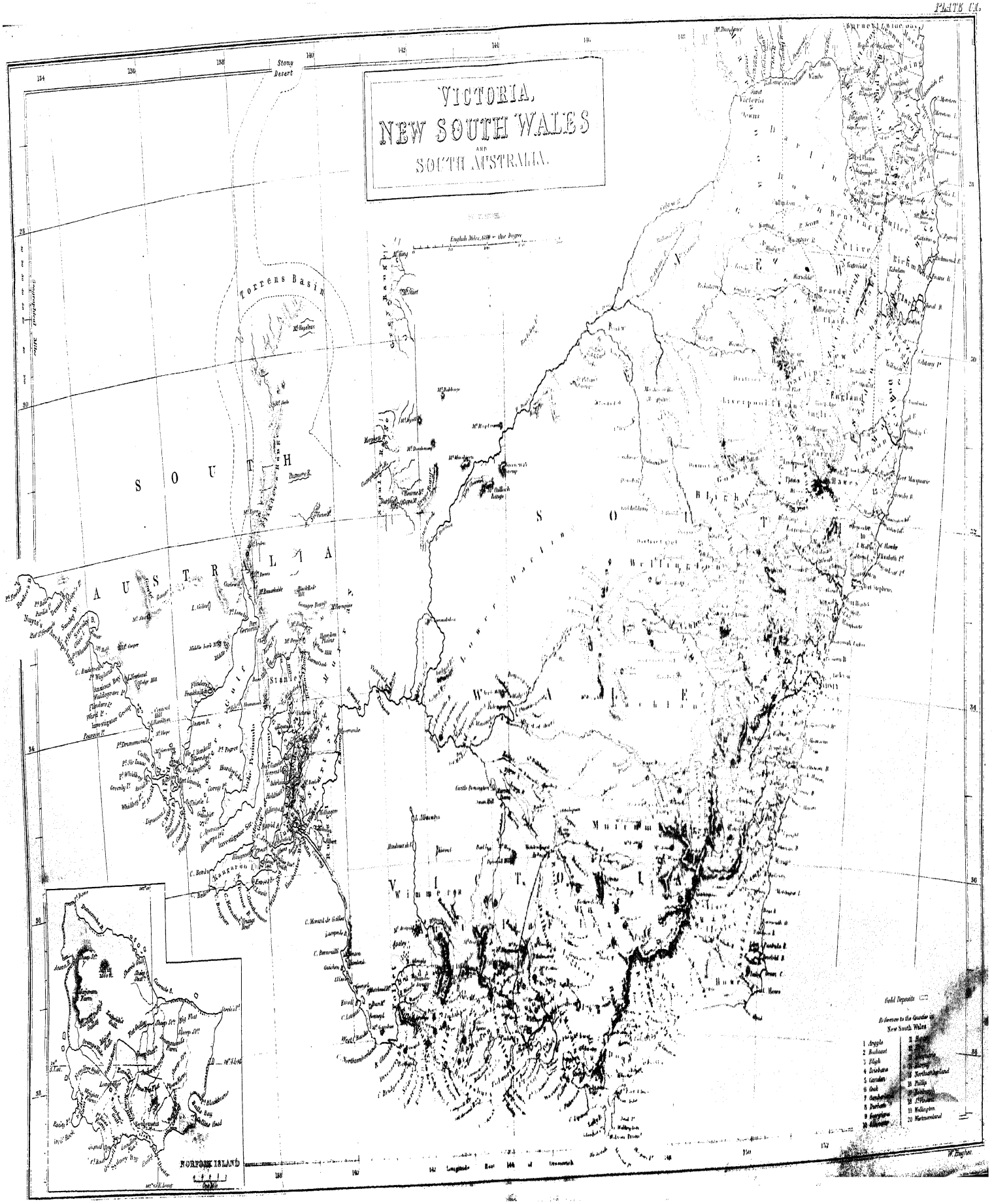
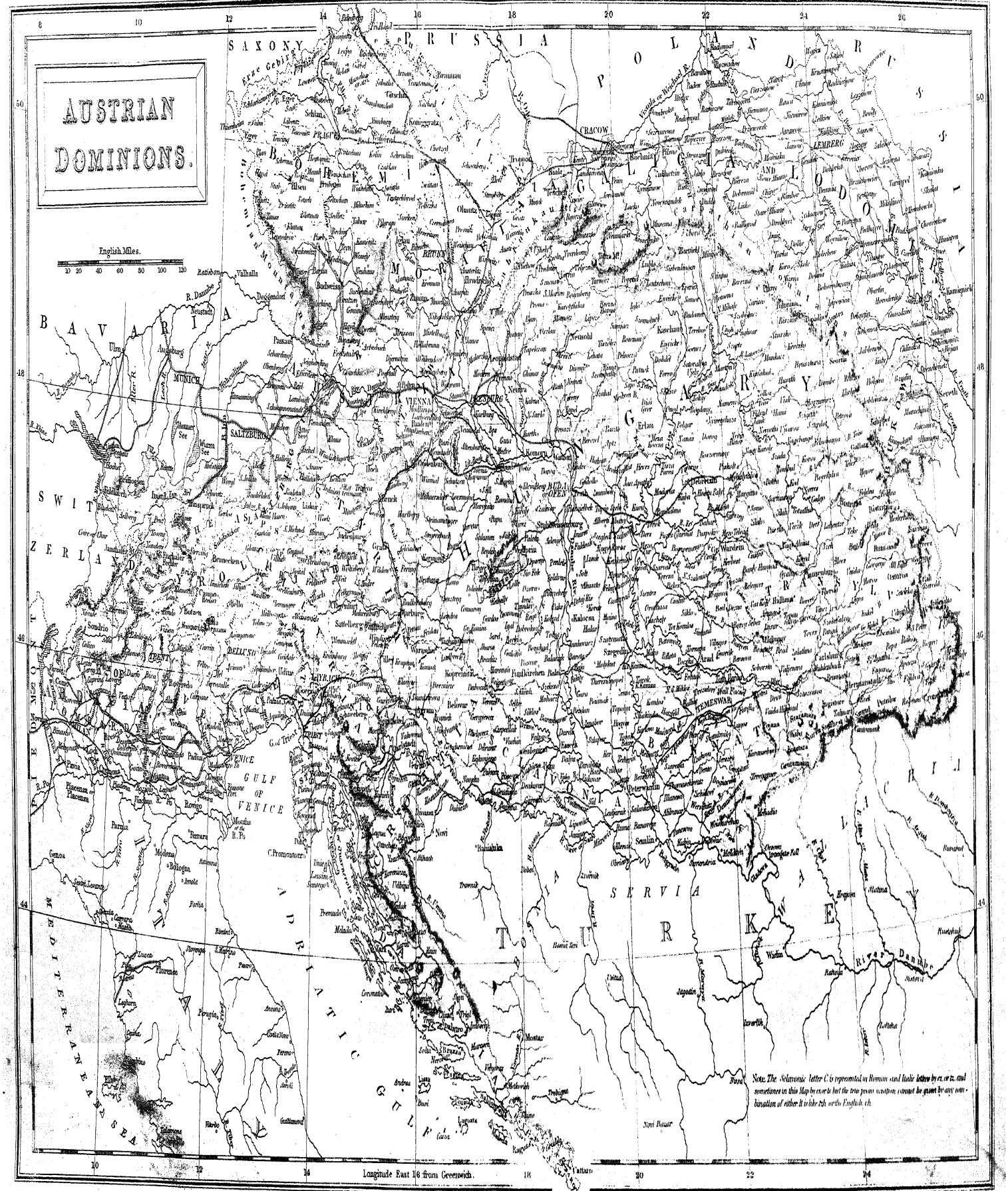


Fig. 20.




AUSTRALASIA.
Note. The shaded part of the Map comprises Australasia
English Miles.
300 200 300 400 500 600 700 800
Longitude East 140 from Greenwich
Engraved by Sidney Hall.
INDIAN OCEAN
PACIFIC OCEAN
GREAT SOUTHERN OCEAN
AUSTRALIA
NEW SOUTH WALES
SOUTH AUSTRALIA
WESTERN AUSTRALIA
VICTORIA
TASMANIA
NEW ZEALAND
NEW GUINEA
BORNEO
Java Sea
Coral Sea
Tropic of Capricorn
Equator
Gulf of Carpentaria
Arnhem Land
Sandalwood
Lombock
Timor
Bangka
Billiton
Bencoolen
Batavia
Madura
Bali
Sumbawa
Flores
Banda Is.
Amboyna
Ceram
Timorlaut
Aru Is.
Tenimber Is.
Kei Is.
Papua or New Guinea
Solomon Is.
New Hebrides
Fiji Islands
Friendly Islands
Navigators Is.
Society Is.
Low Archipelago
Marquesas Is.
Sandwich Is.
Lord Auckland Isles
Antipodes I.
Macquarie I.
Bounty Is.
Chatham I.
Norfolk I.
Lord Howe I.
Kermadec Is.
Hapaee Is.
Tongataboo
Amsterdam I.
Middleburg I.
Anamooka
Annamooka
Hunters I.
Sydney I.
Port Jackson
Port Macquarrie
Moreton Bay
Port Phillip
Port Dalrymple
Port Arthur
Hobart Town
Launceston
Kangaroo I.
Spencer Gulf
St Vincent Gulf
Gulf of St Vincent
Great Australian Bight
Torres Straits
Endeavour Straits
Banks Straits
Bass Straits
Dampier Land
Sandy Desert
Great Sandy Desert
Great Victoria Desert
Nuyts Land
Leeuwin Land
Arnhem Land
Van Diemens Land
Diemens Land
Endeavour R.
Swan R.
Murray R.
Darling R.
Derwent R.
Tamar R.
Port Essington
Raffles Bay
Melville I.
Bathurst I.
Cobourg Peninsula
Wellesley Is.
Sir Charles Hardy Is.
Howe I.
Three Kings
Cape Maria Van Diemen
North Cape
Cape Reinga
Cape Egmont
Mount Egmont
Mount Taranaki
Cape Farewell
Stephens I.
Banks Peninsula
Otago Peninsula
Foveaux Strait
Stewart I.
Chatham I.
Auckland I.
Campbell I.
Bounty Is.
Antipodes I.
Lord Auckland Isles
Aucklands Harbour
Port Ross
Port Cook
Port Pegasus
Port Molyneux
Port Nicholson
Cook Strait
Hawkes Bay
Poverty Bay
Bay of Islands
Hokianga
Kaipara Harbour
Manukau Harbour
Waitemata Harbour
Auckland
Wellington
Nelson
Taranaki
Wanganui
Napier
Gisborne
Wairarapa
Canterbury
Otago
Southland
Westland
Marlborough
Auckland Is.
Campbell I.
Bounty Is.
Antipodes I.
Lord Auckland Isles
Aucklands Harbour
Port Ross
Port Cook
Port Pegasus
Port Molyneux
Port Nicholson
Cook Strait
Hawkes Bay
Poverty Bay
Bay of Islands
Hokianga
Kaipara Harbour
Manukau Harbour
Waitemata Harbour
Auckland
Wellington
Nelson
Taranaki
Wanganui
Napier
Gisborne
Wairarapa
Canterbury
Otago
Southland
Westland
Marlborough


VICTORIA,
NEW SOUTH WALES
AND
SOUTH AUSTRALIA.
Stony Desert
Torrens Basin
S O U T H
A U S T R A L I A
Gulf St Vincent
Spencer's Gulf
Murray R.
Darling R.
Lake Eyre
Lake Torrens
Lake Gairdner
Lake Frome
Lake Hawker
Lake Callabonna
Lake Blanche
Lake Bonney
Lake Alexandrina
Lake Albert
Lake Victoria
Lake Hindmarsh
Lake Wallace
Lake Tyrrell
Lake Buloke
Lake Kenyon
Lake Wellington
Lake Tarli Karlo
Lake Boga
Lake Charm
Lake Coorong
Lake Bael Bael
Lake Cullulleraine
Lake Hattah
Lake Mournpall
Lake Kulkyne
Lake Yamma Yamma
Lake Poopelloe
Lake Bulla Bulla
Lake Tandure
Lake Benanee
Lake Victoria
Lake Cudgellico
Lake Pamamaroo
Lake Menindee



Engraved by Miller Edi.

BALANCE.

Fig. 2

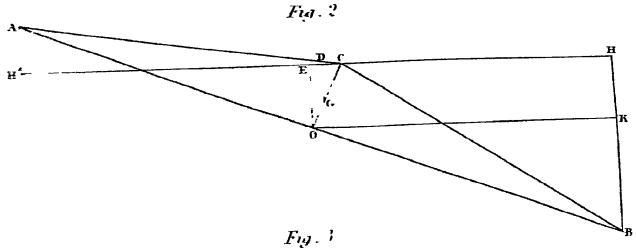
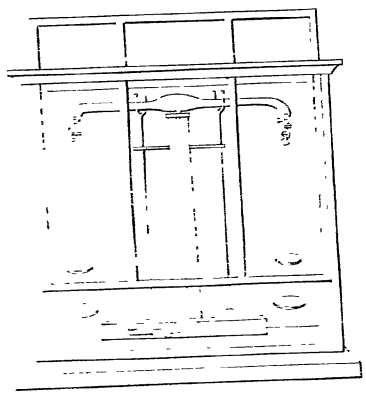
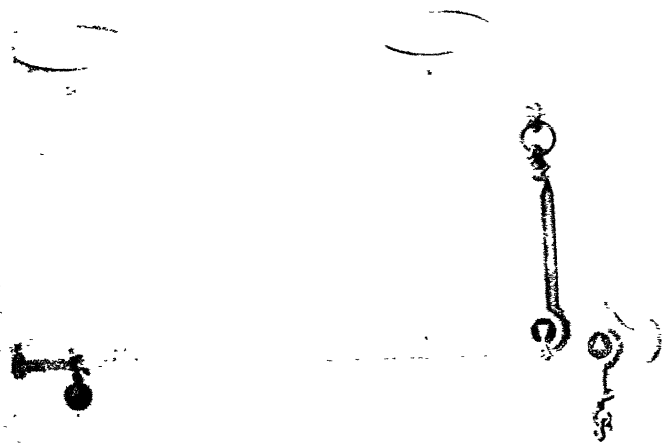
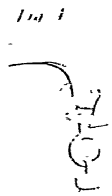


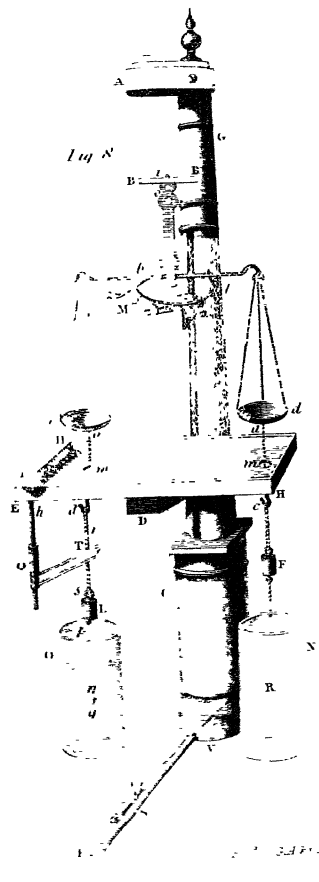
Fig. 3

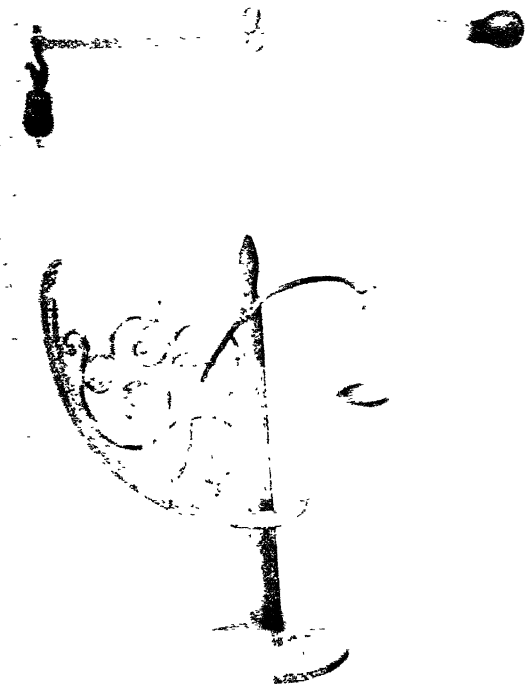


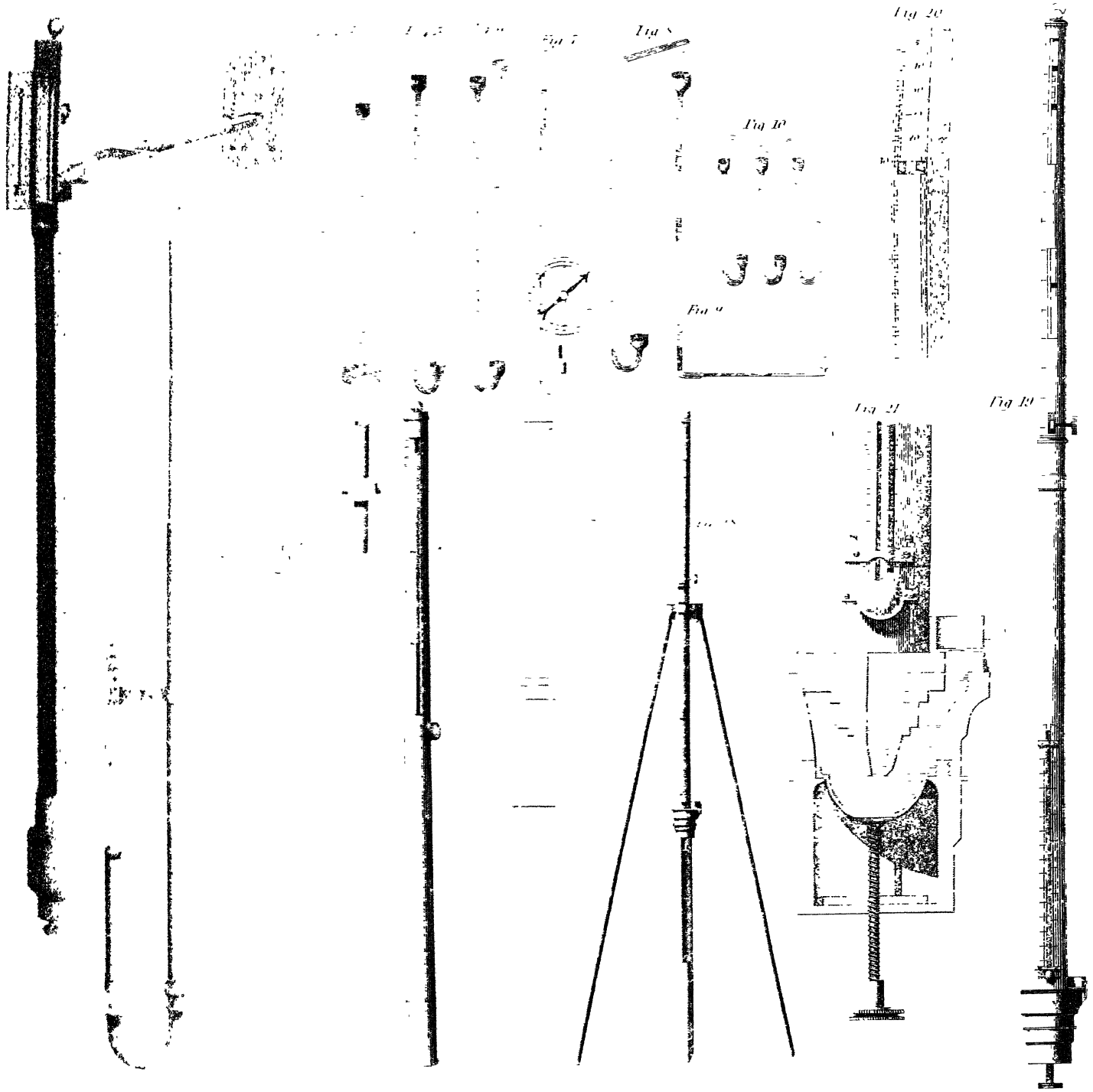




HYDROSTATIC BALANCE





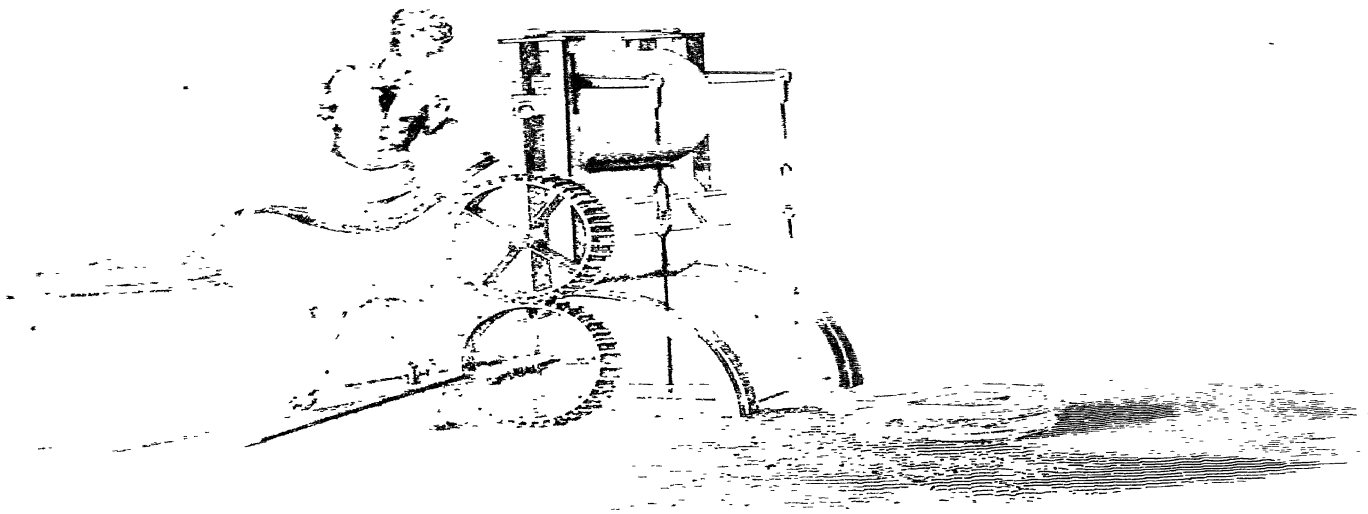

Fig 20
Fig 10
Fig 9
Fig 21
Fig 19


English Feet
5,000
100 English Miles

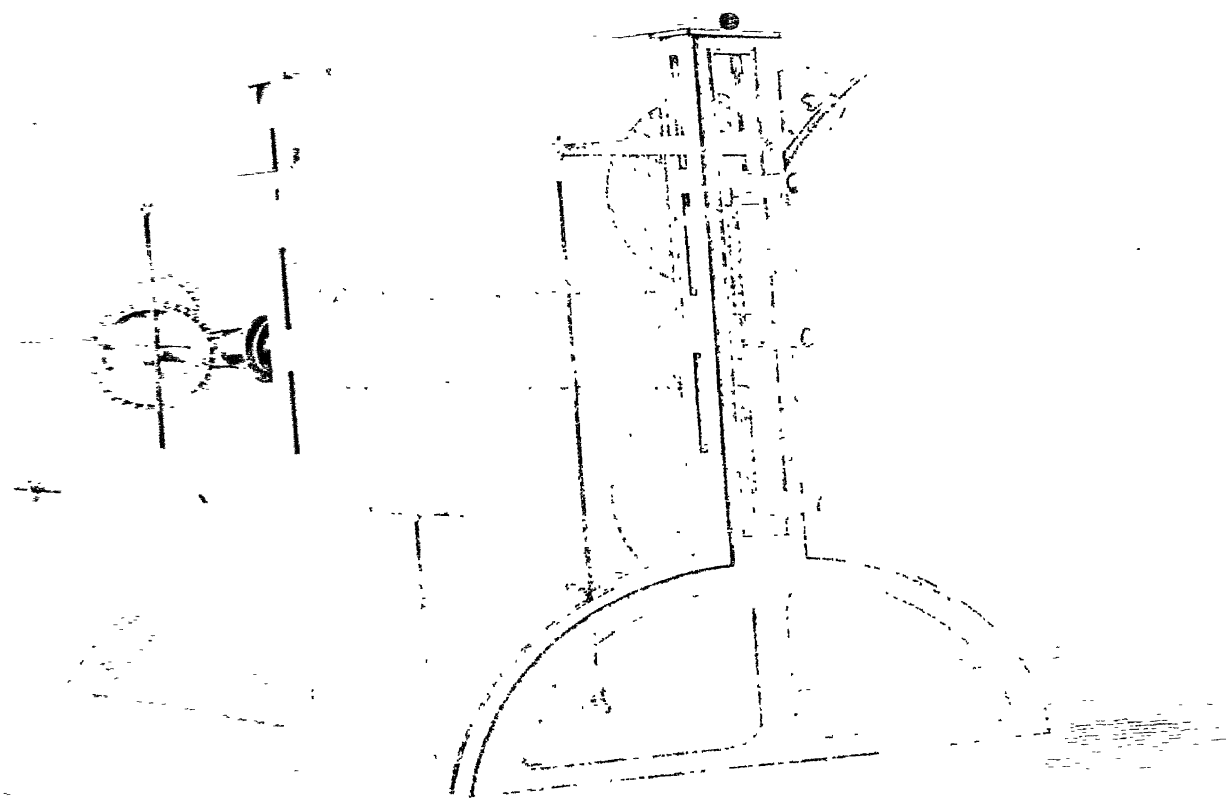
BLEACHING.

Fig 1.

SQUEEZER.



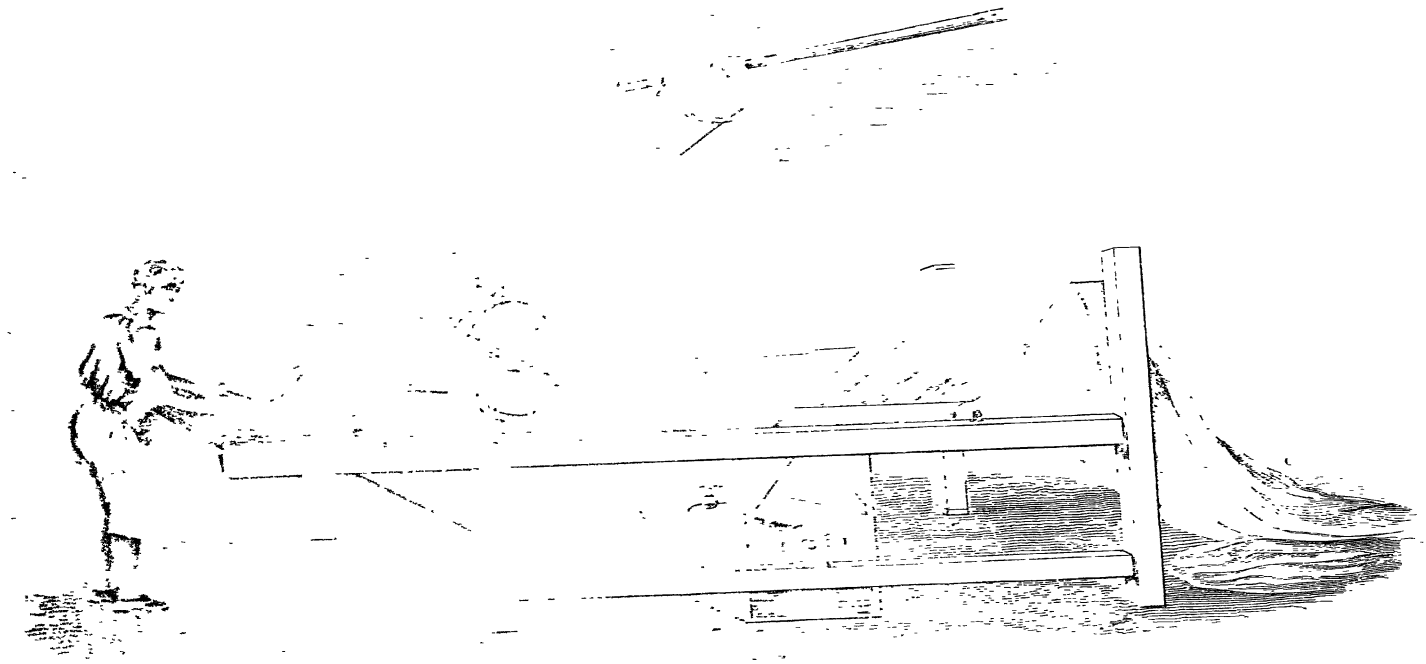
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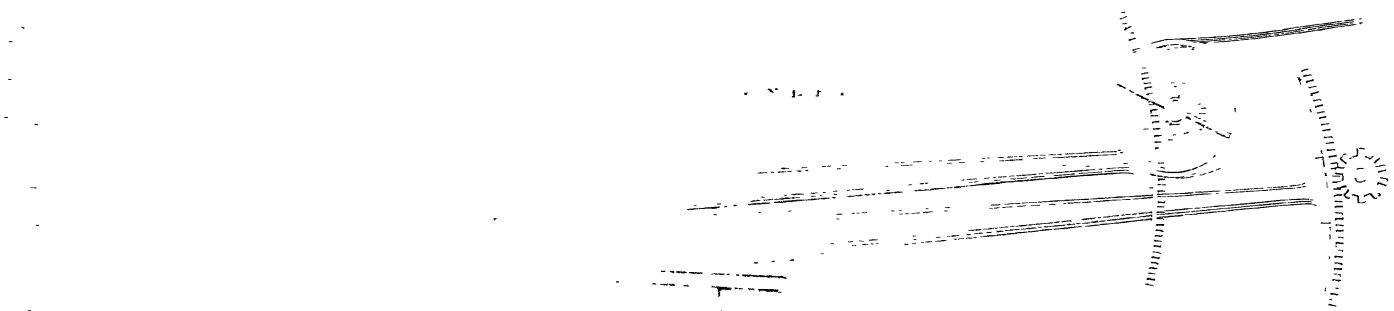


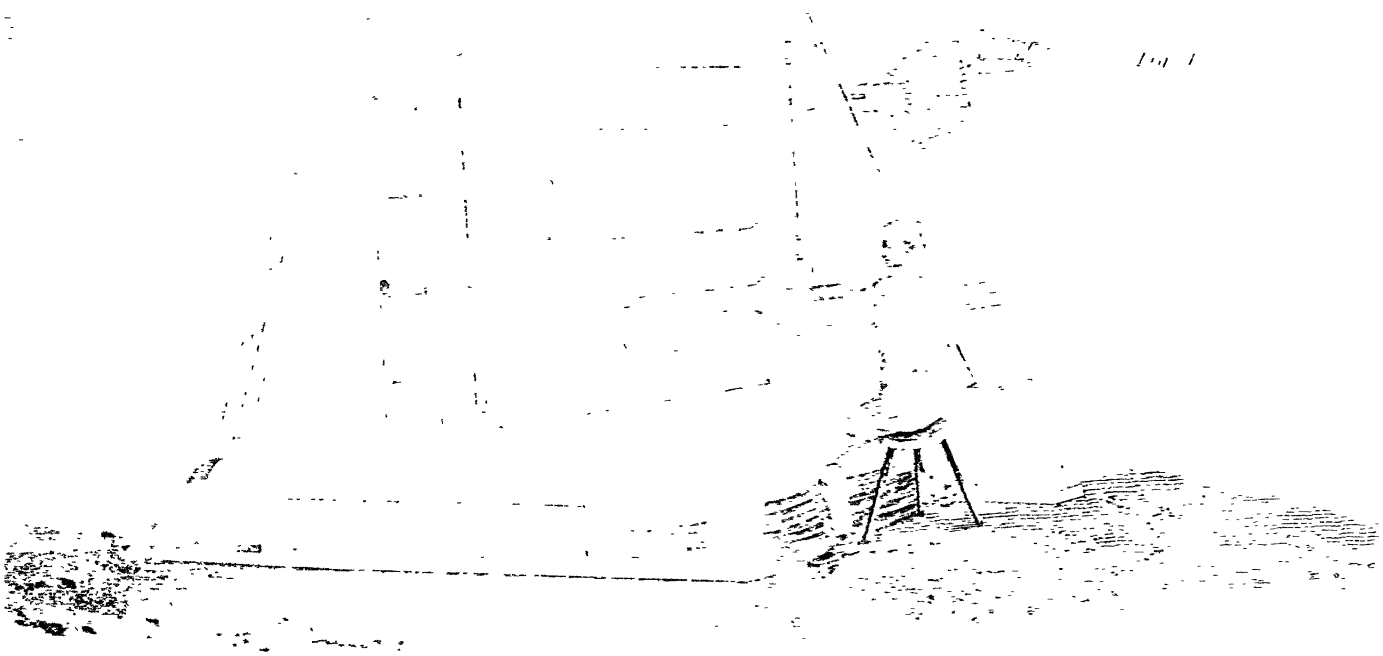
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PLATE CVI.

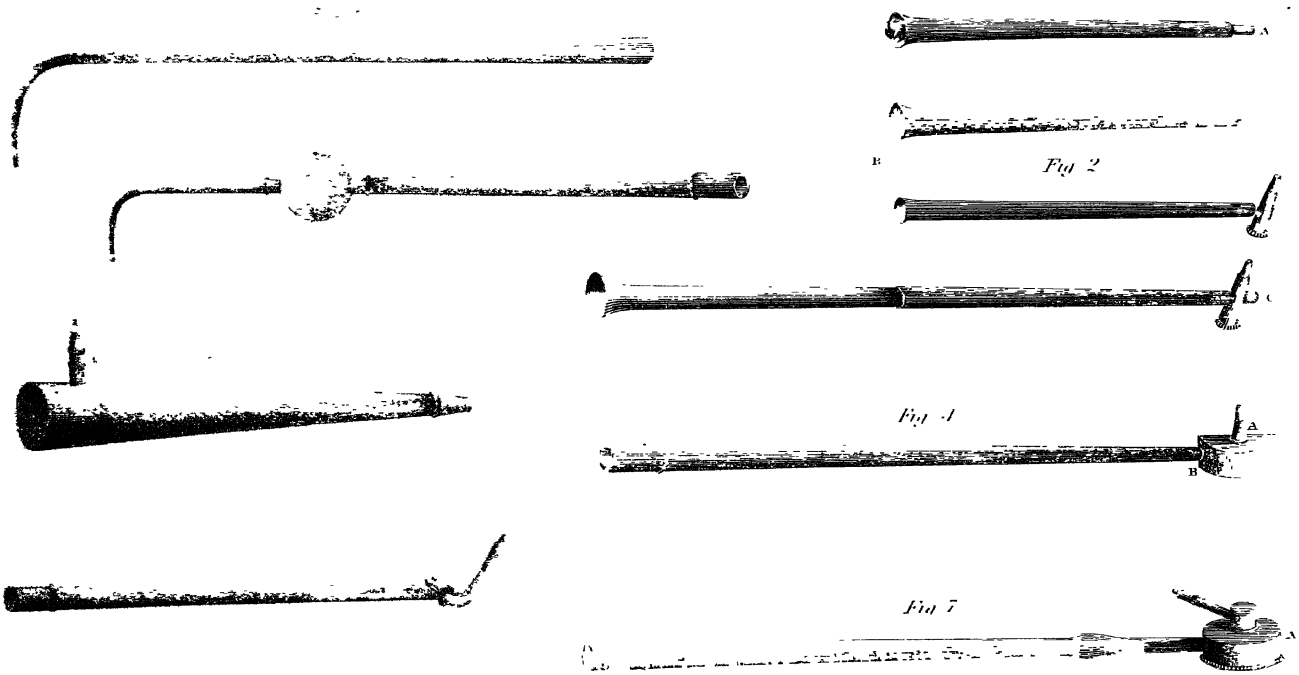
WAULING MACHINE

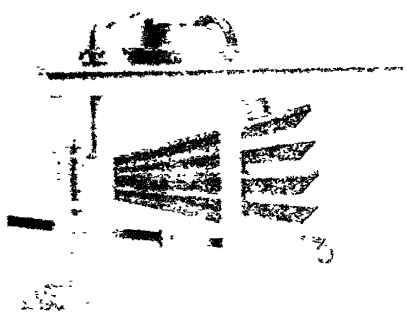


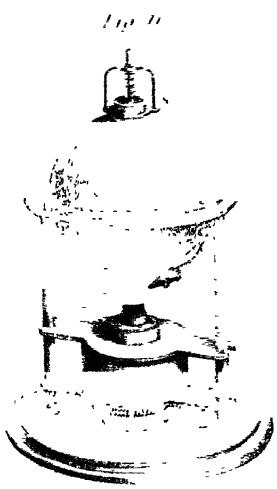


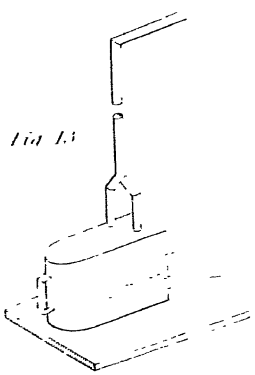


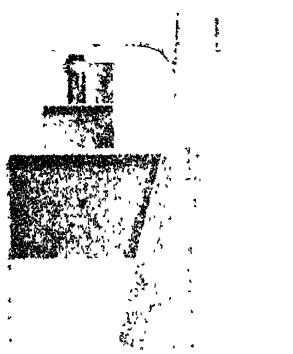
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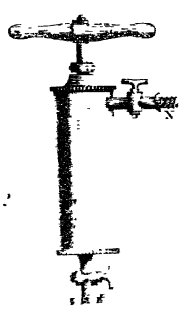


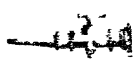












BLOWING MACHINES.

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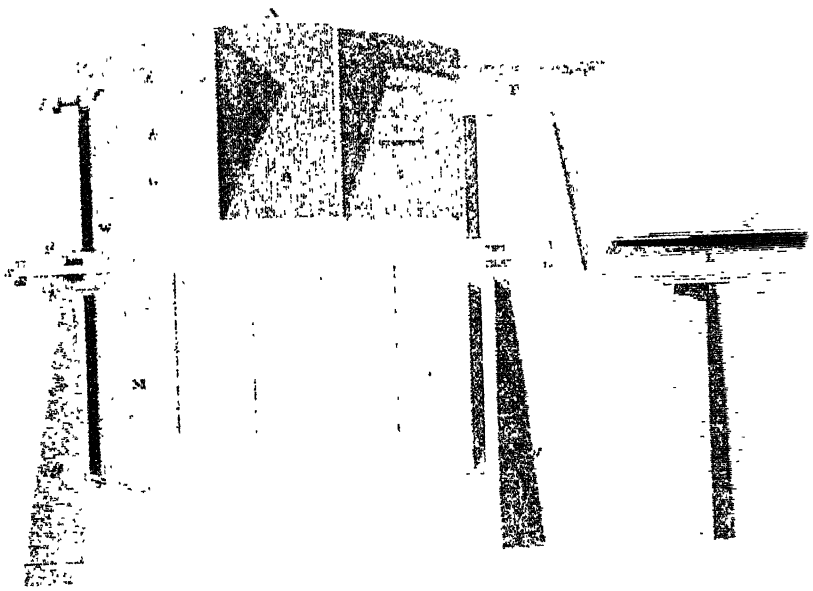


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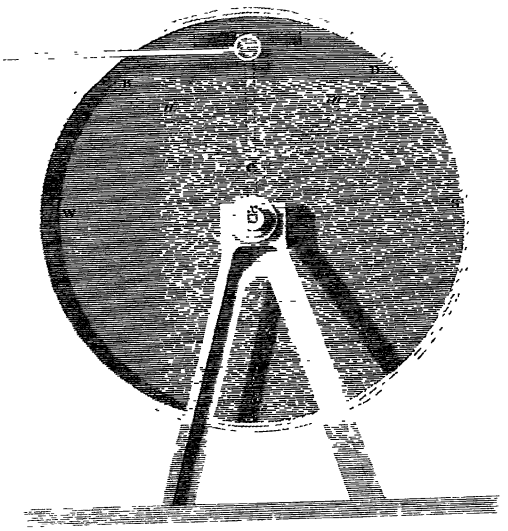
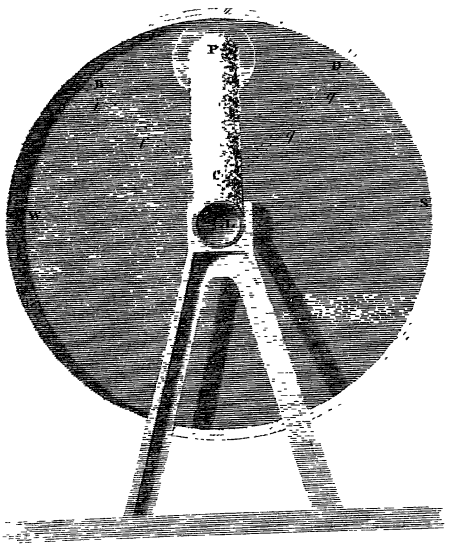
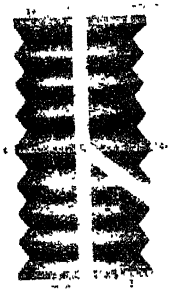


Fig. 3





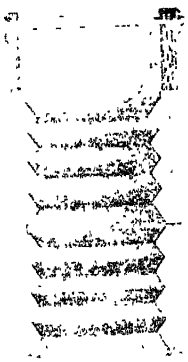


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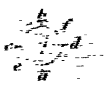


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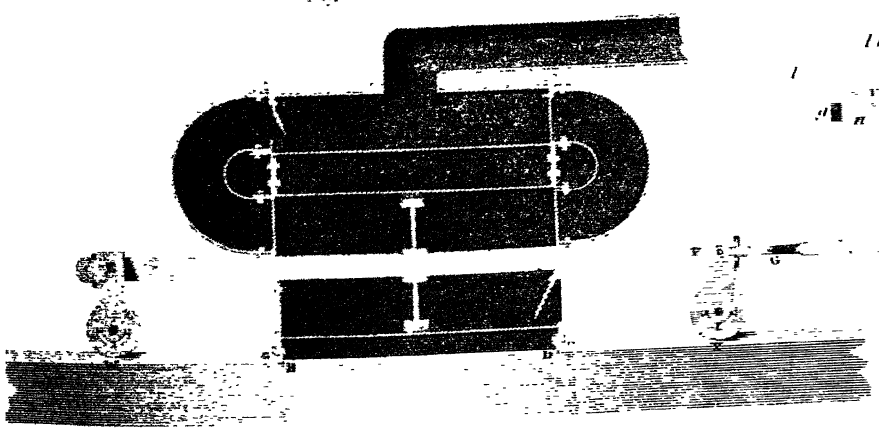


Fig. 8

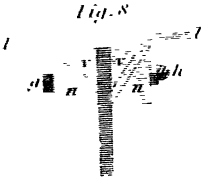
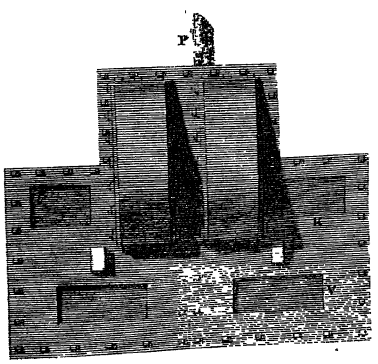


Fig. 7.



PRESIDENT'S
SECRETARIAT

LIBRARY